CDM-EB103-A03

Large-scale Methodology

AM0031: Bus rapid transit projects

Version 07.0

Sectoral scope(s): 07

United Nations
Framework Convention on
Climate Change

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1. Introduction

1. The following table describes the key elements of the methodology.

Table 1. Methodology key elements

Typical projects	Project activities that consist in the construction and operation of a new bus rapid transit system (BRT) for urban road transport of passengers can use the methodology. Replacement, extensions of bus lanes of existing BRT systems or expansions of existing BRT systems (adding new routes and lines) are also allowed to use this methodology
Type of GHG emissions mitigation action	Energy efficiency: Displacement of more-GHG-intensive transportation modes by less-GHG-intensive ones

2. Scope, applicability, and entry into force

2.1. Scope

2. The methodology is applicable to project activities that reduce emissions through the construction and operation of a new BRT system or lane(s) for urban road based transport. The methodology is also applicable to the construction and operation of the extensions of bus lanes of existing BRT systems or expansions of existing BRT systems (adding new routes and lines).

2.2. Applicability

3. 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 in the case of biofuels:[1]

   (a) The project buses shall use the same biofuel blend (same percentage of biofuel) as commonly used by conventional comparable[2] 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;

   (b) The project buses shall not use a significantly higher biofuel blend than cars and taxis.[3]

[1] No provisions to calculate upstream emissions from the production of biofuels are provided in order to keep the methodology simple. Therefore, in order to ensure that the calculated emission reductions are conservative, this applicability condition aims to limit the use of the methodology to cases where the upstream emissions under the project activity are likely to be equal or lower than in the baseline scenario. Note that other methodologies involving fuel switch situations usually require the consideration of upstream emissions.

[2] “Comparable” means of the same fuel type for example project buses using diesel are compared with conventional buses using diesel etc. The comparison is made for each year of monitoring based on official fuels sold. The term “commonly” means the majority of units.

[3] Project proponents wishing to consider project buses with a higher biofuel blend may propose a revision of this methodology.

4. 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).

5. Projects involving BRTs without feeder lines, i.e. passengers realize their trip partially on a MRTS system and partially on conventional buses, shall use the approved methodology "ACM0016: Large-scale Consolidated Methodology: Mass rapid transit projects".

6. The methodology is applicable if the analysis of possible baseline scenario alternatives leads to the result that a continuation of the use of the current modes of transport is the baseline scenario.

2.3. Entry into force

7. The date of entry into force is the date of the publication of the EB 103 meeting report on 14 June 2019.

2.4. Applicability of sectoral scopes

8. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology, application of sectoral scope 7 is mandatory.

3. Normative references

9. This baseline methodology is based on the proposals from the following proposed methodology:

   (a) "NM0105-rev: Baseline Methodology for Bus Rapid Transit Projects," developed by Gruetter Consulting.

10. This methodology also refers to the latest approved versions of the following tool(s):

   (a) "TOOL01: Tool for the demonstration and assessment of additionality;"

   (b) "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"~~Tool to calculate baseline, project and/or leakage emissions from electricity consumption~~;"

   (c) "TOOL18: Baseline emissions for modal shift measures in urban passenger transport";

   (d) "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion";

   (e) "TOOL11: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period";

   (f) "TOOL23: Additionality of first-of-its-kind project activities";

   (g) "TOOL15: Upstream leakage emissions associated with fossil fuel use".

11. For more information regarding the proposed new methodologies and the tools as well as their consideration by the Executive Board (hereinafter referred to as the Board) of the clean development mechanism (CDM) please refer to <http://cdm.unfccc.int/goto/MPappmeth>.

3.1. Selected approach from paragraph 48 of the CDM modalities and procedures

12. Existing actual or historical emissions, as applicable.

4. Definitions

13. The definitions contained in the Glossary of CDM terms shall apply.

14. For the purpose of this methodology, the following definitions apply:

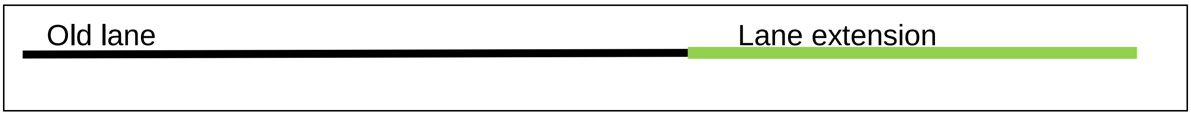
(a) **Bus lane** (or trunk route) - refers to a segregated lane, where only buses are allowed to operate. Private vehicles are not allowed to use the bus lane. Exceptions, such as emergency vehicles, can apply. Bus lanes need not necessarily be physically separated from other traffic lanes. If no physical separation is put in place, then it shall be ensured that enforcement takes place to prevent the usage of the bus lane by other vehicles. The bus lane might share part of the lanes with other modes of transport, e.g. at traffic crossings, bridges, tunnels, in narrow parts or on roads with limited traffic, e.g. in suburban parts of the city. However, for the purpose of this methodology more than half of the included bus lane shall be a bus-only lane;

(b) **Bus rapid transit (BRT) system** - is a bus-based collective urban or sub-urban passenger transit service system that uses bus lanes for trunk routes, and operates at high levels of performance, especially with regard to travel times and passenger carrying capacity;

(c) **City** - is a~~n area of~~ continuous area on which urban settlement has occurred ~~development~~ and includes the historical core area and the adjacent suburbs defined by its administrative boundaries;

(d) **Extensions of bus lanes** - refers to situations where the same bus operates on the previously existing lane and the extended lane, that is passengers do not need to change from one bus to another bus to use the extended bus lane. The entire bus lane is thus composed of an existing or “old lane” and a “lane extension” (the latter is the project activity);

Figure 1. An extension of a bus lane

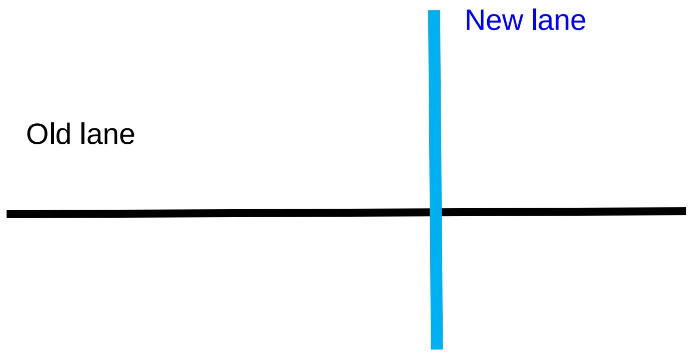


(e) **Feeder routes** - refers to bus routes which have intersections with trunk routes and which “feed” passengers to the trunk routes. Feeder routes are those with less passenger demand and which operate under mixed traffic conditions;

(f) **Mass Rapid Transit Systems (MRTS or MRT systems)** - are collective urban or suburban passenger services operating at high levels of performance, especially with regard to travel times and passenger carrying capacity and can be based on elevated, surface level or underground roads or rail systems. MRTS can be rail-based systems such as subways/metros, Light Rail Transit (LRTs) systems, including trams, or suburban heavy duty rail systems or road-based bus systems. For the purpose of this methodology road-based MRTS are bus systems using bus-lanes, which can also be called BRT systems;

(g) **New bus lanes** - are bus lanes on which buses are operated that are different than buses operated on the previously existing lanes. New bus lanes might share certain stations with an existing lane, but passengers will have to switch buses, if their trip involves stations on the "existing" and the "new" lane;

Figure 2. A new bus lane



(h) **Rebound effect** - is the term used to describe the effect that the BRT has on changing 'consumer behaviour' leading to additional trips. The rebound effect describes the effect that consumption (i.e. in this case the number and length of trips) may increase if prices decline or the quality of the service improves. If the BRT project reduces traffic congestion or improves the quality of transportation and reduces travel time, therefore reducing opportunity costs, it tends to increase the number and/or length of trips undertaken;

(i) **Vehicle speed** - refers to the average speed of a vehicle, which is the total distance travelled by the vehicle divided by the total time taken by the vehicle to cover this distance, on the affected road. For the purpose of this methodology taxis and passenger cars are treated identically.

5. Baseline methodology

5.1. Project boundary

15. 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 extent of the new BRT project system or section(s).

16. In case of using electricity from an interconnected grid or captive power plant for the

propulsion of the transport systems included in the project boundary, the project boundary also includes the power plants physically connected to the electricity system that supplies power to those transport systems.

Figure 3. Project boundary

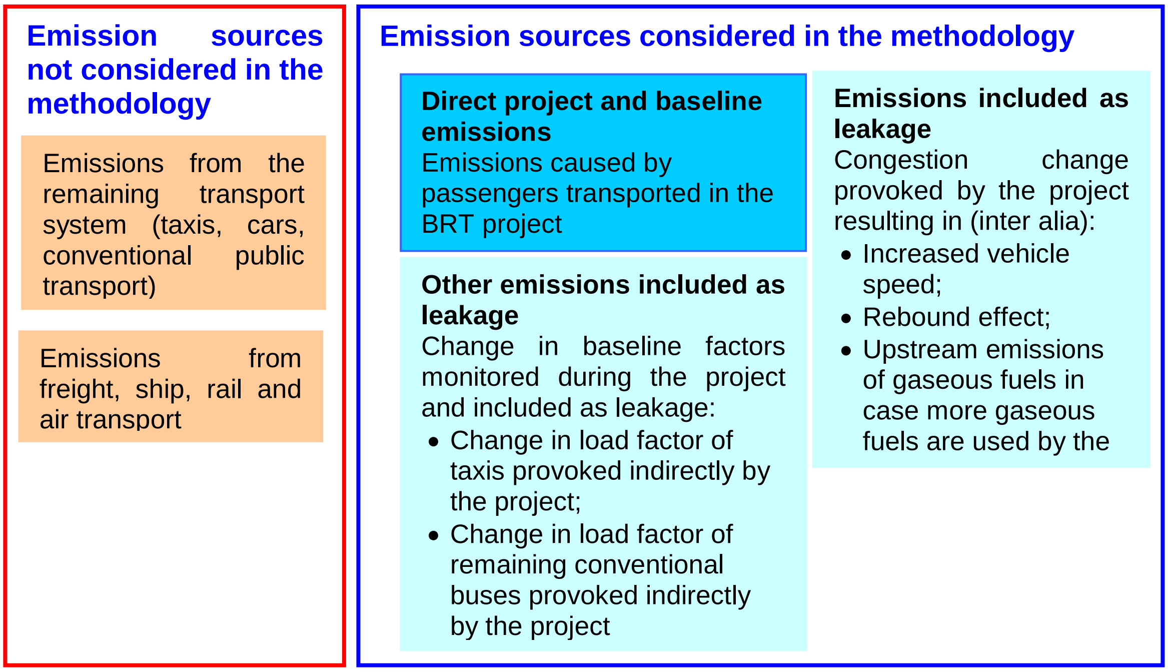


Table 2. Emission sources included in or excluded from the project boundary

	Source	Gas	Included	Justification / Explanation
Baseline	Mobile source emissions from different modes of road transport (buses, passenger cars, motorcycles, taxis), which the passengers of the BRT system would have taken in the absence of the project BRT	CO_2	Yes	Major emission source
		CH_4	Yes	Included only if gaseous fuels are used; excluded for liquid fuels. CH_4 emissions are a minor emission source of the total CO_2e emissions in diesel/gasoline vehicles. Neglecting these emissions in the baseline as well as project emissions is conservative, as fuel consumption and, therefore CH_4 emissions, are reduced through the project

	Source	Gas	Included	Justification / Explanation
		N_2O	No	N_2O emissions are a minor source of the total CO_2e emissions in diesel/gasoline vehicles. Neglecting these emissions in baseline as well as project emissions is conservative, as fuel consumption and, therefore N_2O emissions, are reduced through the project
Project Activity	Emissions from the project BRT (feeder and trunk routes, as applicable)	CO_2	Yes	Major emission source
		CH_4	Yes	Included only if gaseous fuels are used. See explanation above
		N_2O	No	See explanation above

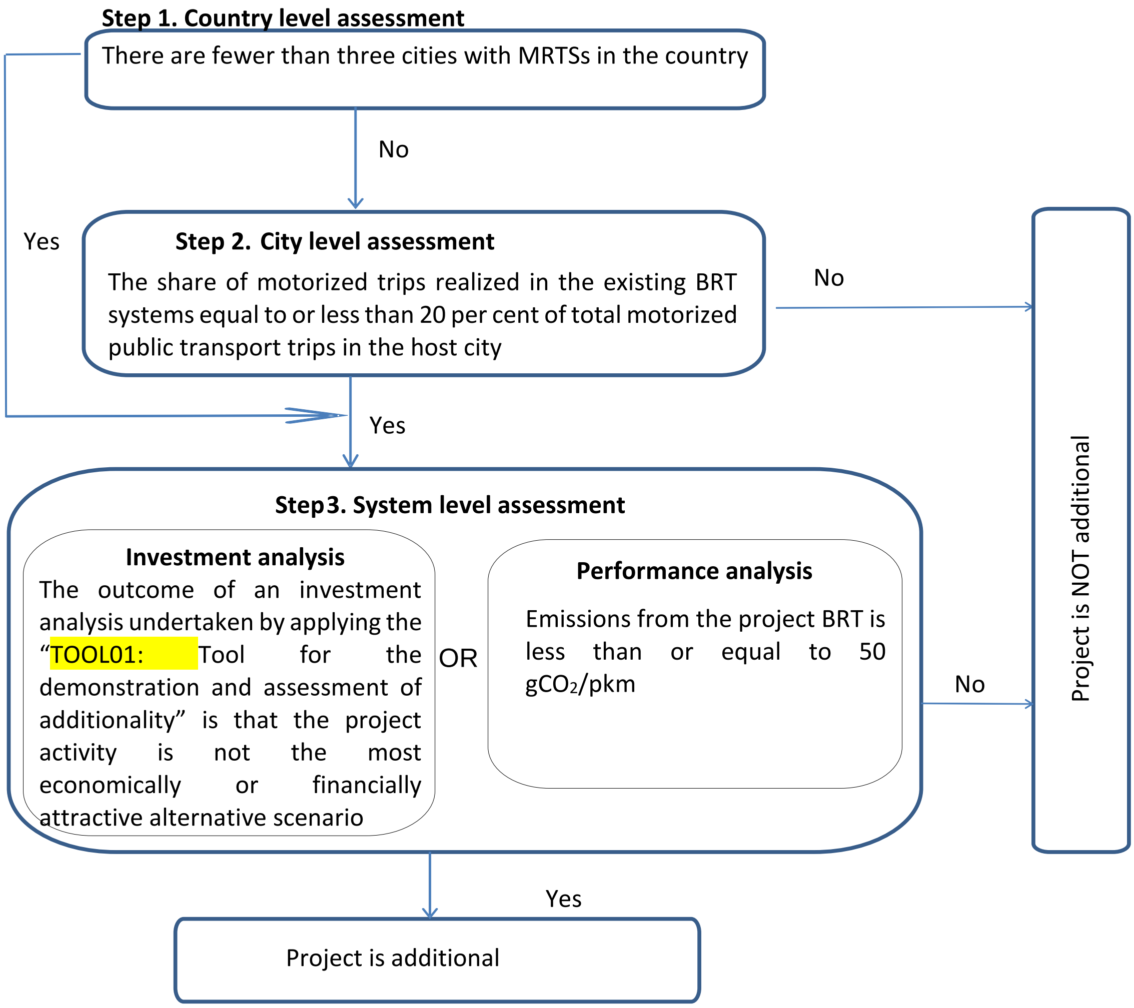
5.2. Additionality demonstration

17. BRT projects implemented in least developed countries (LDC) are deemed to be automatically additional.

18. If BRT projects are implemented in countries other than ~~non-~~LDCs and face the first-if-its-kind barrier, the latest approved version of the “TOOL23: Additionality of first-of-its-kind project activities” shall be followed to demonstrate the additionality of these project activities.

