CLEAN DEVELOPMENT MECHANISM

AM0031

Large-scale Methodology

Bus rapid transit projects

Version 08.0

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:

   (a) Through the construction and operation of a new BRT system or lane(s) for urban road based transport; or

   (b) Through 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. For biofuels, the following conditions apply:[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;

[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.

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

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 BRT system replaces an urban rail-based Mass Rapid Transit System (MRTS).

5. Buses used in routes that were replaced by the project BRT can be retired or relocated to another part of the network.

6. Projects involving BRTs without feeder lines shall use the approved methodology "ACM0016: Large-scale Consolidated Methodology: Mass rapid transit projects".

7. The methodology is applicable for urban or suburban trips. It is not applicable for inter-urban transport.

8. 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.

9. The methodology is not applicable for operational improvements (e.g. new or larger buses) of an already existing and operating BRT.

10. The applicability conditions included in the tools referred to below shall apply.

2.3. Entry into force

11. The date of entry into force is the date of the publication of the EB 110 meeting report on 27 May 2021.

2.4. Applicability of sectoral scopes

12. 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

13. 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.

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

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

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

(b) "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (hereinafter refered as "TOOL05");

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

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

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

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

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

15. 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

16. Existing actual or historical emissions, as applicable.

4. Definitions

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

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

(a) **Affected roads** - the roads influenced by the establishment of the BRT. Affected roads are those inside a radius of minimum 1 kilometer running parallel to the BRT line (roads on both sides of the BRT line are included). Only roads with large traffic volumes are included;

(b) **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;

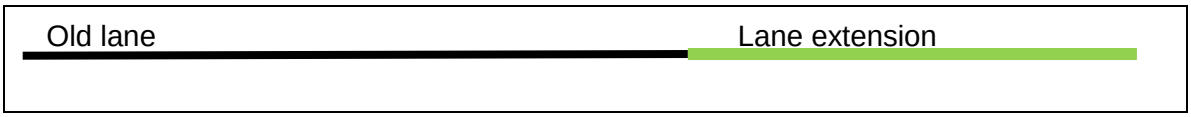
(c) **Bus rapid transit (BRT) system** - is a bus-based collective urban or sub-urban passenger transit service system that uses bus lanes for trunk routes, and operates

at high levels of performance, especially with regard to travel times and passenger carrying capacity;

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

(e) **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

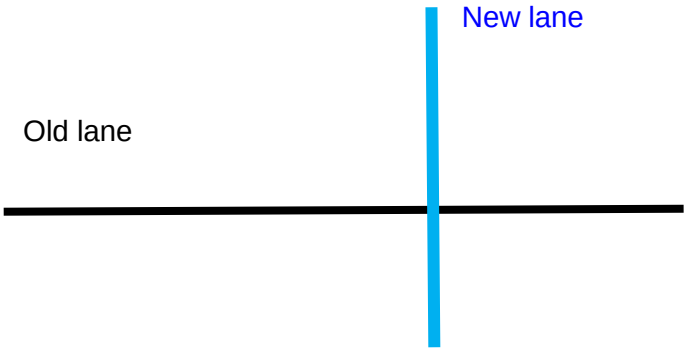


(f) **Feeder routes** - refers to bus routes which have intersections with trunk routes and which "feed" passengers to the trunk routes. Feeder routes are those with less passenger demand and which operate under mixed traffic conditions;

(g) **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;

(h) **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



(i) **Rebound effect** (or take-back effect) - the effect that the BRT has on changing 'consumer behaviour' leading to additional trips. The rebound is an extension of the "Law of Demand", a basic principle of economics, which states that if prices decline, consumption usually increases. If the project BRT 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;

(j) **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

19. 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).

20. 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

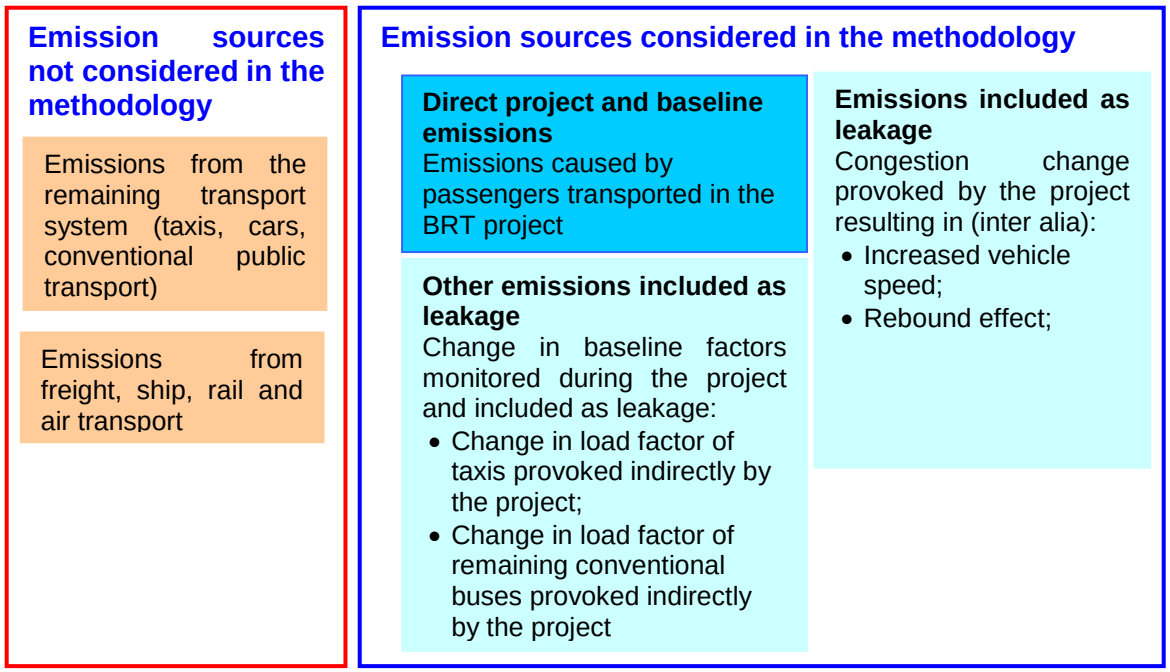


Table 2. Emission sources included in or excluded from the project boundary

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
		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

Source		Gas	Included	Justification / Explanation
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