19. For projects, which are implemented in countries other than ~~non-~~LDCs and which are not the first-of-its-kind, the procedure illustrated in Figure 4 and described below shall be applied.

Figure 4. Additionality demonstration



5.2.1. Step 1: Country level assessment

20. This step aims to determine whether the proposed CDM project activity is common practice in the host country where the project is proposed to be implemented. For this purpose, project participants shall assess whether there are fewer than three cities with MRTS that started commercial operation in the host country of the proposed CDM project activity prior to the start of the CDM project activity.

21. The project participants shall:

(a) Identify all cities with MRTS that have started commercial operation in the host country prior to the start of the CDM project activity. Project participants shall include a brief description of each system in the CDM-PDD;

(b) Identify which MRTS were developed as CDM project activities in the host country (registered project activities and project activities which have been published on

the UNFCCC website for global stakeholder consultation as part of the validation process) and exclude all[4] MRTS developed as CDM project activities from the assessment of common practice in this step.

22. If the number of cities with MRTS (excluding systems developed as CDM project activities) is equal to or exceeds three cities, then projects participants should proceed to Step 2, otherwise project participants should proceed to Step 3 (see Figure 4).

5.2.2. Step 2: City level assessment

23. This step aims to determine whether the proposed project activity is common practice in the host city where the proposed CDM project activity is intended to be implemented. For this purpose, project participants shall assess whether the share of trips realized on the existing public transport system(s) in the host city, which belong to the same public transport category as the proposed CDM project activity, is less than or equal to 20 per cent of total public transport trips in the host city.

24. The project participants shall:

(a) Provide a breakdown of the total public transport trips realized in the host city by the shares of trips realized on different public transport categories, distinguishing between the following public transport categories:

(i) Metro;

(ii) Sub-urban rail;

(iii) Light rail transit including trams;

(iv) Conventional bus system;

(v) BRTs;

(b) Describe in the CDM-PDD the existing public transport systems and identify to which of the public transport categories they belong. Identify also to which public transport category the proposed project activity belongs. Determine and document in the CDM-PDD the shares of trips realized on each relevant public transport system and on each public transport category, expressed in percentages of the total public transport trips realized on all public transport systems in the host city.

25. If the share of motorized trips realized on the existing BRTs exceeds 20 per cent of total motorized public transport trips in the host city, then the proposed CDM project activity is not additional. If the share of trips is less than or equal to 20 per cent, then project participants should proceed to Step 3.

5.2.3. Step 3: System level assessment

26. Two options are provided for the system level assessment of the proposed project activity.

(a) Conduct an investment analysis, following the procedure under section 5.2.3.1 below; or

[4] This is subject to further decisions by the Board.

(b) Conduct a performance analysis, following the procedure under section 5.2.3.2 below.

5.2.3.1. Procedure for Investment analysis

27. The aim of this analysis is to determine whether the proposed project activity is not economically or financially feasible using “Option III: Benchmark analysis”, including the sensitivity analysis, provided in the “TOOL01: Tool for the demonstration and assessment of additionality”.

28. The investment analysis should be undertaken from the perspective of the operator/investor of the public transportation system of the city or urban area, reflecting the costs and revenues from the perspective of the operator/investor. If the project is subsidized through public authorities and institutions (e.g. local or central government, international donor organizations), for example through grants which do not need to be repaid, soft loans or contributions to operating and maintenance costs, or deficit guarantees, the financial assessment is made, taking into account these subsidies, including as investment the total system costs minus any such public subsidies. Any capital that needs to be repaid should be included in the calculations, for example loans by the municipality or city authority should be considered as a capital investment by the project operator and not be subtracted from the total system costs.

29. In applying the investment analysis, the investment analysis may consider cost overruns of former investments in BRTs or reduced revenues of former BRTs investments compared to original projections, which make new investments less viable and riskier. In this case, project participants should evaluate the cost overruns or reduced revenues of former BRTs that were implemented in the same host country in the last 20 years. Information on originally projected and actually observed costs/revenues should be based on official and public data. As a conservative approach, the lower end of the range of cost-overruns or reduced revenues observed over this period should be assumed for the project BRT.

30. If the sensitivity analysis is not conclusive, then the project activity is not additional. If the sensitivity analysis confirms the proposed project activity is not economically attractive, then the proposed project activity is additional.

5.2.3.2. Procedure for a performance analysis

31. The BRT project shall demonstrate that the forecasted emissions from the project BRT system is less than or equal to 50 gCO_2/pkm to demonstrate that project is additional.[5]

32. For this purpose, the annual emissions from the project BRT system shall be calculated based on expected efficiency and fuel type of the project buses, annual number of passengers expected to travel and an average trip distance that these passengers are expected to travel when the system reaches its planned capacity. A four-step model, or equivalent, of the transportation system of the project city as mentioned under section 5.7 below shall be used as the basis for forecasting the number of passengers and distance of travel on the system. This analysis shall be conducted one time ex ante for the purpose

[5] Refer section 3 of “Performance benchmarks in draft revision of AM0031, AM0101 and ACM0016” available as annex 3 to 67th meeting report of Meth Panel.

of additionality demonstration. All assumptions used in calculations need to be documented and substantiated in the CDM-PDD.

33. If the project activity is deemed to be additional, then the baseline scenario is assumed to be the continuation of the use of current modes of transport provided that the project participants can provide an explanation showing that the existing transport system (possibly expanded using additional vehicles) would be ~~sufficient~~ able to meet the transportation demand that will be met by the project system.

5.3. Baseline emissions

34. Baseline emissions are estimated using two main steps:

(a) Step 1: Determination of emissions per passenger transported per vehicle category. This is calculated ex ante, including the usage of a fixed technology change factor. If the surveys indicate that changes in trip distance or fuel type used would lead to lower baseline emission factors, then the baseline emission factor is adapted to potential changes in trip distance and type of fuel used by passenger cars;

(b) Step 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~~ surveys conducted in year 1 and year 4 of the crediting period, with changes only being applied, if the baseline emissions factors would be lower than the original factor. The system operator records passenger numbers.

35. If the project participants choose not to claim emission reductions for switch to buses from ~~does not generate credits for the modal shift, it need not determine emissions per passenger using~~ passenger cars, taxis or motorcycles, ~~. t~~ ~~T~~he annual modal survey will also not include these categories or questions related directly to these categories (change of trip distance of passenger cars or fuel type of passenger cars). The survey will, however, include the categories of public transport, non-motorised transport (NMT), and induced traffic (i.e. categories with emission factors lower than the project, to ensure that emission reductions are not overstated).

36. Baseline emissions are determined using the latest approved version of the “TOOL18: Baseline emissions for modal shift measures in urban passenger transport” using parameters estimated based on data collected during the survey in the year 1 and 4 of the crediting period;

37. When applying equation 5 of the “TOOL18: Baseline emissions for modal shift measures in urban passenger transport” the parameters, share of passengers who shifted from electricity-based or road based vehicle category *i* (S_i) and share of passenger-kilometers who shifted from electricity-based or road-based vehicle category *i* (SD_i) should be calculated taking into account all passengers travelling in the project BRT, including induced traffic (i.e. those passengers who responded in the survey that they would not have travelled in the absence of the project BRT). In case the baseline considers the expansion of the existing system with additional vehicles, then the determination of parameter $SFC_{i,n,x}$ under TOOL18 should take into account the share of new vehicles in the respective vehicle category.

38. Criteria for identifying the vehicle categories are as follows:

(a) At a minimum, public transport, non-motorised transport and induced traffic have to be included;

(b) Conditions to include categories with reliable data on fuel consumption and load factors;

(c) Only include categories that are relevant for the BRT project. If the project will only generate credits from public transport without modal shift, then passenger cars, taxis and motorcycles need not be included;

(d) Differentiate relevant fuel types for each category. Diesel, gasoline and gas (CNG or LPG) are listed separately if a minimum of 10 per cent of vehicles of the respective category use such a fuel, while the threshold for zero-GHG-emission[6] fuels is minimum 1 per cent. The 10 per cent threshold is justified, as GHG emission differentials between diesel, gasoline and gaseous fuels are less than 20 per cent;

(e) In case of a system extension, the currently operating system is not included as a vehicle category.

39. The time period for data on the number of passengers and the distance they travel shall be the same (e.g. one year or one month). All data used is determined ex ante. A ~~change~~ decrease in the occupancy rate of buses is registered as leakage of the project.

40. 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.

5.4. Project emissions

41. The emissions from the new project transport system (i.e. trunk routes and if applicable feeder lines) are considered as project emissions, including emissions from trips undertaken in the new system.

42. Total emissions can be calculated in one of the two ways indicated in sections 5.4.1 or 5.4.2 below, depending on data availability. If records exist, the data quality of both alternatives is equal. Reliable data are, for example, based on electronic measurement of fuel consumption or data monitored by the bus company managing the units. For both alternatives, specific fuel consumption data (i.e. consumption per distance driven) needs to be crosschecked in the QA system. Cross-checks include a comparison over time within the same company, as well as a comparison with, for example other companies operating BRT systems using the same type of buses.

5.4.1. Alternative A: Use of fuel consumption data

43. This alternative is based on the total fuel consumed by trunk buses and feeder buses. For BRTs using liquid fossil fuels, the project emissions from fossil fuel consumption shall be estimated using the latest approved version of the “TOOL03: Tool to calculate project or

[6] Zero-emission in the context of operating emissions and not well-to-wheel or life-cycle emissions; this includes hydrogen.

leakage CO_2 emissions from fossil fuel combustion". The following guidance is provided for applying the tool:

(a) The parameter $PE_{FC,j,y}$ in the tool corresponds to the project emissions from the project transport system that uses fossil fuels in year *y*; and

(b) Element process *j* corresponds to the combustion of fuel type *n* in the project vehicles.

44. For BRTs using gaseous fossil fuels, the project emissions from fossil fuel consumption shall be estimated based in one of the following approaches:

(a) If fuel is being measured on a mass basis, ~~according to~~ the following equation shall be applied:

$$PE_y = \sum_n \left[FC_{PJ,n,y} \times NCV_n \times \left(EF_{CO2,n} + GWP_{CH4} \times EF_{CH4,n}\right)\right] \times 10^{-6} \quad \text{Equation (1)}$$

Where:

PE_y	=	Project emissions in year *y* (tCO_2e)
$FC_{PJ,n,y}$	=	Total consumption of fuel type *n* in year *y* by the project (~~million litres~~t) by both trunk buses and feeder buses (tonne)
NCV_n	=	Net calorific value of the fuel type *n* (~~GJ/T~~TJ/Gg)
$EF_{CO2,n}$	=	CO_2 emission factor for fuel type *n* (~~g~~tCO_2~~ per litre~~/TJ)
$EF_{CH4,n}$	=	CH_4 emission factor for gaseous fuel type *n* (~~g~~tCH~~O2~~$_4$~~e per litre~~/TJ~~, based on GWP~~)
GWP_{CH4}	=	Global warming potential of the CH_4 (tCO_2e/tCH_4)
n	=	Fuel type used by the project

(b) If fuel is being measured on a volumetric basis, the following equation shall be applied:

$$PE_y = \sum_n \left[FC_{PJ,n,y} \times NCV_n \times \rho_n \times \left(EF_{CO2,n} + GWP_{CH4} \times EF_{CH4,n}\right)\right] \times 10^{-6} \quad \text{Equation (2)}$$

Where:

PE_y	=	Project emissions in year *y* (tCO_2e)
$FC_{PJ,n,y}$	=	Total consumption of fuel type *n* in year *y* by the project by both trunk buses and feeder buses (L)
NCV_n	=	Net calorific value of the fuel type *n* (TJ/Gg)
ρ_n	=	Density of the fuel type *n* (t/L)
$EF_{CO2,n}$	=	CO_2 emission factor for fuel type *n* (tCO_2/TJ)
$EF_{CH4,n}$	=	CH_4 emission factor for gaseous fuel type *n* (tCH_4/TJ)

GWP_{CH4}	=	Global warming potential of the CH_4 (tCO_2e/tCH_4)
n	=	Fuel type used by the project

45. For BRTs using electricity, the emissions from electricity consumption are based on the latest approved version "TOOL05: Baseline, Tool to calculate baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

5.4.2. Alternative B: Use of specific fuel consumption and distance data

46. Total project emissions under alternative B are calculated from the following equation.

$$PE_y = \left[\left(EF_{km,TB,y} \times DD_{TB,y}\right) + \left(EF_{km,FB,y} \times DD_{FB,y}\right)\right] \times 10^{-6}$$ Equation (3)

Where:

PE_y	=	Project emissions in year *y* (t CO_2e)
$EF_{km,TB,y}$	=	Emissions factor per kilometer for trunk buses in year *y* (gCO_2e/km per kilometer). Calculated through equation (4) below
$DD_{TB,y}$	=	Total distance driven by trunk buses in year *y* (km)
$EF_{km,FB,y}$	=	Emissions factor per kilometer for feeder buses in year *y* (gCO_2e per kilometer/km). Calculated through equation (4) below
$DD_{FB,y}$	=	Total distance driven by feeder buses in year *y* (km)

47. $EF_{km,TB,y}$ and $EF_{km,FB,y}$ are determined based on the This alternative uses as a basis fuel efficiency data (i.e. consumption per kilometer driven).

(a) If the specific fuel consumption is determined on a mass basis (i.e. in mass units/km), the following equation shall be applied

$$EF_{km,j,y} = \sum_n \left[SEFC_{j,n,y} \times NCV_n \times \left(EF_{CO2,n} + GWP_{CH4} \times EF_{CH4,n}\right)\right] \times 10^{-3}$$ Equation (4)

Where:

$EF_{km,j,y}$	=	Emissions factor per kilometer for project bus category *j* in year *y* (gCO_2e per /kmkilometer)
$SFEC_{j,n,y}$	=	Specific energy consumption of fuel type x n in project bus category *j* in year *y* (litre per kilometerg/km)
NCV_n	=	Net calorific value of the fuel type *n* (GTJ/tGg)
$EF_{CO2,n}$	=	CO_2 emission factor for fuel type *n* (tkgCO_2 per litre/TJ)
$EF_{CH4,n}$	=	CH_4 emission factor for gaseous fuel type *n* (tkg CH_4/TJ gCO2 4e per litre/TJ, based on GWP)
GWP_{CH4}	=	Global warming potential of the CH_4 (tCO_2e/tCH_4)
n	=	Fuel type used by project bus category *j*
j	=	Bus category (FB = feeder buses; TB = trunk buses)

(b) If the specific fuel consumption is determined on a volumetric basis (i.e. in volume units/km), the following equation shall be applied

$$EF_{km,j,y} = \sum_{n}[SFC_{j,n,y} \times NCV_n \times \rho_n \times (EF_{CO2,n} + GWP_{CH4} \times EF_{CH4,n})] \times 1{,}000 \quad \text{Equation (5)}$$

Where:

$EF_{km,j,y}$	=	Emissions factor per kilometer for project bus category *j* in year *y* (gCO_2e/km)
$SFC_{j,n,y}$	=	Specific consumption of fuel type *n* in project bus category *j* in year *y* (L/km)
NCV_n	=	Net calorific value of the fuel type *n* (TJ/Gg)
ρ_n	=	Density of the fuel type *n* (t/L)
$EF_{CO2,n}$	=	CO_2 emission factor for fuel type *n* (tCO_2 /TJ)
$EF_{CH4,n}$	=	CH_4 emission factor for gaseous fuel type *n* (tCH_4/TJ)
GWP_{CH4}	=	Global warming potential of the CH_4 (tCO_2e/tCH_4)
n	=	Fuel type used by project bus category *j*
j	=	Bus category (FB = feeder buses; TB = trunk buses)

48. Fuel-efficiency data is derived from annual data reported by the bus companies operating the units either for all units or for a representative sample of comparable units (comparable technology, vintage and size). To ensure a conservative approach, the specific fuel consumption of comparable vehicles, if based on sample measurement, should be taken as the upper 95 per cent confidence level of the sample measurement conducted.

49. If the CDM project includes only parts of a larger activity (e.g. a certain line of a comprehensive BRT development), the fuel used for the CDM project ~~is~~ shall be separated from the total fuel used. The separation is done (in order of preference) by the following means:

(a) By operators: this method is used if certain operators are assigned to certain parts of the project;

(b) By distance driven: the fuel share for each part of the project is based on the share of kilometers per project part;

(c) By passengers: the fuel share for each part of the project is based on the share of passengers per part of the project (based on the entry points of passengers).

5.5. Leakage

50. The leakage is estimated using following equation

$$LE_y = LE_{UP,y} + LE_{LF,Z,y} + LE_{LF,T,y} + LE_{CONG,y} \quad \text{Equation (6)}$$

Where:

LE_y	=	Leakage emissions in year *y* (t CO_2e)

$LE_{UP,y}$	=	Leakage upstream emissions of gaseous fuels during the year *y* (t CO_2e)
$LE_{LF,Z,y}$	=	Leakage emissions from change of load factor in buses in year *y* (t CO_2e)
$LE_{LF,T,y}$	=	Leakage emissions from change of load factor in taxis in year *y* (t CO_2e)
$LE_{CONG,y}$	=	Leakage emissions from reduced congestion in year *y* (t CO_2e)

51. The following leakage sources need to be considered:

(a) Change in load factor of the baseline transport system due to the project, that is the project potentially influences the occupancy rate of the remaining vehicles. This is monitored in the year 1 and 4 of the crediting period. Leakage from the change in load factor of buses is only included, if the load factor of buses has decreased by more than 10 percentage points of the monitored value compared with the baseline value;

(b) Reduced congestion in remaining roads, provoking higher average vehicle speed, plus a rebound effect. An ex-ante test is used to determine if ~~The total impact of congestion is monitored in the year 1 and 4 of the crediting period, in case~~ the implementation of the project activity leads to a reduction of road capacity (e.g. the project utilises an existing road by separating one of its lanes to be exclusively used by the project BRT), in which case the total impact of congestion is monitored in the year 1 and 4 of the crediting period ~~and not monitored, i~~In case the implementation of the project activity does not lead to a reduction of road capacity (e.g. the project provides a new road infrastructure), this source is not monitored;

(c) In case quantity of gaseous fuels used in the project is more than in the baseline ~~case~~, the upstream emissions of gaseous fuels should be included. No leakage emissions should be included, if quantity of gaseous fuels used in the baseline is more or equal to amount of gaseous fuels that is used than in the project as this would lead to negative leakage.

52. ~~For the sake of~~As a conservative approach, leakage is only considered if the total annual effect is to reduce estimated emission reductions and where total net leakage effects are negative ($LE_y < 0$), project participants should assume $LE_y = 0$.

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

5.5.1. Change in load factor

54. The project could have a negative impact on the load factor of taxis or on the load factor of the remaining conventional bus fleet. The changes in load factors of taxis and buses are, thus, monitored in the year 1 and 4 of the crediting period. Leakage is only included if the load factor changes by more than 10 per cent, 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 taxis to the BRT project. 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.

55. Leakage emissions from changes in load factors of conventional buses, not belonging to the project:

$$ROC_{iZ,y} = \frac{OC_{i,y}}{CV_{i,y}}$$ Equation (7)

Where:

$ROC_{i,y}$	=	Average occupancy rate relative to capacity in category *i* in year *y*
$OC_{i,y}$	=	Average occupancy of a vehicle in vehicle category *i* in year *y* (passengers)
$CV_{i,y}$	=	Average capacity of a vehicle in vehicle category *i* in year *y* (passengers)
i	=	Vehicle category: conventional buses (Z)

56. 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. Data for the $ROC_{i,y}$ calculation shall be monitored directly through visual surveys.

$$LE_{LF,Z,y} = EF_{km,Z,y} \times VD_{Z,x} \times N_{Z,y} \times \left(1 - \frac{ROC_{Z,y}}{ROC_{Z,x}}\right) \times 10^{-6}$$ Equation (8)

Where:

$LE_{LF,Z,y}$	=	Leakage emissions from a change in the load factor of buses Z in year *y* (tCO_2e)
$EF_{km,Z,y}$	=	Eemission factor per kilometer for buses Z in year x *y* (gCO_2e/km per kilometer)
$VD_{Z,x}$	=	Annual distance driven per vehicle for buses Z in year *x* (kilometerskm). Calculated through equation (7) below
$N_{Z,y}$	=	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* (percentage). Calculated through equation (5) above, where the vehicle category *i* is bus
$ROC_{Z,x}$	=	Average occupancy rate relative to capacity of buses in year *x* (percentage). Calculated through equation (5) above, where the vehicle category *i* is bus
x	=	Most recent calendar year prior to the start of commercial operation of the project BRT system or prior to the submission of the CDM-PDD for validation, whatever is earlier

$$VD_{Z,x} = \frac{\sum_i DD_{i,S,x} + DD_{i,M,x} + DD_{i,L,x}}{\sum_k N_{Z,k,x}}$$ Equation (9)

Where:

$VD_{Z,x}$	=	Annual distance driven per vehicle for buses Z in year *x* (km)
$DD_{i,S,x}$	=	Total distance driven by small (S) buses i in year *x* (km)
$DD_{i,M,x}$	=	Total distance driven by medium (M) buses i in year *x* (km)
$DD_{i,L,x}$	=	Total distance driven by large (L) buses i in year *x* (km)
$N_{Z,k,x}$	=	Number of buses ~~Z~~ of size k ~~in the conventional bus system Z~~ in year *x*
k	=	Bus size: small (S), medium (M) and large (L) buses
x	=	Most recent calendar year prior to the start of commercial operation of the project BRT system or prior to the submission of the CDM-PDD for validation, whatever is earlier

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

58. This equation determines leakage emissions from a change in load factors of taxis.

$$LE_{LF,T,y} = EF_{BL,km,T,x} \times VD_{T,x} \times N_{T,y} \times \left(1 - \frac{OC_{T,y}}{OC_{T,x}}\right) \times 10^{-6}$$ Equation (10)

Where:

$LE_{LF,T,y}$	=	Leakage emissions from a change in load factor of taxis in year *y* (tCO_2e)
$EF_{BL,km,T,x}$	=	Baseline emission factor per kilometer for taxi in year *x* (g CO_2e ~~per~~/km)
$VD_{T,x}$	=	Average distance driven by taxi in year *x* (km)
$N_{T,y}$	=	Number of taxis operating in year *y*
$OC_{T,y}$	=	Average occupancy rate of taxi in year *y* (passengers only: Driver not counted)
$OC_{T,x}$	=	Average occupancy rate of taxi in year *x* (passengers only: Driver not counted)
x	=	Most recent calendar year prior to the start of commercial operation of the project BRT system or prior to the submission of the CDM-PDD for validation, whatever is earlier

59. If $OC_{T,x}$ - $OC_{T,y} \leq 0.1$ then $LE_{LF,T,y} = 0$, that is if the occupancy rate of taxis is not reduced by more than 0.1 then the project has had no negative effect.

60. The measurement 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.

5.5.2. Impact of reduced congestion on remaining roads

61. The implementation of a BRT project may have different overall impacts on congestion. On the one hand, a project BRT system may be implemented on an existing road by dedicating one or more of the lanes of the road to be exclusively used by the project BRT

(with an exception of emergency vehicles). This may result in a reduced road capacity available to the vehicles operating on that road prior to the project activity, which, in turn, may increase the congestion on that reduced road capacity and, therefore, lead to higher emissions. On the other hand, an implementation of the project BRT may provide a new road infrastructure. In this case, the project BRT will likely attract passengers from conventional modes of transport and reduce the number of vehicles on the affected roads and, therefore reduce congestion. In this case, reduced congestion may have the following impacts relevant for GHG emissions:

(a) "Rebound effect" leading to additional trips and thus higher emissions;

(b) Higher average speeds and less stop-and-go traffic leading to lower emissions.

62. In the case that the implementation of the project activity leads to a reduction of road capacity available for individual motorised transport modes, the impact of changes in congestion shall be monitored in the year 1 and 4 of the crediting period. In other cases (e.g. the project provides a new road infrastructure not taken from the existing road space in the city), monitoring of these changes is not required.[7] This change in road capacity available for individual motorised transport modes may result from the reduction of road space due to the implementation of BRT and/or a potential reduction of traffic flow due to the withdrawal of conventional public transport units as a result of the project activity.

63. To determine whether road capacity is reduced the following procedure shall be applied:

5.5.2.1. Step (a): Determination of the additional road capacity available to motorised transport modes

64. The following equation determines the additional road capacity, available to the transport modes remaining in operation, as a result of the implementation of project activity in the year *y*~~*when the project BRT system is intended to reach its planned capacity*~~:

$$ARS_y = \sum \frac{BSCR_y}{N_{Z,x}} \times SRS_x - \frac{RS_x - RS_y}{RS_{\cancel{y}x}}$$ Equation (11)

Where:

ARS_y	=	Additional road space available in year *y* (in percentage)
$BSCR_y$	=	Cumulative bus units ~~retired~~ displaced by the BRT on the trunk lanes as a result of the project in year *y* (units)
$N_{Z,x}$	=	Total number of buses Z in use in year *x* (units)
SRS_x	=	Share of road space used by public transport in year *x* (in percentage). Calculated based on equation (10) below
RS_x	=	Total road space available in year *x* (lane- kilometers)
RS_y	=	Total available road space due to the project in year *y* ~~(= RSB minus kilometer of lanes that where reduced due to dedicated bus lanes)~~ (lane- kilometers)

[7] Emission reductions due to the speed increase of the traffic flow generally outweigh the increase in emissions resulting from the traffic induction of passenger cars as a result of reduced congestion.

x	=	Most recent calendar year prior to the start of commercial operation of the project BRT system or prior to the submission of the CDM-PDD for validation, whatever is earlier

65. If $ARS_y < 0$, then we have a reduced road capacity in that year, and there may be increased emissions due to reduced vehicle speed, but reduced emissions due to a negative "rebound effect".

66. This equation is required to determine *SRS* if no recent and good quality study is available which has calculated this parameter:

$$SRS_x = \frac{DD_{Z,x} \times 2.5}{DD_{Z,x} \times 2.5 + DD_{T,x} + DD_{C,x}}$$ Equation (12)

Where:

SRS_x	=	Share of road space used by public transport in in year *x* (in percentage)
$DD_{Z,x}$	=	Total distance driven by public transport buses in year *x* (km)
$DD_{T,x}$	=	Total distance driven in kilometers by taxis in year *x* (km)
$DD_{C,x}$	=	Total distance driven in by passenger cars in year *x* (km)
x	=	Most recent calendar year prior to the start of commercial operation of the project BRT system or prior to the submission of the CDM-PDD for validation, whatever is earlier

67. It is assumed that one bus occupies 2.5 times more road space than a personal car or a taxi.

68. For all distance variables the same vintage of data, the same spatial scope and the same time-span (e.g. one month or one year) is required.

69. If ARS_y is negative, leakage emissions due to increased congestion as a result of the reduced road capacity due to the project activity shall be quantified as per Step (b) below. If ARS_y is positive, $LE_{CON,y}$ is assumed to be zero and no monitoring is required in this case.

5.5.2.2. Step (b): Calculation of $LE_{CON,y}$

70. The corresponding emissions $LE_{CON,y}$ are calculated as follows:

$$LE_{CON,y} = max\{(LE_{REB,y} + LE_{SP,y}); 0\}$$ Equation (13)

Where:

$LE_{CON,y}$	=	Leakage emissions from reduced congestion in year *y* (t CO_2e)
$LE_{REB,y}$	=	Leakage emissions due to induced traffic/rebound effect in year *y* (t CO_2e)
$LE_{SP,y}$	=	Leakage emissions due to change in vehicle speed in year *y* (t CO_2e)

5.5.2.2.1. Determination of emissions due to induced traffic/rebound effect (*$LE_{REB,y}$*)

71. The concept to capture emissions from induced traffic (or rebound effect) includes the following assumptions (induced traffic is measured for passenger cars and taxis):

    (a) The distance driven on the affected roads by all additional cars/taxis is considered as additional trip distance, that is it is assumed that formerly used alternative routes are shorter, which is a conservative assumption;

    (b) All additional cars/taxis on the affected roads are considered to be induced by the project and not by external effects such as general traffic growth, which again is a conservative assumption.

72. The monitoring is realized through measurements of traffic flows and distance driven by passenger cars and taxis on the affected roads. Monitoring is realized in the years 1 and 4 of the crediting period, when applicable.

73. Ex ante, the "affected roads" are identified and clearly listed in the CDM-PDD including a map. The procedure to identify the "affected roads" is described in the definition section of the methodology under the term "affected roads".

74. A negative rebound effect based on additional congestion is expected in this situation. For each affected road the average speed of cars/taxis is monitored and compared with the baseline one.

75. The rebound effect for the affected roads is calculated as follows:

$$LE_{REB,y} = 10^{-6} \times \sum_{i} \left(TD_{i,y} \times EF_{km,i,y} \times \left(N_{i,y} - N_{i,x} + N_{i,S,y} \right) \right) \quad \text{Equation (14)}$$

Where:

$LE_{REB,y}$	=	Leakage emissions due to rebound effect in year *y* (t CO_2)
$TD_{i,y}$	=	Average trip distance driven by vehicle category *i* in year *y* (km)
$EF_{km,i,y}$	=	Emission factor per kilometer for vehicle category *i* in year *y* (gCO_2/km)
$N_{i,y}$	=	Number of vehicles in vehicle category *i* per annum used in the project boundary in year *y*
$N_{i,x}$	=	Number of vehicles in vehicle category *i* per annum used in the project boundary in year *x*
$N_{i,S,y}$	=	Number of vehicles in vehicle category *i* per annum not used anymore due to mode shift to the BRT in year *y*. Determined based on equation (15) below
i	=	Vehicle category: passenger cars (C) and taxis (T)
x	=	Most recent calendar year prior to the start of commercial operation of the project BRT system or prior to the submission of the CDM-PDD for validation, whatever is earlier

76. The number of cars and taxis per annum not used anymore due to mode shift to the BRT in year *y* is calculated as:

$$N_{i,S,y} = \frac{S_{i,y} \times P_y}{OC_{i,x}}$$ Equation (15)

Where:

$N_{i,S,y}$	=	Number of vehicles in vehicle category *i* per annum not used anymore due to mode shift to the BRT in year *y*
$S_{i,y}$	=	Share of passengers transported by the project who in absence of the latter would have used vehicle category *i* in year *y* (percentage)
P_y	=	Total passengers transported by the project in year *y* (passengers)
$OC_{i,x}$	=	Average occupancy rate of vehicle category *i* in year *x* (passengers)
i	=	Vehicle category: passenger cars (C) and taxis (T)
x	=	Most recent calendar year prior to the start of commercial operation of the project BRT system or prior to the submission of the CDM-PDD for validation, whatever is earlier

77. The net share of passengers that shifted from car/taxi to the BRT is based on the percentage of passengers who in the baseline would have used cars/taxis at least partially for their trip minus the share of passengers of the BRT who use cars/taxis partially for their trip to and/or from the BRT.

5.5.2.3. Step (c): Determination of emissions due to changes in vehicle speed ($LE_{SP,y}$)

78. Leakage emissions due to changes in vehicle speed are determined only for cars and taxis, as presented below:

$$LE_{SP,y} = 10^{-6} \times \sum_{i} \left(N_{i,y} \times TD_{i,y} \times \left(EF_{km,VP,i,y} - EF_{km,VB,i,x} \right) \right)$$ Equation (16)

Where:

$LE_{SP,y}$	=	Leakage emissions due to changes in vehicle speed of cars and taxis in year *y* (tCO_2)
$N_{i,y}$	=	Number of vehicles in vehicle category *i* per annum used in the project boundary in year *y*
$TD_{i,y}$	=	Average trip distance driven by vehicle category *i* in the project boundary in year *y* (km)
$EF_{km,VP,i,y}$	=	Emission factor per kilometer for vehicles in vehicle category *i* at the project speed in year *y* (gCO_2/km)
$EF_{km,VB,i,x}$	=	Emission factor per kilometer for vehicles in vehicle category *i* at the baseline speed in year *x* (gCO_2/km)
i	=	Vehicle category: passenger cars (C) and taxis (T)

x	=	Most recent calendar year prior to the start of commercial operation of the project BRT system or prior to the submission of the CDM-PDD for validation, whatever is earlier

79. The project speed on the affected roads is monitored in the years 1 and 4. Vehicle speed is monitored under moving conditions. The same method should be used for determining the baseline and project speed.

80. The number of cars and taxis on the affected roads are monitored through visual or electronic counting.

81. To determine the emission factor per kilometer of cars/taxis at the project speed and baseline speed, project proponents can either use a speed dependency factor developed with an officially recognized methodology for the project region with the corresponding documentation to ensure good quality (this is the preferred option) or use as a default relationship between the speed dependency factor and emissions for passenger cars developed by CORINAIR. The same vehicle speed is used for passenger cars and taxis.

$$\frac{EF_{km,VP,i,y}}{EF_{km,VB,i,x}} = \left(\frac{V_{P,y}}{V_{B,x}}\right)^{-0.7}$$ Equation (17)

Where:

$EF_{km,VB,i,x}$	=	Emission factor per kilometer for vehicles in vehicle category *i* at the baseline speed in year *x* (gCO_2/km)
$EF_{km,VP,i,y}$	=	Emission factor per kilometer for vehicles in vehicle category *i* at the project speed in year *y* (gCO_2/km)
$V_{B,x}$	=	Average speed of vehicles in vehicle category *i* in year *x* (km/h)
$V_{P,y}$	=	Average speed of vehicles in vehicle category *i* in year *y* (km/h)
i	=	Vehicle category: passenger cars (C) and taxis (T)
x	=	Most recent calendar year prior to the start of commercial operation of the project BRT system or prior to the submission of the CDM-PDD for validation, whatever is earlier

82. $V_{B,x}$ and $V_{P,y}$ in this case refer to moving speed, i.e. the speed of the vehicle under moving conditions.

5.5.3. Upstream emissions of gaseous fuels ($LE_{US,y}$)

83. 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 “TOOL15: Upstream leakage emissions associated with fossil fuel use” shall be used to calculate leakage. The following leakage sources shall be considered:

    (a) 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;

(b) In the case LNG is used in the project activity: 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.

5.6. Emission reductions

$$ER_y = BE_y - PE_y - LE_y$$ Equation (18)

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e)
BE_y	=	Baseline emissions in year *y* (t CO_2e)
PE_y	=	Project emissions in year *y* (t CO_2e)
LE_y	=	Leakage emissions in year *y* (t CO_2e)

5.7. Changes required for methodology implementation in 2nd and 3rd crediting periods

84. When a renewable crediting period is chosen, project participants shall use a four-step model, or equivalent, of the transportation system of the project city for the purpose of modelling the modal split, share of passengers who shifted from electricity-based or road-based vehicle category *i*, S_i or share of passenger-kilometers who shifted from electricity-based or road-based vehicle category *i*, SD_i, and an average trip distances travelled by passengers who shifted from electricity-based or road-based vehicle category D_i for the second and third crediting periods. The model should be tested and calibrated with the results of origin-destination surveys. For the determination of the baseline emissions, the most conservative value shall be used between estimates of baseline emissions based on the modelled parameters and the parameters determined via passenger surveys.

85. Percentage or share of vehicle-kilometers or vehicles in vehicle category *i* using fuel type *n* in year *y* of the second or third crediting period, $N_{i,n,y}/N_{i,y}$, or parameters used to estimate this share $N_{i,y}$ and $N_{i,n,y}$, which are the number of vehicle-kilometers or vehicles in vehicle category *i,* and the number of vehicle-kilometers or vehicles in vehicle category *i* using fuel type *n* in year *y*, can be based on data from municipal transit authorities on vehicle registration statistics from the respective city or data from vehicle control stations (technical and emission control stations). If no city/municipal data is available, regional data (canton, state) or, as a last option, national data can be used.

86. Furthermore, project participants shall apply the latest approved version of the “TOOL11: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period”.

5.8. Data and parameters not monitored

87. In addition to the parameters listed below, the procedures contained in the tools referred to in this methodology also apply.

Data / Parameter table 1.

Data / Parameter:	$DD_{i,S,x}$, $DD_{i,M,x}$, $DD_{i,L,i,x}$
Data unit:	km
Description:	$DD_{i,S,x}$: Total distance driven by small (S), medium (M) and large (L) buses *i* in year *x* $DD_{i,M,x}$: Total distance driven by medium (M) buses *i* in year *x* $DD_{i,L,i,x}$: Total distance driven by large (L) buses *i* in year *x*
Source of data:	Data from bus companies (company records), municipal transit authorities or specific studies conducted by the project proponent of a third party. Data vintage is maximum three years
Measurement procedures (if any):	The data source used to monitor this parameter shall also be used to monitor parameter $N_{Z,k,x}$, as well as $SFEC_{i,n,x}$ and $P_{i,x}$ in the tool "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
Any comment:	Used for baseline emissions calculation in case fuel consumption data for buses is based on specific fuel consumption (SFC) values obtained through sampling or from literature, and for leakage emissions calculation. Statistics is based, in general, on samples. Required for all sub-categories of baseline buses and taxis, and potentially other categories. To ensure consistency, it is important to have the same data source to monitor distance driven and passengers for public transport. Data can be either with or without the informal sector as long as above mentioned parameters are from the same data source. In general, data including only the formal sector is of a better data quality and should thus be taken

Data / Parameter table 2.

Data / Parameter:	$N_{Z,k,x}$
Data unit:	-
Description:	Number of buses in conventional bus system Z of size *k* in year *x*
Source of data:	Data from bus companies (company records), municipal transit authorities or specific studies conducted by the project proponent of a third party. Data vintage is maximum three years
Measurement procedures (if any):	The data source used to monitor this parameter shall also be used to monitor parameter $DD_{i,S,x}$, $DD_{i,M,x}$, $DD_{i,i,x}$ as well as $SFC_{i,n,x}$ and $SEC_{i,x}$ in the "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"

~~Monitoring frequency:~~ ~~-~~ ~~QA/QC procedures:~~ ~~-~~ Any comment:	Used to determine leakage emissions from changes in load factors of buses (calculation of $VD_{Z,x}$). Statistics is based, in general, on samples. Required for all sub-categories of baseline buses and potentially other categories. To ensure consistency, it is important to have the same data source to monitor distance driven and passengers for public transport. Data can be either with or without the informal sector as long as above mentioned parameters are from the same data source. In general, data including only the formal sector is of a better data quality and should thus be taken

Data / Parameter table ~~7.~~ 3.

Data / Parameter:	$VD_{T,x}$
Data unit:	km
Description:	Average distance driven by taxi in year *x*
Source of data:	Official statistics or specific studies conducted by the project proponent. Vintage maximum three years
Measurement procedures (if any):	-
~~Monitoring frequency:~~ ~~-~~ ~~QA/QC procedures:~~ ~~-~~ Any comment:	Used to calculate leakage emissions from a change in load factors of taxis

Data / Parameter table 4.

Data / Parameter:	$OC_{i,x}$
Data unit:	Passengers
Description:	Average occupancy rate of vehicle category *i* in year *x* (passengers only, driver must not be counted)
Source of data:	As per the "Data/Parameter table 8" from the "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
Measurement procedures (if any):	As per the "Data/Parameter table 8" from the "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
Any comment:	Vehicle category *i* represents taxi (T) when determining the parameter $OC_{T,x}$ in equation (8), or represents buses (Z) when determining the parameter $ROC_{Z,x}$ in equation (6)

Data / Parameter table ~~3.~~ 5.

Data / Parameter:	SRS_x
Data unit:	%
Description:	Share of road space used by public transport in year *x*
Source of data:	Official statistics or studies conducted by the project proponent or a third party

Measurement procedures (if any):	Based on calculations made for urban infrastructure and transport scenarios or on the calculation method provided using data on the distance driven by various vehicle categories
Any comment:	Used for urban transport and infrastructure models; see baseline equations for the calculation of SRS if the data is not available from reports. The share of road space used by public transport is a figure often calculated in transport studies. If no reliable data is available as proxy the relative distance driven per different vehicles can also be taken. SRS would then be the distance driven by the public transport (baseline) divided by the total distance of all vehicles driven (baseline). This would be a conservative factor as buses are larger than private cars and thus occupy a larger share of road space per kilometer driven

Data / Parameter table ~~5.~~ 6.

Data / Parameter:	***RS_x, ~~RS_y~~***
Data unit:	Lane-km
Description:	Total road space available in year *x* ~~*and year y*~~
Source of data:	Official statistics or studies conducted by the project proponent or a third party
Measurement procedures (if any):	Based on ~~calculation (RSy) and~~ infrastructure statistics
Any comment:	Road space baseline based on official information. Reduced road space based on construction plans (reduced road space is lanes which were eliminated due to dedicated bus lanes). ~~Road space project = road space baseline – eliminated lanes~~

Data / Parameter table 7.

Data / Parameter:	***RS_y***
Data unit:	Lane-km
Description:	Total space available due to the project activity
Source of data:	Official statistics or studies conducted by the project proponent or a third party
Measurement procedures (if any):	Based on infrastructure statistics
Any comment:	Road space based on official information and on construction plans. During the crediting period the actual RS_y implemented should be checked against the ex ante expectation. If there are differences, the Project Proponent should demonstrate why it does not affect the project design (i.e. by applying equation 9 again), or request a Post Registration Change to incorporate or eliminate the leakage calculation

Data / Parameter table ~~4.~~ 8.

Data / Parameter:	***DD**$_{Z,x}$**, DD**$_{T,x}$**, DD**$_{C,x}$*
Data unit:	km
Description:	$DD_{Z,x}$: Total distance driven by public transport buses~~, taxis, and passenger cars~~ in year *x* $DD_{T,x}$: Total distance driven by public transport taxis in year *x* $DD_{C,x}$: Total distance driven by passenger cars in year *x*
Source of data:	Official statistics or studies conducted by the project proponent or a third party
Measurement procedures (if any):	-
Any comment:	Used to calculate SRS, if provided calculation method is applied

Data / Parameter table 9.

Data / Parameter:	$N_{i,x}$
Data unit:	Vehicles
Description:	Number of vehicles in vehicle category *i* per annum used in the project boundary in year *x*
Source of data:	Official statistics or specific studies done by the project proponent or a third party. Vintage of maximum three years allowed
Measurement procedures (if any):	-
Any comment:	Per vehicle category, the number of vehicles per relevant fuel type (gasoline, diesel, LNG, CNG or electric vehicles) needs to be identified. Only categories where modal shift is expected (next to public transport) are included

Data / Parameter table ~~6.~~ 10.

Data / Parameter:	$V_{B,x}$
Data unit:	km/h
Description:	Average speed of vehicles in vehicle category *i* in year *x*
Source of data:	Based on transport models
Measurement procedures (if any):	Traffic models use such data and have verified them
Any comment:	For determination of emissions due to changes in vehicle speed ($LE_{SP,y}$). The average speed of passenger cars before the project start

Data / Parameter table ~~8.~~ 11.

Data / Parameter:	GWP_{CH4}
Data unit:	~~g~~tCO_2/~~g~~tCH_4
Description:	Global Warming Potential of methane
Source of data:	IPCC~~Project participants shall update GWPs according to any decisions by the CMP. For the first commitment period GWP = 25~~

Measurement procedures (if any):	Shall be updated according to any future COP/MOP decisions-
Any comment:	Used for all vehicle categories which use gaseous fuels

6. Monitoring methodology

6.1. Monitoring procedures

88. BRT systems have as a core environmental aspect that the resource efficiency of transporting passengers in a city shall be improved that is fuel consumption and emissions per passenger trip shall be reduced compared to the situation without the project. The methodology directly addresses the objective of increased resource efficiency and is thus based upon emissions per transported passenger.

89. The monitoring methodology for the baseline has ex ante determined emission factors per passenger transported for all modes of transport with the use of the “TOOL18: Baseline emissions for modal shift measures in urban passenger transport”. These factors are fixed, but not constant. For passengers using the project, 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. To ensure a conservative approach the baseline emission factors are only changed if the monitoring results show that the new factors would be lower than the ones originally used.

90. The total baseline emissions are derived by applying to these emission factors the activity level (passengers per mode transported) of the project. With respect to these emission factors, data sources are either from recent statistics or measurements made or are based on fixed default values taken from the international literature, primarily IPCC. Preference is for local data. Default values are the last options in case of non-availability of more precise data. The project proponents can choose to either invest resources to carry out measurements or opt for the simpler and less expensive alternative of using default values with the trade-off of claiming less emission reductions as the default values in the “TOOL18: Baseline emissions for modal shift measures in urban passenger transport” are very conservative. All the data used to calculate the baseline emission factors are collected ex ante. For calculating the total baseline emissions, the number of passengers using the project and the traffic mode they would have used in absence of the new transport system needs to be monitored (public transport, taxis, passenger cars, motorcycles, non-motorized transport or induced traffic). Baseline emissions can thus only be calculated ex post.

91. The monitoring methodology for the project is based on measuring the total fuel consumption and thus emissions of the new transport system. From a methodological viewpoint, data is derived from measurements. Data reliability is very high due to having exact measurements and established control procedures for the data required. Default values for fuel consumption cannot be used for project emissions.

92. QA and QC is assured by having a monitoring manual containing inter alia how to proceed with key measurements and survey, how to screen data for quality and potential errors and by training the staff in charge of monitoring. For the periodic survey of passengers and the surveys monitoring the load factor, the core outline shall be included in this methodology and the CDM-PDD shall contain a detailed design of both instruments.

Table 4. Main points of the monitoring methodology

Element	Monitoring methodology
1. Core data for determining baseline emissions: (a) Fuel consumption and distance driven per vehicle category and fuel type; (b) Technology improvement factor; (c) Passengers per transport mode using the project transport system after the project start (relative distribution and absolute numbers)	1. Fuel consumption based on measurement of a representative sample, international literature, IPCC values related to local circumstances and distance driven based on official statistics; 2. Default value based on international literature; 3. Monitored in the year 1 and 4 of the crediting period by the project proponent based on surveys plus registration of total passengers transported by the system
2. Core data for determining project emissions: (a) Fuel consumption of the project system; or (b) Fuel efficiency and distance driven by project units	1. Measured annually by the project proponent based on company accounts and measurements; or 2. Distance driven measured annually by GPS; fuel efficiency based on measurement
3. Core data for determining leakage: (a) Change in load factor; (b) Congestion impact (rebound effect and change in vehicle speed)	1. Measured regularly by the project proponent based on representative samples; 2. Based on transport models, local statistics and default values from international literature sources; Congestion impact shall be monitored in the years 1 and 4 of the crediting period in case the implementation of the project BRT reduces road space

93. Describe and specify in the CDM-PDD all monitoring procedures, including the type of measurement instrumentation used, the responsibilities for monitoring and QA/QC procedures that will be applied. Where the methodology provides different options (e.g. use of default values or on-site measurements), specify which option will be used. All meters and instruments should be calibrated regularly as per industry practices.

6.2. Data and parameters - Project emissions

94. Fuel-efficiency data is derived from annual data reported by the bus companies operating the units either of all units or of a representative sample of comparable units (comparable technology, vintage and size). To ensure a conservative approach ensuring that project emissions are not overstated, the lower 95% confidence level is taken if data for specific fuel consumption is based on sampling.

95. If the CDM project includes only parts of a larger activity, the fuel used for the CDM project is separated from the total fuel used. The separation is done (in order of preference) by the following means:

(a) By operators: this method is used if certain operators are assigned to certain parts of the project;

(b) By distance driven: the fuel share for each part of the project is based on the share of kilometers per project part;

(c) By passengers: the fuel share for each part of the project is based on the share of passengers per part of the project (based on the entry points of passengers).

6.3. Data and parameters - Baseline emissions

6.3.1. Details of data on fuel consumption baseline

96. Measurement of fuel consumption data using a representative sample for the respective category and fuel type. Factors such as the specific urban driving conditions (drive-cycle, average speed etc.), vehicle maintenance and geographical conditions (altitude, road gradients, etc.) are thus included. The sample shall be large enough to be representative.[8] To ensure a conservative approach the lower 95% confidence level of the sample measurement to be taken. This ensures a conservative approach. Such surveys are potentially conducted by international organizations or by local transit or environmental authorities. As such surveys are, however, costly they are only available in few cities. More guidance is available in the “TOOL18: Baseline emissions for modal shift measures in urban passenger transport”

6.3.2. Details of survey to identify mode of transport

97. The survey is used to distribute the electronically or mechanically registered total number of passengers to different transport modes that they would have used in absence of the project. The basic goal of this survey is to identify the mode of transport used in absence of the project. Additionally the survey is also used to track any changes in distance driven by passengers (which in absence would have used passenger cars, motorcycles or taxis) as well as the fuel type used in passenger cars for passengers using the project system who an absence of the latter would have used passenger cars. The precise survey methodology to be used will vary with each individual project.

98. The CDM-PDD shall contain an elaborated version of such a survey.

99. The survey is conducted annually during project duration based on a representative survey of all passengers. The categories of transport modes include public transport (buses and, if applicable, rail-based urban MRTS), taxis, passenger cars, motorcycles, non-motorized transport and induced traffic (i.e. passenger would not have realized the trip in absence of the project). The relative distribution is measured and the absolute numbers are calculated based on total passengers transported. Additionally, per specific transport mode the users are asked for their trip origin and destination to calculate distance driven. Users of the project system that would have used passenger cars in absence of the BRT system are additionally asked what fuel type their passenger car uses.

100. The following survey principles shall be followed:

(a) The survey shall be realized with maximum 5% error margin and a 95% confidence interval. This confidence interval corresponds to the guidelines issued by the Board at its 22nd meeting annex 2 (EB 22 report, annex 2, D, page 3): “Methodologies employing sampling to derive parameters in estimating emissions reductions shall quantify these parameter uncertainties at the 95% confidence level”;

[8] Variances of fuel consumption will result due to different routes, load factors, engine and vehicle types, driver, driving conditions, ambient conditions etc.

(b) The sampling size is determined by the 95 per cent confidence interval and the 5 per cent maximum error margin;

(c) Sampling shall be statistically robust and relevant that is the survey has a random distribution and is representative of the persons using the BRT system;

(d) 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);

(e) Only persons over age 12 are interviewed;

(f) 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);

(g) The survey shall be executed by an external organization with specialized knowledge on survey and survey techniques;

(h) Training of the people conducting the survey shall be made by the organization performing the latter to ensure good quality. The training shall be based on standard questionnaire techniques and quality assurance;

(i) Before starting the official monitoring a test-run using the same questionnaire should be realized. This to ensure that the questions and multiple-choice answers are correctly understood by the passengers;

(j) The CDM-PDD shall contain the design details of the survey. Relevant for the CDM-PDD is that the design can guarantee a representative survey with the targeted confidence interval. The same question should be used throughout the crediting period to ensure consistency;

(k) The survey shall allow for a clear separation of modes of transport which the passenger would have used in absence of the project;

(l) The survey should include control questions to assure a conservative approach;

(m) BRT projects are in general implemented gradually. The questions asked by surveys can thus compare a still existing public transport system with the project situation;

(n) If a passenger is not sure how he would have made a trip he is assigned to induced transport. This ensures a conservative approach.

101. The default questionnaire to be used is included in Appendix 5 below. This questionnaire should be used by all projects except if valid arguments exist to change the questionnaire and to adapt it to local circumstances. The questionnaire shall be realized in the local language.

102. Equation (1) of the “TOOL18: Baseline emissions for modal shift measures in urban passenger transport” is used to calculate transport emissions factor per kilometer of vehicle category.

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

6.3.2.1. Two methodological alternatives are proposed for the fuel consumption data (in order of preference)

104. **Alternative 1:** Measurement of fuel consumption data using a representative sample for the respective category and fuel type. To ensure a conservative approach the lower 95 per cent confidence level of the sample shall be taken for calculations.

105. **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.

106. A technical improvement factor is thereafter introduced. The technology improvement factor results in dynamic emission factors for the different units.

6.3.3. Calculate emissions per passenger per vehicle category

107. This step calculates emission factors showing the emissions per passenger per average trip for each vehicle category and uses equation (2) and equation (3) of the “TOOL18: Baseline emissions for modal shift measures in urban passenger transport” for electricity based transport system and fuel based transport system such as passenger cars, taxis, motorcycles, and buses.

108. The time period for passengers and distance shall be equal (e.g. one year or one month). All data used is determined ex ante project. A change in the occupancy rate of buses is registered as leakage of the project.

6.3.4. Change of baseline parameters during the project crediting period

109. The baseline emissions for all passengers transported are calculated using the “TOOL18: Baseline emissions for modal shift measures in urban passenger transport”, where two options are available, taking into account the mode of transport, which the person would have used in absence of the project. Passengers transported are determined through the project (activity level of the project). The total amount of passengers transported by the project shall be reported by the system operator.

6.4. Data and parameters - Leakage

6.4.1. Details of load factor study

110. Changes in load factor of the remaining conventional buses and taxis shall be monitored in the years 1 and 4 of the crediting period. If the load factor reduces less than 10 per ~~centage~~ cent, ~~points~~ no leakage is included. If the load factor reduces by more than 10 per cent~~age points~~ relative to the measurement before project start (benchmark), then leakage

is calculated and included. In this case the amount of leakage is the cumulative sum of all years since the last load factor survey was realized, assuming that the reduction of the load factor occurred immediately since the last survey. The guidelines for the establishment of load factor studies for buses are provided under Appendix 1 and 2 and the guidelines for the establishment of load factor studies for taxis/motorcycles or passenger cars are provides under Appendix 3.

6.5. Data and parameters monitored

111. All data collected as part of monitoring should be archived electronically and be kept at least for two years after the end of the last crediting period. One hundred per cent of the data should be monitored if not indicated otherwise in the tables below. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

112. In addition to the parameters listed in the tables below, the procedures contained in the tools referred to in this methodology also apply.

Data / Parameter table ~~9.~~ 12.

Data / Parameter:	$FC_{PJ,n,y}$
Data unit:	~~Million litres~~ tonne or L
Description:	Total consumption of fuel type *n* in year *y* by the project by both trunk buses and feeder buses
Source of data:	Based on company records
Measurement procedures (if any):	-
Monitoring frequency:	Annual
QA/QC procedures:	Data of measurements can be cross-checked against specific fuel consumption data. Variations in the specific fuel consumption from the average factor need to be controlled. Variations are possible due to different bus models used, variations resulting from routes and frequency, load factor variances and driver variances
Any comment:	Used when Alternative A is applied. In case of bio-fuel blends being used, the biofuel share shall be transparently recorded and emissions are only calculated for the fossil fuel share of the blend. It shall be shown that conventional comparable urban buses use the same biofuel blend as project buses

Data / Parameter table ~~22.~~ 13.

Data / Parameter:	$EF_{CO2,n}$
Data unit:	~~g~~kgCO_2/~~J~~TJ
Description:	CO_2 emission factor for fuel type *n*

<table>
<tr><td>Source of data:</td><td>The following data sources may be used, if the relevant conditions apply:
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>(a) Values provided by the fuel supplier in invoices taken from a sample of fuel stations in the larger urban zone of the city</td><td>Conditions for using the data source</td></tr>
<tr><td>(b) Measurements by the project participants taken from a sample of fuel stations in the project boundary</td><td>This is the preferred source</td></tr>
<tr><td>(c) Regional or national default values</td><td>If (a) is not available</td></tr>
<tr><td>(d) IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td></td></tr>
</table></td></tr>
<tr><td>Measurement procedures (if any):</td><td>For (a) and (b): measurements should be undertaken in line with national or international fuel standards.

For (a): if fuel suppliers provide the NCV value and the CO_2 emission factor on the invoices and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, options (b), (c) or (d) should be used</td></tr>
<tr><td>Monitoring frequency:</td><td>For (a) and (b): the CO_2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated.

For (c): review the appropriateness of the values annually.

For (d): any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>QA/QC procedures:</td><td>-</td></tr>
<tr><td>Any comment:</td><td>Vehicle owners or operators can buy fuel from a variety of sources (fuel stations). In practice therefore it is considered to be simpler to determine the parameter using options (c) or (d)</td></tr>
</table>

Data / Parameter table ~~23.~~ 14.

Data / Parameter:	$\boldsymbol{EF_{CH4,n}}$
Data unit:	~~$gCO2_e$/litre~~ $kgCH_4/TJ$
Description:	CH_4 emission factor for gaseous fuel type *n*

Source of data:	The source of data should be the following, in order of preference: project specific data, country specific data or IPCC default values. As per guidance from the Board, IPCC default values should be used only when country or project specific data are not available or difficult to obtain
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	
Any comment:	-

Data / Parameter table ~~10~~. 15.

Data / Parameter:	***SF~~E~~C***$_{j,n,y}$
Data unit:	~~L~~g/km or L/km
Description:	Specific ~~energy~~ consumption of fuel type *n* in project bus category *j* in year *y*
Source of data:	Based on company records
Measurement procedures (if any):	Based on specific studies or calculated based on total fuel consumed and total distance driven per bus size sub-category. If based on studies, the specific fuel consumption is taken of a representative sample of comparable project units in terms of technology, vintage and size. Buses of the sample shall be project units running on project bus lanes. The sample criteria are based on technology (Euro standard), age, and bus size. The sample shall be representative of the route(s) serviced by the project as well as the operation frequencies during the day to account for differences of fuel consumption related to time. Measurement procedures shall include distance driven (preferably recorded by GPS or other electronic means with a maximum error level of 5 per cent) and the fuel consumed monitored either through appropriate equipment installed in the units or through standard measurement procedures at a calibrated fuel station
Monitoring frequency:	Annual
QA/QC procedures:	To be conservative project fuel consumptions based on specific fuel consumption values of samples shall be based on the upper limit of the uncertainty band at a 95 per cent confidence level that is with 95 per cent confidence the actual average fuel consumption is equal to or lower than the value used by the project
Any comment:	Used when Alternative B is applied. In case of bio-fuel blends being used, the biofuel share shall be transparently recorded and emissions are only calculated for the fossil fuel share of the blend. It shall be shown that conventional comparable urban buses use the same biofuel blend as project buses

Data / Parameter table 16.

Data / Parameter:	ρ_n
Data unit:	t/L

<table>
<tr><td>Description:</td><td>Density of the fuel type n</td></tr>
<tr><td>Source of data:</td><td>The following data sources may be used, if the relevant conditions apply:
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>(a) Values provided by the fuel supplier in invoices taken from a sample of fuel stations in the larger urban zone of the city</td><td>Conditions for using the data source</td></tr>
<tr><td>(b) Measurements by the project participants taken from a sample of fuel stations in the project boundary</td><td>This is the preferred source</td></tr>
<tr><td>(c) Regional or national default values</td><td>If (a) is not available</td></tr>
</table></td></tr>
<tr><td>Measurement procedures (if any):</td><td>For (a) and (b): measurements should be undertaken in line with national or international fuel standards.

For (a): if fuel suppliers provide the density, the NCV value and the CO_2 emission factor on the invoices and these two values are based on measurements for this specific fuel, this density should be used. If another source for the density emission factor is used or no density is provided, options (b) and (c) should be used</td></tr>
<tr><td>Monitoring frequency:</td><td>For (a) and (b): the density should be obtained for each fuel delivery, from which weighted average annual values should be calculated.

For (c): review the appropriateness of the values annually</td></tr>
<tr><td>QA/QC procedures:</td><td></td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

Data / Parameter table ~~11.~~ 17.

Data / Parameter:	$DD_{TB,y}$
Data unit:	km
Description:	Total distance driven by trunk buses in year *y*
Source of data:	Based on company records
Measurement procedures (if any):	Based on GPS (preferred), other electronic means, odometer or number of units per route and turnover per route
Monitoring frequency:	Continuously, aggregated at least annually
QA/QC procedures:	In many systems operators are paid according to distance driven. Payment of operators can thus be used to check the distance driven
Any comment:	Used when Alternative B is applied

Data / Parameter table ~~12.~~ 18.

Data / Parameter:	***$DD_{FB,y}$***
Data unit:	km
Description:	Total distance driven by feeder buses in year *y*
Source of data:	Based on company records
Measurement procedures (if any):	Based on GPS (preferred), other electronic means, odometer or number of units per route and turnover per route
Monitoring frequency:	Continuously, aggregated at least annually
QA/QC procedures:	In many systems operators are paid according to distance driven. Payment of operators can thus be used to check the distance driven
Any comment:	Used when Alternative B is applied

Data / Parameter table ~~16.~~ 19.

Data / Parameter:	***$OC_{i,y}$***
Data unit:	Passengers
Description:	Average occupancy of a vehicle in vehicle category *i* in year *y*
Source of data:	Survey conducted by an external survey company
Measurement procedures (if any):	Based on survey
Monitoring frequency:	The year 1 and 4 of the crediting period
QA/QC procedures:	See appendix 5 for the survey design. Important is that the same methodology is used to measure the occupancy rate thus ensuring data consistency. For QA a precise and transparent data collection protocol is thus established detailing methodology and operational issues (including frequency, location, time, duration of measurement). The data is only required at a medium level as only changes >10 percentage points will be registered
Any comment:	The occupancy rate of taxis and the remaining bus fleet is monitored through representative samples. If results show negative changes > 10 per cent in the load factor, this change is included in the leakage calculation for all years since the last monitoring of the load factor. When applying equation (6), the vehicle category *i* represents buses (Z). When applying equation (8), the vehicle category *i* represents taxis (T)

Data / Parameter table ~~17.~~ 20.

Data / Parameter:	***$CV_{i,y}$***
Data unit:	Passengers
Description:	Average capacity of a vehicle in vehicle category *i* in year *y*
Source of data:	Official statistics
Measurement procedures (if any):	-

Monitoring frequency:	In the year 1 and 4 of the crediting period
QA/QC procedures:	-
Any comment:	-

Data / Parameter table ~~18.~~ 21.

Data / Parameter:	***$N_{Z,y}$, $N_{T,y}$***
Data unit:	-
Description:	Number of conventional buses and taxis in year *y*
Source of data:	Official registration statistics or survey conducted by an external survey company
Measurement procedures (if any):	Based on survey, if not sourced from official registration statistics
Monitoring frequency:	The year 1 and 4 of the crediting period
QA/QC procedures:	See appendix 5 for the survey design. In general various official sources are available (vehicle registration data; transportation statistics). Important is to ensure that over time the same source or the same calculation method (e.g. average of sources) is applied
Any comment:	-

Data / Parameter table ~~25.~~ 22.

Data / Parameter:	***$BSCR_y$***
Data unit:	units
Description:	Cumulative bus units displaced by the BRT on the trunk lanes ~~retired~~ as a result of the project in year *y*
Source of data:	Municipal transit authorities, official statistics or studies ordered by project proponent
Measurement procedures (if any):	-
Monitoring frequency:	Annual
QA/QC procedures:	-
Any comment:	Used to calculate ARS_y The number of buses circulated in trunk lanes prior to the construction of the project activity that have ceased to circulate in trunk lanes due to the project activity are to be considered. These buses can be retired or used in another part of the network to meet a growing demand ~~as an alternative method to situations when the project participants are not able to monitor this parameter from municipal transit authorities, official statistics or studies ordered by project proponent~~.

Data / Parameter table ~~13.~~ 23.

Data / Parameter:	***$TD_{i,y}$***
Data unit:	km
Description:	Average trip distance driven by vehicle category *i* in year *y*

Source of data:	Survey
Measurement procedures (if any):	-
Monitoring frequency:	The year 1 and 4 of the crediting period and re-test survey of the year 1 only
QA/QC procedures:	Data is based on origin-trip survey used to design the project including the QA procedures involved in such studies. The same data source should be used to monitor OC_i and $OC_{i,y}$ to ensure data consistency. The annual survey is based on a questionnaire, which is representative. Data from the annual survey is however only used if this results in lower baseline emissions (i.e. lower trip distances are monitored than the original baseline data)
Any comment:	Required for categories of baseline vehicles (taxis, personal cars and motorcycles) if passenger-km is calculated based on occupancy rate and trip distance. Average trip distances for passengers using the project system are recorded through surveys based on the mode of transport they would have used in absence of the project (for users which would have used a passenger cars, taxis or motorcycle; only required if modal shift effects are accounted for in emissions reductions attributed to the project)

Data / Parameter table 24.

Data / Parameter:	$EF_{km,i,y}$
Data unit:	gCO_2/km
Description:	Emission factor per kilometer for vehicle category *i* in year *y*
Source of data:	Determined based on equation (1) from the “TOOL18: Baseline emissions for modal shift measures in urban passenger transport”
Measurement procedures (if any):	Determined based on equation (1) from the “TOOL18: Baseline emissions for modal shift measures in urban passenger transport”
Monitoring frequency:	Determined based on equation (1) from the “TOOL18: Baseline emissions for modal shift measures in urban passenger transport” for the year 1 and 4 of the crediting period (and re-test survey of the year 1 only)
QA/QC procedures:	-
Any comment:	In Equation 6, the vehicle category *i* is represented by buses (Z)

Data / Parameter table ~~19.~~ 25.

Data / Parameter:	$N_{i,y}$
Data unit:	Vehicles
Description:	Number of vehicles in vehicle category *i* per annum used in the project boundary in year *y*
Source of data:	Official statistics or specific studies done by the project proponent or a third party. Vintage maximum three years
Measurement procedures (if any):	-
Monitoring frequency:	Before project start and in the year 1 and 4 and re-test survey in the year 1 only (in the case of modal shift for passenger cars)

QA/QC procedures:	In general, various official sources are available (vehicle registration data; transportation statistics). Important is to have the same data source to monitor distance driven and passengers for public transport to ensure consistency. Data can be either with or without the informal sector as long as above-mentioned parameters are from the same data source. In general data including only the formal sector is of better data quality and should thus be taken. To ensure quality, the data source and calculation method need to be stated. With the survey data on the fuel type of passenger cars used by passengers now using the BRT system is recorded. Changes to the baseline emission factor for passenger cars are only made if the monitored data results in lower emission factors, not so however if the data results in higher emission factors
Any comment:	Per vehicle category the amount of vehicles per relevant fuel type (gasoline, diesel, LNG, CNG or electric vehicles) needs to be identified. Only categories are included where modal shift is expected (next to public transport). Recording of fuel type used by passengers using the project system who in absence of the project would have used a passenger car (only required if a modal shift of passenger cars is included in the project) shall be conducted in the year 1 and 4 of the crediting period and re-test survey in the year 1 only. When applying equation (6), the vehicle category *i* represents buses (Z). When applying equation (8), the vehicle category *i* represents taxis (T).~~-~~

Data / Parameter table ~~14.~~ 26.

Data / Parameter:	$S_{i,y}$
Data unit:	%
Description:	Share of passengers transported by the project who in absence of the latter would have used vehicle category *i* in year *y*
Source of data:	Survey conducted by an external survey company
Measurement procedures (if any):	Based on passenger survey
Monitoring frequency:	Fixed crediting period OR first seven years of a renewable crediting period: The year 1 and 4, with the retest survey in year 1 only. Second and third crediting periods of a renewable crediting period: Year 1
QA/QC procedures:	See appendix 5 for the survey design. Statistics on the total number of passengers of the project system is based on electronic or mechanic measurements and is cross-checked against financial receipts from the sale of tickets
Any comment:	Via a survey, the project monitors which transport mode passengers would have used in absence of the project. The survey is also required if no modal shift is included in the project. In this case the modes of transport are only public transport, NMT, rail based urban transit and induced traffic

Data / Parameter table ~~15.~~ 27.

Data / Parameter:	***P_y***
Data unit:	Passengers
Description:	Total passengers transported by the project in year *y*
Source of data:	Municipal transit authorities or specific studies done by the project proponent or a third party
Measurement procedures (if any):	Statistics is based on electronic or mechanic measurements
Monitoring frequency:	Annual
QA/QC procedures:	Cross-checked against financial receipts from the sale of tickets
Any comment:	Statistics of transit management unit show the number of passengers transported by the project in total. This is based on electronic or mechanical measurement of all passengers using the system. Used to calculate ex post the baseline emissions and to fulfil the applicability conditions

~~**Data / Parameter table 20.**~~

~~**Data / Parameter:**~~	~~***$TD_{i,y}$***~~
~~Data unit:~~	~~km~~
~~Description:~~	~~Average trip distance driven by vehicle category *i* in the project boundary in year *y*~~
~~Source of data:~~	~~Official statistics or specific studies done by the project proponent or a third party. Vintage maximum three years~~
~~Measurement procedures (if any):~~	~~-~~
~~Monitoring frequency:~~	~~-~~
~~QA/QC procedures:~~	~~-~~
~~Any comment:~~	~~-~~

Data / Parameter table ~~21.~~ 28.

Data / Parameter:	***$NCV_{NG,y}$***
Data unit:	GJ/m^3
Description:	Net calorific value of the natural gas used by the project during the year *y*
Source of data:	Local, regional, national data or IPCC
Measurement procedures (if any):	Annually
Monitoring frequency:	-
QA/QC procedures:	-

Any comment:	In case of IPCC default values, the upper limit of the uncertainty at a 95 per cent confidence interval should be taken. Note that IPCC default values are provided in the unit of TJ/Gg. To convert from mass to volume unit, the density of the fuel should be determined in accordance with the options and relevant conditions provided in the latest approved version of the “TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”

Data / Parameter table ~~24.~~ 29.

Data / Parameter:	$V_{P,y}$
Data unit:	km/h
Description:	Average speed of vehicles in vehicle category *i* in year *y*
Source of data:	Municipal transit authorities or studies ordered by project proponent
Measurement procedures (if any):	On-board measurements determining the total average speed and the average moving speed (when circulating) on the remaining roads based, for example on GPS measuring. This parameter should be monitored for each affected road in the project boundary
Monitoring frequency:	Once in the years 1 and 4 of the crediting period
QA/QC procedures:	-
Any comment:	-

Data / Parameter table ~~26.~~ 30.

Data / Parameter:	$LE_{US,y}$
Data unit:	t CO_2
Description:	Leakage upstream emissions of gaseous fuels during the year *y*
Source of data:	As per “TOOL15: Upstream leakage emissions associated with fossil fuel use”
Measurement procedures (if any):	As per “TOOL15: Upstream leakage emissions associated with fossil fuel use”
Monitoring frequency:	As per “TOOL15: Upstream leakage emissions associated with fossil fuel use”
QA/QC procedures:	As per “TOOL15: Upstream leakage emissions associated with fossil fuel use”
Any comment:	As per “TOOL15: Upstream leakage emissions associated with fossil fuel use”

Appendix 1. Guideline for the establishment of load factor studies for buses based on visual occupation surveys

1. Load factor surveys based on visual occupation studies use the following procedures:

    (a) Vehicle categories are defined according to the characteristics of the fleet and types of services (e.g. with or without standing passengers);

    (b) Occupation categories are defined (usually five or six), for instance <50 per cent occupied, 50-100 per cent seats occupied, 100 per cent seats occupied, <50 per cent space for standing passengers occupied, 50-100 per cent of standing space occupied, overload (>100 per cent of legally permitted space occupied);

    (c) The number of passengers corresponding to each vehicle category and type of service is defined. A pilot study could be completed to calibrate the levels of occupation with actual in vehicle counts;

    (d) Formats for field study are prepared;

    (e) Field data collectors are trained;

    (f) Locations, days and times for field study are defined. Points are strategically located to cover all the routes with the minimum of points. Suggested days are Tuesday to Thursday, avoiding days immediately after or before a holiday. A typical season (school or university vacations) should be avoided. The recommended time period for the study is 6AM-9PM. Measurements should be realized for all weekdays proportional to the number of buses displaced on these days. The same days and time periods need to be chosen for the baseline as well as for the monitoring studies to ensure data comparability;

    (g) Field data is collected. Coverage of the occupation counts should be higher than 95 per cent of the number of buses that cross the checkpoint. 100 per cent coverage is desired. To control this outcome, a separate vehicle count is advised. Data can be adjusted with the actual count;

    (h) Data is digitized and its quality is controlled. In case of mistakes in data collection, counts should be repeated;

    (i) The total number of vehicles, number of available spaces (vehicle capacity) and the total number of passengers is reported. Occupation is the number of passengers divided by the vehicle capacity.

2. The average load factor is equal to the average load factor of each route multiplied by the total number of passengers in the route, divided by the total passengers in the network.

Appendix 2. Guideline for the establishment of load factor studies for buses based on boarding-alighting surveys

1. Load factor surveys based on boarding-alighting studies for buses use the following procedure:

    (a) Routes for the survey shall be selected, weighted upon the expected number of passengers per route. Only active routes are included;

    (b) The load factor (occupation rate) is defined as the average percentage of capacity of the vehicle used by passengers. The average load factor of a route is based on the average of each load factor between each station of the specified route;

    (c) The common operational procedure used is to ride on the unit and count at each station the number of passengers boarding and alighting. Instead of manual controls electronic or mechanical controls can be used;

    (d) Locations, days and times for the survey are defined. Atypical seasons (school or university vacations) should be avoided. The recommended time period for the study is the entire period of operation of the selected buses. Measurements should be realized for all weekdays proportional to the number of buses displaced on these days. The same days and time periods need to be chosen for the baseline as well as for the monitoring studies to ensure data comparability;

    (e) The survey shall be conducted during the entire operation period of buses (not only peak or off-peak hours);

    (f) The units selected are clearly identified including licence plate, day monitored, number of turn-arounds, route and route distance;

    (g) Data are digitized and its quality is controlled. In case of mistakes in data collection, counts should be repeated.

2. Boarding and alighting information can also be obtained in some cases from electronic means such as electronic ticketing, digital camera passenger identification per bus, monitoring of average bus weight per station, etc.

Appendix 3. Guideline for the establishment of load factor studies for taxis/motorcycles or passenger cars

1. This study is only conducted if modal shift is claimed from former taxi passengers. The actual number of passengers excluding the driver of taxis is counted in a given point within a given time period. The counting is based on visual occupation counting the number of passengers occupying the taxi.

2. The actual number of passengers excluding the driver of taxis is counted in a given point within a given time period. The counting is based on visual occupation counting the number of passengers occupying the vehicle excluding the driver for taxis. The procedures to establish visual occupation are:

    (a) Locations, days and times for field study are defined. Suggested days are Monday to Friday, avoiding days immediately after or before a holiday. A typical season (school or university vacations) should be avoided. The recommended time period for the study is 6AM-9PM. The same days and time periods need to be chosen for the baseline as well as for the monitoring studies to ensure data comparability;

    (b) Field data is collected. Coverage of the occupation counts should be higher than 95% of the number of taxis that cross the checkpoint. One hundred per cent coverage is desired. To control this outcome a separate vehicle count is advised. Data can be adjusted with the actual count;

    (c) Data is digitized and its quality is controlled. In case of mistakes in data collection counts should be repeated;

    (d) Occupation is the number of passengers using the vehicle. The driver is not counted for taxis. Taxis without passengers are counted as no (zero) occupation;

    (e) The total number of vehicles and the total number of passengers is reported. The average occupation rate of vehicles is the total number of passengers divided by the total number of vehicles in which counts were performed;

    (f) The study is realized in different locations of the project boundary;

    (g) The same methodology is used for the load study performed prior to the project start and during its monitoring. Locations of monitoring can, however, 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.

Appendix 4. Methodological design of the BRT survey

1. Methodological design of survey

1. The methodological design of the survey is presented in detail. The following points are discussed:

   (a) Survey objective;

   (b) Target population;

   (c) Sample frame;

   (d) Sample design;

   (e) Relative error level;

   (f) Geographical coverage;

   (g) Sample frequency;

   (h) Sample size;

   (i) Size and result of the pilot test;

   (j) Selection method of the sample;

   (k) Methodology for information collection and estimation of the parameters;

   (l) Data verification and validation including QA and QC;

   (m) Survey realization;

   (n) Calculation of a trip distance in the survey;

   (o) Default questionnaire.

2. Whenever the BRT is extended, a new survey distribution is realized and data of the new survey is used for calculating emissions reductions achieved from the moment of the BRT extension.

Table 1. Technical Summary Data Sheet of the Survey Strategy and sample design in the BRT passenger survey

Parameter	Main parameters: • Baseline emissions; Secondary parameters and inputs: • Proportion of passengers using each mode of transport, with the project and in absence of the project; • The average distance travelled by these modes with the project and in absence of the project
Target population	Passengers over 12 years using the BRT

Sample frame	Passenger flow in all the stations of the BRT
Sample design	Two staged probabilistic design: • First stage: stratified – simple random sampling (SRS); • Second stage: systematic sampling based on passengers flow per station. Stratum: Stations. Sub stratum: Days in a week and hours
Relative error level (CV)[1]	For the survey a global desired level of precision (relative standard error or coefficient of variation – CV) between 5% and 10% for the parameters of interest, which also implies that having precision levels of 90/10, is required. Results obtained are based on a 95% confidence level using the more conservative boundary
Coverage	The project boundary where the BRT operates
Size of Universe	Generally, in one day an BRT mobilizes between 100,000 and 3,000,000 passengers, depending on the type of transport system
Sample size	The estimated sample size ranges from 6,000 to 8,000 surveys in the measuring week with a re-test sample size of around 50% of the original sample.[2] The final sample size determination depends on the transport system characteristics regarding daily passenger flow and number of stations. The sample size indicated is an estimate and needs to be determined per project type (see corresponding chapter)
Sample frequency	Once in the years 1 and 4 of the crediting period during an entire week plus one re-test in the year 1 only
Method of information collection	The information will be obtained through the face-to-face application of the established questionnaire on a random base
Consistency of the survey results	The internal consistency of the results of the survey shall be carefully checked. The reliability will be measured using the Cronbach's alpha. A coefficient of over 0.7 has to be reached, values over 0.9 shall be re-checked to avoid redundancy of data. In case the survey does not demonstrate internal consistency in their results, it will be rejected and another survey could be arranged

2. Survey objective

3. The survey objective is to determine the baseline emissions caused by passengers which use the BRT and in absence of the latter would have used other modes of transport to realize their trip.

3. Target population

4. The target population are all passengers over 12 years of age. Smaller children are excluded due to problems in answering the questions. Also, smaller children, in general, are accompanied by their parents or an adult and thus have the same trip sequence as the adult person.

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[1] Relative error level refers to the coefficient of variation (CV), which is calculated as the ratio between the standard deviation of the average and the population average.

[2] The re-test sample size is determined based on the variances encountered in the original sample.

4. Sample frame

5. The sample frame is the passenger flow in all the stations of the BRT. Data for the passenger frame is obtained from the system manager.

5. Sample design

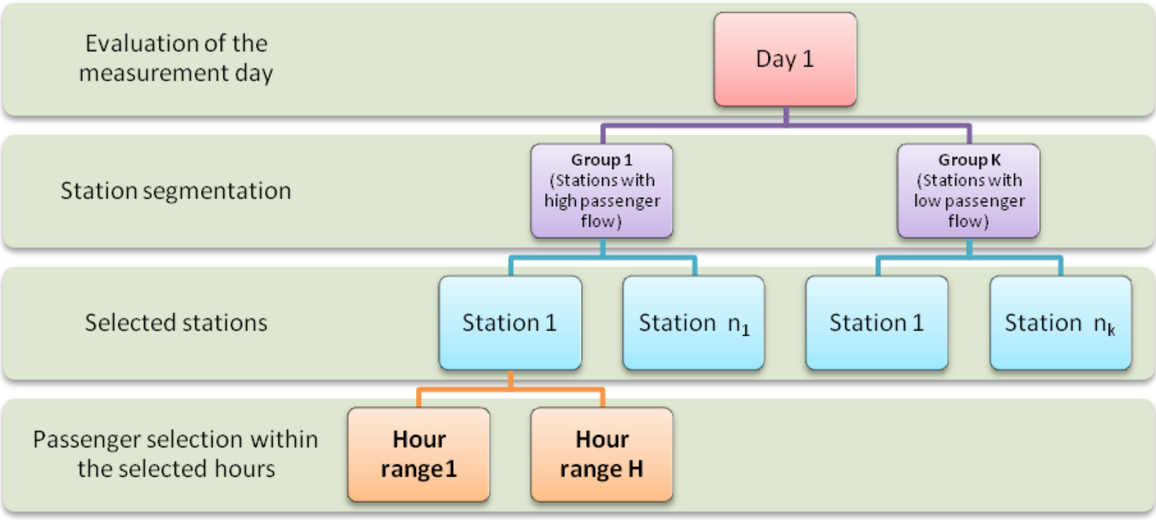
6. A two staged probabilistic design is applied:

(a) First stage: Stratified – Simple Random Sampling (SRS);

(b) Second stage: Systematic sampling based on passengers flow per station.

7. The stratification model used is represented by the following scheme, where the process for a specific day is shown, applies routinely for the seven measurement days.

Figure 1. Stratification model for sample design



8. Main strata (Stations): First a cluster analysis is performed that groups the stations depending on the passenger flow per station to provide information for busier stations and less frequented stations. In practical terms, three groups of stations are created: stations with a high, medium and low passenger volume. In the case of large heterogeneity of passenger flows an additional group is included to control this variability.

9. Sub strata: Sub strata are built from the passenger flow information reported per day and hour. Sub strata are formed in such a manner that information is taken for the seven days of a week, and within each day, hours ranges are arranged according to the passenger flow.

10. In BRTs, there are generally predefined hourly passenger flow ranges (peak/off-peak hours) through which the fixed hours when passengers are surveyed during the seven week days are defined taking into account that peak hours have to be included i.e. in each of these hours information is collected and off-peak hours are partially included.

11. The sample is to be distributed in each day according to the average passenger flow per day and within the day, as per the users per day or hour range. Within each day, a random station selection process is to be carried out within the defined strata, in such a way that during the evaluation week the possibility for all stations to be visited is created. The station grouping is carried out according to a multi-variant cluster analysis, using as a classification variable the passenger flow reported daily by station.

6. Relative error level

12. For the survey, a global desired level of precision (relative standard error or coefficient of variation – CV) between 5 per cent and 10 per cent for the parameters of interest is required, which also implies having precision levels of 90/10.

13. It is considered that the result of an estimate is:

    (a) Statistically robust if its coefficient of variation is less than 5 per cent;

    (b) Practically acceptable if its coefficient of variation is between 5 per cent and 10 per cent;

    (c) Of low precision if its coefficient of variation is higher than 10 per cent and less than 15 per cent;

    (d) It is not considered as robust if its coefficient of variation is higher than 15 per cent.

14. For the results obtained, a 95 per cent confidence level is calculated taking the (conservative) lower boundary for baseline emissions. The parameters determined in the survey are thus quantified at the 95% confidence level following the annex 2 (EB 22 report, annex 2, D, page 3): "Methodologies employing sampling to derive parameters in estimating emissions reductions shall quantify these parameter uncertainties at the 95% confidence level".

7. Geographical coverage

15. The geographical coverage is the area where the BRT operates (project boundary).

8. Sample frequency

16. The survey is realized minimum once during the year 1 and 4 of the crediting period plus a re-test survey realized in the year 1 only, thus achieving two samples in the year 1, and one sample per the year 4 of the crediting period. The survey shall take place during an entire week. The selected week shall not correspond to a public holiday and shall be representative for the average demand for transport services in the considered year.

17. To guarantee that there is no seasonality, and if there was, the way in which it would be approached, the following steps are taken:

    (a) In the first year and while the system is stabilized, a single measurement is taken and a second measurement is carried out in a later period (test-retest method), with a sample size of less than half of the initial survey;

    (b) With the passenger flows data of the first year, and with the comparison between the first survey and the test-retest, it is defined if there is any seasonality degree in the year. If there is an evidence of seasonality, within each period where there are

apparent differences, independent surveys are performed and at the end, the results are compared regarding the emissions difference and the parameters on the use of modes of transport and the average travel distance;

(c) If there are no significant differences between the analysis periods, the measurements of later years shall be done only once a year, on the contrary, they shall be carried out in the periods in which seasonality is identified;

(d) Independent from the result, at least one measurement in a whole week will always be performed in the year 4 of the crediting period, and the application of the test-retest method in the year 1. The two measurements in the year 1 are done in different periods, one in the first semester of the year and the other in the second semester.

18. The criteria for identifying if there is any seasonality are the following one:

(a) A test of mean comparison is carried out between the data reported on the flow of passengers between months, and in the same way, within the weeks of each month;

(b) A further test consists in the application of a times series model SARIMA, where it is estimated if there is any seasonality degree in the passengers flows, either weekly or monthly. Through the functions of auto-correlation and partial auto-correlation, it is identified if there is any pattern in the data.

9. Sample size

19. For the calculation of the sample size, a global level of precision (relative standard error or coefficient of variation – CV) between 5 per cent and 10 per cent for the parameters of interest has to be met. This implies at the same time having precision levels of 90/10, i.e. a minimum confidence level of 90 per cent and a maximum precision level of 10 per cent.

20. In general, determining the sample size is done by simulation following the Särndal methodology (1992), in which a CV is fixed and the sample size is found by solving *n* of the formula of the estimator variance according to the design used in each case.

Equation (1)

$$\hat{t}\ \hat{t}\ CV = \left(\frac{\sqrt{V\left(\hat{t}\ \hat{t}_{y}\right)}}{\hat{t}\ \hat{t}_{y}}\right)100$$

21. Where $\hat{t}\ \hat{t}\ \hat{t}_{y}$ is the estimate of the average for parameter of interest *y* and $V\hat{t}\left(\hat{t}\ \hat{t}_{y}\right)$ is the variance of this estimate.

22. The stratification structure complies with the principles of independence and invariance, reason for which in the formula for the CV in this study, the estimated variance of the estimator results from adding those obtained in each stratum (see section 11 of this appendix which provides formulas for the calculation of the variance in case of multi-stage designs).

23. The main parameter of interest is the distance per mode of transport for each passenger. The distance per mode is one parameter, that is D(i) indicating distance travelled by passengers using mode *i*.

24. However, an important parameter to determine the sample size is the percentage of passengers which use mode *i*. This is relevant as only few passengers of the new system would have used certain modes such as passenger cars (the large majority of users come from conventional public transport). However, even if their share is low they could still have an impact on emission reduction calculations due to their high emission factor. For the survey to be reliable, it needs a sufficient number of respondents also in modes used less frequently. The sample size determination is thus influenced strongly by the share of passengers per mode to have the desired precision level for this variable and therefore also for the main parameter of interest being the distance per mode. To determine the sample size ex ante therefore a pre-survey is conducted and/or data from other comparable-projects are taken.

25. In practical terms, the procedure for determining the sample size is:

(a) The results of the pilot test are taken as reference for the simulation (mean and standard deviation); This is especially important concerning share of modes for passengers as this determines the sample size to a considerable extent as some modes have a low frequency (e.g. passenger cars, potentially taxis and motorcycles);

(b) Simulation is subject to the modification of standard deviations larger than the one found in the pilot test, with the objective of obtaining an optimum sample size even under high variability conditions (limitation of the maximum variability level);

(c) The simulation process is first done using the results of the pilot survey under a SRS design, and under the multistage design (see the formulae described in section 11 and section 12 of this appendix) and thereafter the design effect (Deff) is determined corresponding to the ratio between the variance of the multi-stage design, and the variance of a SRS design;

(d) Finally, based on the simulation and the presentation of different scenarios corresponding to different sampling sizes and various assumptions about the standard deviations of parameters of interest (for instance by using a deff factor between 2 and 3), the sample size that best adjusts to the expected error levels is taken.

26. The DOE shall verify that the procedures used to derive the sample size will lead to the level of precision for the parameters of interest stipulated above.

9.1. Design effect (Deff)

27. The ratio between the variance of the particular design and the variance under a SRS design, is called the design effect (Deff). In this way, when Deff is less than 1 it implies that the selected design has more precision than the SRS one, and when it is larger than 1, the proposed design is less efficient than the SRS one.

10. Size and result of pilot test

28. The data obtained for a similar transport system will be used as a reference and pilot result. In case the BRT is already operating, it is recommended to realize a pilot sample which can be of a smaller sample size and simplified concerning stratification, etc. In cases where the BRT is not operating, results from comparable surveys from comparable BRTs from other cities can be used as a reference.

11. Selection method of the sample

29. Stations, hours and passengers shall be selected for the sample. The selection method has to demonstrate that it guarantees a random and non-biased selection process, which is especially important in face-to-face interviews. The random distribution allows that the sample mirrors the total population in any other non-observed variables such as age, gender, religion, personal preferences, etc. A control is realized if the sample matches the total population in several of these parameters to ascertain that the sample reflects truly the population with all its characteristics.

11.1. Selection of stations and evaluation hours

30. Given that there is a complete list of stations that are part of each established group (stratum), the selection of stations is carried out according to a SRS design, through the negative coordinated algorithm.

31. The same happens for the defined hour ranges: within each range a specific hour is selected under this method for the sample selection.

11.1.1. Algorithm of the negative coordinated method

(a) N: Universe size;

(b) n: Sample size to be selected.

32. A value 0< π<1 is fixed and for each one of the universe elements random events $\xi_1, \ldots, \xi_N$ are carried out uniformly distributed (0,1). Which ones belong to the sample is decided as follows:

(a) If $x_k < p$ then k belongs to the sample;

(b) If x_k ³ p then k does not belong to the sample.

33. In this way the probabilities of being part of the sample of the first and second order are:

$$p_k = p, p_{kl} = p^2$$

34. Since the expectation of the sample size is equal to $\sum_u \pi_k$ in the SRS design, it complies with $E(n_s) = \sum_u \pi_k = n$ therefore the departure point is from an expected sample size equal to n, further it is said that $\pi_k = \pi = n/N$ and from that value, the selection is carried out.

11.2. Selection of passengers

35. Given that there is no reference frame or list frame for the identification of BRT users, the selection of the sample in the last stage shall be performed according to the systematic sampling design, replicated identically for each stratum and considering the following steps:

(a) A random starting point is generated according to the statistics tables of uniform distribution between 1 and the average flow of passengers in the evaluation hour;

(b) Systematic selection of passengers: every n^{th} passenger entering the station, starting with the random number. In this way, if the random number is 20, the first passenger selected is the 20^{th} that enters the station, the 2^{nd} n+20 and thus successively every n^{th} passenger. The number *n*, called selection interval, will be determined based on the passenger flow per hour and the sample distribution of the specific measurement day.

12. Methodology for information collection and estimation of the parameters

12.1. General considerations on information collection

36. The information will be obtained through the face-to-face application of the established questionnaire.

37. According to the selected days and hour range, each survey interviewer shall carry out the number of established surveys. Given that the selection of people is done randomly in a time range, the start point, that is, the person number from which the contact begins is random and is defined by the appointed pollster supervisor.

38. The random selection of individuals, as well as the sufficiency in the sample size, enables obtaining dispersion and representation of the study population through the sample. Further, it allows controlling factors that may affect the user type, in terms of use of modes of transport and distance in these travels. Some of these such as the social-economic level, the residence zone, vehicle ownership, among others, shall be represented within the selected sample.

39. It is recommended that, in addition to the surveyors, other personnel systematically and in parallel to the information collection asks about and registers the system users' social-economic level, gender (observable) and age, with the purpose that these data guarantee that people included in the sample correspond to the general demographic characteristics of the system users.

40. The age ranges recommended are:

(a) From 12 to 17 years;

(b) From 18 to 25 years;

(c) From 26 to 35 years;

(d) From 36 to 45 years;

(e) From 46 to 55 years;

(f) From 56 to 65 years;

(g) More than 65 years old.

41. If a surveyed person is not willing to answer the question, the interviewer shall locate the person in the range according to his/her appearance.

42. For socio economic levels the ranges recommended are five different ranges of minimum salary. This needs to be adapted to the country circumstances, so that a representative stratification is reached.

43. *n* measurements of later years, when any of the modes of transport to which the survey refers, are extinct at the moment of applying the survey or simply to clarify the issue or modes of transport to which the question refers to, photos or graphs with an amplified size can be used, to guarantee the correct interpretation of the question.

12.2. Method of estimation and expansion factors

44. In accordance with the sample strategy and with the sample design specified in section 4 of this appendix there exist two stages in the method of estimation and selection of sampling observation units:

12.2.1. Selection of stations (SRS design)

12.2.1.1. Selection of passengers in accordance with the systematic design taking as auxiliary information the flow of passengers in the range of hours defined

45. Having in mind that the design used in each stratum is identical, the probabilities of inclusion shall be calculated on an equivalent basis in each stratum.

46. First stage:

$$\pi_{li} = \frac{n_{lhsp}}{N_{lhsp}} \quad \text{Equation (2)}$$

Where

π_{li}	=	Probability of inclusion in the sample in the first stage (1)
n_{lhsp}	=	Number of stations *sp* selected in the stratum h (3 stratus are created that is high, medium and low passenger flow)
N_{lhsp}	=	Total number of stations *sp* in the stratum h
sp	=	Stations of the system

47. Second stage:

$$\pi_{k/i} = \frac{n_{ihsp}}{N_{ihsp}} \quad \text{Equation (3)}$$

Where:

$\pi_{k/i}$	=	Probability of inclusion of the individual passenger *k* in the sample in the second stage (*i*), given the selection of the first stage (*I*)
n_{ihsp}	=	Number of passengers selected in the station s*p,* in stratum *h*
N_{ihsp}	=	Total number of passengers in the station s*p,* in stratum *h*

48. The general formula to calculate the expansion factor is:

49. $f_i = \frac{1}{\pi_k}$, where *k* indicates the *k*th element of the sample.

50. Thus, the expansion factors are:

51. First stage:

$$f_i = \frac{n_{lhsp}}{N_{lhsp}}$$ Equation (4)

52. Where: n_{lhsp} and N_{lhsp} are as previously defined.

53. Second stage:

$$f_i = \frac{N_{ihsp}}{n_{ihsp}}$$ Equation (5)

54. Where n_{ihsp} and N_{ihsp} are established according to the total flow of passengers in the station *sp* during the day.

55. Estimator of the total for the variable of interest:[3]

$$\hat{t}_{\pi} = \sum_{h} \frac{N_{Ihsp}}{n_{Ihsp}} \sum\nolimits_{s_I} \hat{t}_{i\pi}$$ Equation (6)

56. $\hat{t}\ \hat{t}\ \hat{t}_{\pi}$ corresponds to π estimator of sample designs without replacing sample units, see Särndal et al. (1992)
Where:

$$\hat{t}\ \hat{t}\ \hat{t}_{i,\pi} = \frac{N_{ihsp}}{n_{ihsp}} \sum\nolimits_{s_i} y_{ksp}$$ Equation (7)

57. Where "s_i" represents the sample of passengers in the second phase and "*k*" the information of the *k*th individual selected.

[3] The variables of interest used to calculate totals correspond to the trip distances per mode of passengers of the BRT (the parameter is not distance alone it is trip distance per mode) in the baseline situation (for BE).

58. Estimator of the variance:

$$\hat{V}(\hat{t}_{\pi}) = \sum_{h}\left[\frac{N_{Ihsp}}{n_{Ihsp}}\left(n_{Ihsp} - N_{Ihsp}\right)S^2_{\hat{t}s_I} + \frac{N_{Ihsp}}{n_{Ihsp}}\left(\sum_{s_I}\frac{N_{ihsp}}{n_{ihsp}}\left(n_{ihsp} - N_{ihsp}\right)S^2_{s_i}\right)\right]$$ Equation (8)

Where:

$$\hat{t}\,S^2_{\hat{t}\ \hat{t}\ s_I} = \frac{1}{n_{Ihsp}-1}\,\hat{t}\ \hat{t}\sum_{s_I}\left[\hat{t}\ \hat{t}_{\ i\pi} - \left(\sum_{s_I}\hat{t}\ \hat{t}_{\ i,\pi}/n_{Ihsp}\right)\right]^2$$ and Equation (9)

$$S^2_{ys_I} = \frac{1}{n_{ihsp}-1}\,\bar{y}\sum_{s_i}\left(y_{ksp} - \bar{y}\ \bar{y}_{\ ksp}\right)^2$$

59. The parameter (R) is not used to calculate directly BE or the distance per mode of transport which is the main parameter and the one required for calculating BE. It is however fundamental to determine the required simple size as proportions of passengers using various transport modes are required for the simple size determination. (R) is also required for various other parameters where proportions are determined in the survey (e.g. income category). These other parameters are not used directly to determine BE, but are important information sources to assess if the survey has any bias or if other factors such as gender or income influence the outcome. The parameter (R) is therefore used for survey information gathered based on proportions.

60. Estimator for the variable of interest:

$$\hat{\boldsymbol{R}}\ \hat{t}\ \hat{t} = \frac{\hat{t}\ \hat{t}_{\ y\pi}}{\hat{t}\ \hat{t}_{\ z\pi}},$$

61. Where $\hat{t}\ \hat{t}\ \hat{t}_{\ y\pi}$ and $\hat{t}\ \hat{t}\ \hat{t}_{\ z\pi}$ are totals.

62. *R* represents the relation between two variables, which in the particular case is a proportion, where $\hat{t}_{zp}$ estimates the universe of the study (N).

63. The parameter (R) is not used to calculate directly BE or the distance per mode of transport which is the main parameter and the one required for calculating BE. It is however fundamental to determine the required simple size as proportions of passengers using various transport modes are required for the sample size determination as well as eventually for leakage calculations. (R) is also required for various other parameters where proportions are determined in the survey (e.g. income category). These other parameters are important information sources to assess if the survey has any bias or if other factors such as gender or income influence the outcome. The parameter (R) is therefore used for survey information gathered based on proportions.

64. Example: to calculate the proportion of users per mode of transport "X"a *R* ratio has to be calculated, taking into consideration as variable *y*: "Users can use the mode X" and as variable *z* "surveyed users". Thereafter *ty* and *tz* represent the estimators associated to the total of the two variables.

65. Variance estimator:

$$\hat{V}(\hat{R}) = \sum_h \left[\frac{N_{Ihsp}}{n_{Ihsp}} \left(n_{Ihsp} - N_{Ihsp}\right) S^2_{\hat{t}us_I} + \frac{N_{Ihsp}}{n_{Ihsp}} \left(\sum_{s_I} \frac{N_{ihsp}}{n_{ihsp}} \left(n_{ihsp} - N_{ihsp}\right) S^2_{u_{ki}} \right) \right] \quad \text{Equation (10)}$$

Where:

$$u_{kshp} = \hat{R}\ \hat{t}\ \frac{y_{ksp} - \hat{R}\ \hat{R}\ z_{ksp}}{\hat{t}\ \hat{t}_{z\pi}} \quad \text{Equation (11)}$$

66. Thus it is established that:

Equation (12)

$$_{\hat{t}us_I} S^2_{\hat{t}us_I\ \hat{t}us_I} = \frac{1}{nIhsp-1}\ \hat{t}\ \hat{t} \sum_{S_I} \left[\hat{t}\ \hat{t}_{ui} - \left(\sum_{S_I} \hat{t}\ \hat{t}_{ui} / n_{Ihsp} \right) \right]^2 \text{ and}$$

$$S^2_{u_k} = \frac{1}{n_{ihsp} - 1}\ \bar{u} \sum_{s_i} \left(u_{ksp} - \bar{u}\ \bar{u}_{ksp} \right)^2$$

67. Other alternative methods to estimate the variance, especially helpful in multi-staged designs of complex samples can be used such as Jacknife or Bootstrap.

68. Based on the formerly described formulas and based upon if it is a total or a proportion the parameter $\hat{t}_p$ and associated the variance $\hat{V}(\hat{t}_p)$ is determined.

69. To calculate the confidence interval, a normal distribution is assumed (large sample size) using the formula for a 95 per cent confidence interval:

$$\hat{t}\ \hat{t}\ \hat{t}_{\pi} \pm Z_{0.95} \times \hat{V}\ \hat{t} \sqrt{\hat{V}\ \hat{V}\ \left(\hat{t}\ \hat{t}_{\pi}\right)} \quad \text{Equation (13)}$$

70. $\hat{t}\ \hat{t}\ \hat{t}_{\pi}$ represents BE. For BE the lower confidence interval is taken.

71. The DOE shall verify the validity of the statistical procedures used and the assumptions made to determine the total baseline emissions including the determination of their respective 95 per cent confidence intervals.

72. Summarized to calculate the expansion factor the following data is required next to the data resultant from the survey:

(a) Number of stations;

(b) Passenger flow per station per hour, day and week;

(c) Selection rate of passengers surveyed per hour per station (i.e. each *n* passenger was selected for an interview);

(d) Based on this information the total baseline for the BRT for the survey week can be calculated with a confidence interval of 95 per cent. For the total baseline emissions, the lower 95 per cent boundary is taken to have a conservative calculation of emission reductions. For total annual or period baseline emissions, the baseline emission per passenger of the survey week is calculated and

thereafter multiplied with the total passengers transported by the BRT per annum or period.

13. Data verification and validation including QA and QC

13.1. Criteria for evaluating data consistency

73. Considering that in the year 1 there should be at least two measurements (the weekly measurement and the test-retest) and in the year 4 at least one measurement, through these the consistency on information collection is to be guaranteed.

74. The assessment of consistency can be carried out by three supplementary statistical methods:

    (a) A mean difference test is performed through a t – Student test, where the differences presented between both measurements are evaluated, for: 1. Proportion of users that use each type of modes of transport and 2. Average trip travel distance;

    (b) To perform the mean difference test, it is necessary to determine beforehand, if the two samples come from the same population. Thereafter a F-test is carried out to determine the variability difference between one and the other. To assess that data used to estimate the study parameters follow the same distribution the Mann Whitney non-parametric U test and the Wilcoxon T test can be used;

    (c) To evaluate the users proportion per modes of transport, the Pearson's Chi Square can be used, where categories are defined for each mode of transport;

    (d) Globally and internally in each survey realized, consistency of data reported in the survey should be assessed through the Cronbach alpha coefficient. In practice a value higher than 0.7 in the coefficient has to be reached. Values over 0.9 shall be rechecked to avoid redundancy of data.

75. For the internal consistency the Cronbach alpha coefficient is to be used whilst to test for consistency between different periods of measurement the first two options of testing are used.

76. The Cronbach alpha coefficient shall be calculated for each stratum established as these *a priori* control the variations in the responses and therefore the control eliminates biases which could be generated due to heterogeneity and inconsistency in information.

14. Survey realization

77. The survey shall be conducted by a company with minimum three years of experience in comparable surveys in the respective country to ensure a professional survey implementation. The following principles are to be followed in the survey realization:

    (a) Non-responses should be recorded;

    (b) Record and store all original surveys;

    (c) Surveys are conducted at MRTS stations when people wait for MRTS-boarding. It should be avoided to realize the survey with people de-boarding the MRTS as the latter will not want to invest time in a survey thus potentially giving wrong answers.

14.1. Preparation phase

78. This phase is characterized by the development of all the activities previous to the implementation of the field operation and it is divided in:

(a) Drafting of a manual on information collection and basic concepts. The manual on information collection and basic concepts covers in general terms the profile of the field personnel, the questionnaire structure, the instructions and specifications for filling in the questionnaire, the definitions and basic concepts of the study and the instructions and formats used;

(b) Selection and training of field personnel. The selection and training of the field personnel is performed on the concepts of filling in questionnaires, in order to select the most adequate survey interviewers for the development of the field work.

A pre-test is performed with the aim of familiarizing the supervisors with the instrument of information collection and establishing in general terms the acceptance degree of the population facing the instrument's application. The pre-test is also to assure that respondents understand what the MRTS is as they might not have taken a similar system before, to ensure that all the concepts are clearly defined and the questions are not ambiguously phrased and avoid interviewer errors. Interviewers may misread the question or twist the answers in their own words and thereby introduce bias. The pre-test has to detect and minimize this potential error.

The results of the pre-test shall be documented and shall be taken into consideration for the modification of the final instrument and for the preparation of the model of information collection.

14.2. Validation process of the information

79. A supervisor should be used in the field to carry out the field verifications, guaranteeing the validity of the gathered information as well as the attained coverage.

15. Calculation of trip distance in the survey

80. Trip distances need to be determined for each surveyed passenger. The following procedures are applied:

(a) For NMT, others and induced traffic this is not required as the applied EF is “0”;

(b) For users of buses either:

(i) The shortest possible geographical distance based on electronic maps or measuring the distance between the two points with GPS or a comparable mean or through distance measurement on maps; or

(ii) Measuring the actual distance from the bus entry station to the bus exit station based on (electronic) route maps of the bus operators with official distances or measuring, e.g. with GPS the distances between the involved stations;

(c) For users of passenger cars, taxis, motorcycles, motorized rickshaws and other modes of motorized transport except buses based on the shortest possible geographical distance based on electronic maps or measuring the distance between the two points with GPS or a comparable mean or through distance measurement on maps.

81. A default questionnaire to be used is included below. This questionnaire should be used by all projects except if valid arguments exist to change the questionnaire and to adapt it to local circumstances. The questionnaire shall be realized in the local language. The questionnaire needs to be adapted to national or local circumstances, the wording needs to be checked locally and local test-runs should be performed to ensure that the questions are simple, easily understood, cannot be misinterpreted and lead to reliable results. The survey is reviewed in the language of users of the project, not translated directly from the CDM methodology.

82. References for survey design:

(a) Bautista, L. (1998). "*Diseños de Muestreo Estadístico*". Publication of the Universidad Nacional de Colombia;

(b) Cochran, W.G. 1977, Sampling Techniques, 3d ed, Wiley, New York;

(c) Särndal, C-E., Swensson, B., Wretman, J. (1992). "*Model Assisted Survey Sampling*". Springer – Verlag, New York.

Appendix 5. Default questionnaire for modal split survey

Interviewer: ....

Date: ....

Time: ....

Bus identification (line): ....

"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 system he/she is using currently to the one which existed formerly respectively (according to project) continues to exist in other parts of the city not served by the BRT system;*
- *Persons which cannot relate it to any mode of transport are taken as induced traffic (conservative default parameter).*

Multiple-choice **answers**
(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 (this exists normally still as BRT systems are implemented gradually; otherwise a description can be given of the former existing system including photos of former buses);
2. Passenger car → please go to 2A;
3. Taxi (if relevant in the project) → please go to 3A;
4. Motorcycle (if relevant in the project) → please go to 4A;
5. Rail-based urban transit;
6. NMT (per foot or bicycle);
7. I would not have made the trip (induced traffic).

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 transboarding such as first using a feeder line and then a main line. 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): ....

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 transbording such as first using a feeder line and then a main line. It is thus the origin and final destination of the passengers trip and not of the ride on this specific bus-line.

Origin (departing point): ....

Destination (final point): ....

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 transbording such as first using a feeder line and then a main line. It is thus the origin and final destination of the passengers trip and not of the ride on this specific bus-line.

Origin (departing point): ....

Destination (final point): ....

The project proponent shall include the questionnaire as annex to the CDM-PDD. The questionnaire is to be reviewed by the DOE. The DOE assesses if the questionnaire is in accordance with the principles (core elements of survey) specified above.

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Document information

Version	*Date*	*Description*
07.0	14 June 2019	EB 103, Annex 3 Revision to: • Expand the baseline scenario by adding an option for possible expansion of the existing transport system using additional vehicles; • Allow the expansion of the existing BRT system; • Address inconsistencies regarding the survey and equations; • Include parameters in section 5.8 and section 5.9; • Exclude parameters in section 5.9.
06.0	24 July 2015	EB 85, Annex 4 Revision to: • Introduce a reference to the tool “Baseline emissions for modal shift measures in urban passenger transport”; • Improve the approaches on additionality demonstration; • Improve guidance on the renewal of the crediting period; • Improve the language, readability, clarity and consistency.
05.0.0	23 November 2012	EB 70, Annex 14 • Introduces provisions and guidance for project proponents for the renewal of the crediting period and improves the language, readability, clarity and consistency.
04.0.0	25 November 2011	EB 65, Annex 13 • Introduces an innovative approach to additionality demonstration; • Limits the crediting period to 10 years; • Introduces additional formula to calculate the emission factor for the baseline bus system based on its total fuel consumption;

Version	*Date*	*Description*
		• Reduces monitoring requirements set in the monitoring survey from annual monitoring to monitoring in the years 1 and 4; • Reduces monitoring requirements for leakage. For leakage from changes in load factor of buses and taxes, the frequency of monitoring is reduced from every 3 years to the years 1 and 4. For leakage from reduced congestion, the requirement to estimate it ex ante is replaced with the requirement of (1) not to conduct monitoring, in case the implementation of the project activity does not lead to a reduction of road space; and (2) to monitor in the year 1 and 4, in case the implementation of the project activity leads to a reduction on road space; • Removes an applicability condition requiring to prove that the local regulations do not constrain the establishment or expansion of a BRT system; • Removes an applicability condition requiring that the BRT system partially or fully replaces a traditional public transport system in a given city and stating that the methodology cannot be used for BRT systems in areas where currently no public transport is available; • Removes the option to determine baseline emissions using sectoral data (Path B); • Removes the requirement to conduct the policy effects on emission reductions; • Removes the requirement to conduct the sensitivity analysis; • Improves the requirements on measurement of specific fuel consumption in the baseline and project to use the lower and upper 95% confidence levels in case of sample measurement, respectively; • Removes the requirement to account for CH_4 and N_2O emissions from gasoline and diesel, requiring to account for these emissions for gaseous fuels only; • Introduces the Tool to calculate project and leakage emissions from fossil fuel consumption; • Introduces more guidance on conducting the survey; • Improves the format of the methodology to be in line with the current template for CDM large scale methodologies; • Improves the language, readability and clarity.
03.1.0	26 November 2010	EB 58, Annex 2 The methodology was revised to include project activities that use more gaseous fuels in the project activity than in the baseline scenario

Version	*Date*	*Description*
03	16 October 2009	EB 50, Annex 5 The methodology was revised in response to AM_REV_0160. The revision expanded the applicability of the methodology to situations in which electricity is used in the transport systems included in the project boundary; and removed, from the applicability conditions, the restriction imposed in the use of biofuels, whose use was limited to a 3% blend with fossil fuels in the previous versions of the methodology.
02	17 July 2009	EB 48, Annex 6 The methodology was revised in response to AM_REV_0142. The revision expanded the applicability of the methodology to include situations in which the baseline public transport system and other public transport options include rail-based systems.
01.1	28 November 2008	EB 44, Annex 9 Editorial revision to introduce the parameter TRC which was missing in Equation 22.
01	28 July 2006	EB 25, Annex 1 Initial adoption.

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