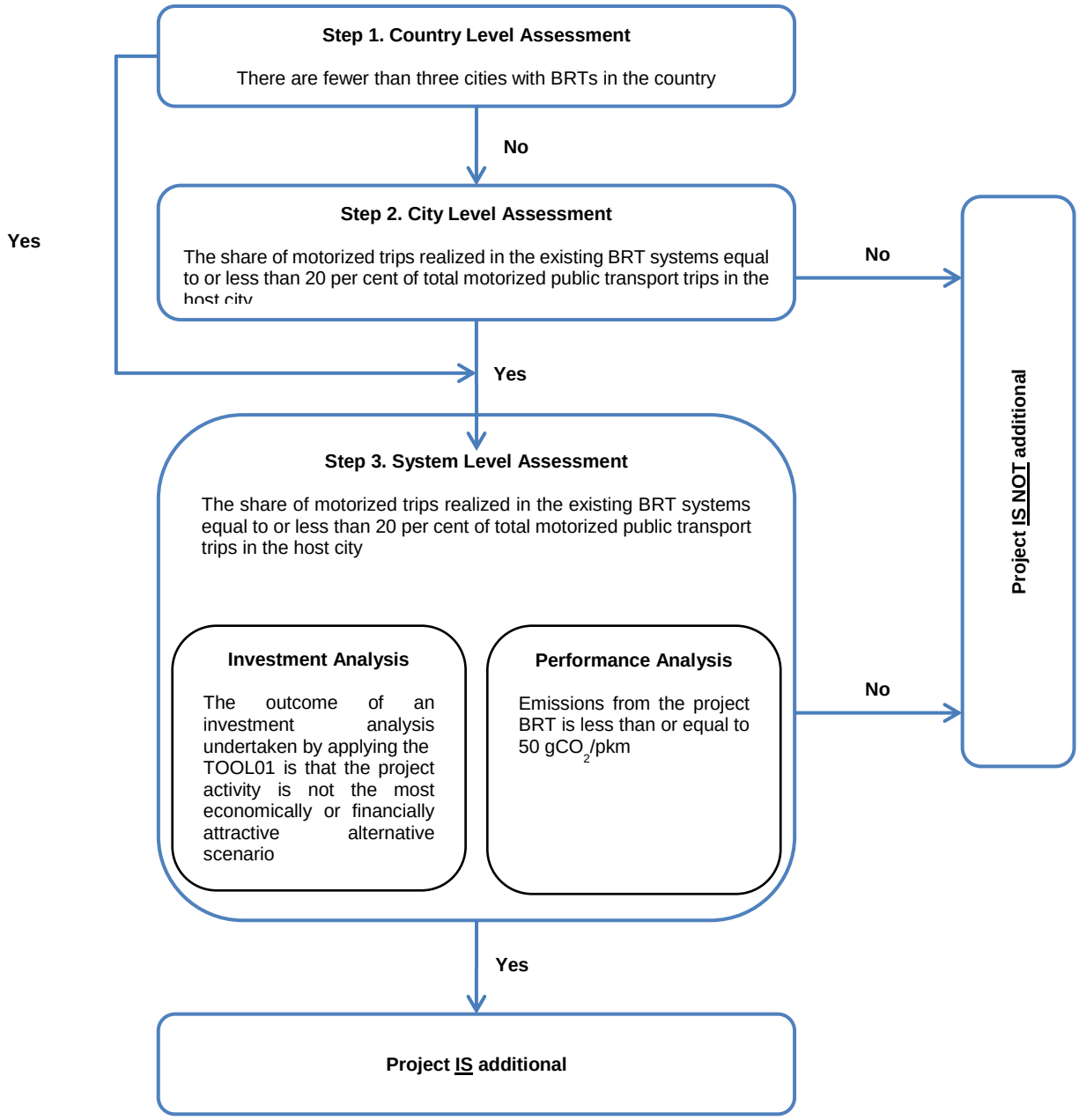
5.2. Additionality demonstration

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

22. If BRT projects are implemented in countries other than LDCs and face the first-if-its-kind barrier, additionality shall be demonstrated by following the latest approved version of the TOOL23.

23. For projects, which are implemented in countries other than 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

24. 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.

25. The project participants shall:

    (a) Identify all cities with BRTs 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 BRTs 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] BRTs developed as CDM project activities from the assessment of common practice in this step.

26. If the number of cities with BRTs (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

27. 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.

28. 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.

29. 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.

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

5.2.3. Step 3: System level assessment

30. 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

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

5.2.3.1. Procedure for Investment analysis

31. 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.

32. 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.

33. 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.

34. 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

35. 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]

36. 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

[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.

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

37. 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 able to meet the transportation demand that will be met by the project system.

5.3. Baseline emissions

38. Baseline emissions are estimated based on the lastest version of TOOL18 and, taking into account the following provisions:

(a) The core baseline parameters used for calculating baseline emission are updated through surveys conducted at the end of years 1 and 4 of the crediting period, and changes only apply if the baseline emissions factors would be lower than the original factors;

(b) When applying equation 4 of TOOL18, the parameter "Share of passengers who shifted from electricity-based or road based vehicle category *i* (S_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.

(c) If the project participants choose not to claim emission reductions for switching from passenger cars, taxis or motorcycles to buses, the 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);

(d) Criteria for identifying the vehicle categories are as follows:

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

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

(iii) 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;

(iv) 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;

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

(e) 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);

(f) A decrease in the occupancy rate of buses is registered as leakage of the project;

(g) 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

39. Project emissions from the BRT system (i.e. trunk routes and if applicable feeder lines) are based on the fuel and/or electricity consumed by the BRT system.

$$PE_y = PE_{FC,y} + PE_{EC,y} \quad \text{Equation (1)}$$

Where:

PE_y	=	Project emissions from the BRT system in year *y* (tCO_2)
$PE_{FC,y}$	=	Project emissions from fuel consumption in year *y* (tCO_2)
$PE_{EC,y}$	=	Project emissions from electricity consumption in year *y* (tCO_2)

5.4.1. Project emissions from fuel consumption

40. The methodology provides two alternatives to determine project emissions from fuel consumption, 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.

5.4.1.1. Alternative A: Use of fuel consumption data

41. 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

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

estimated using the latest approved version of the TOOL03. 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.

42. 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, the following equation shall be applied:

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

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 (t) by both trunk buses and feeder buses (tonne)
NCV_n	=	Net calorific value of the fuel type *n* (TJ/Gg)
$EF_{CO2,n}$	=	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

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

$$PE_{FC,y} = \sum_{n} \left[FC_{PJ,n,y} \times NCV_n \times \rho_n \times \left(EF_{CO2,n} + GWP_{CH4} \times EF_{CH4,n} \right) \right] \times 10^{-6} \quad \text{Equation (3)}$$

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

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

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

$$PE_{FC,y} = \left[\left(EF_{km,TB,y} \times DD_{TB,y}\right) + \left(EF_{km,FB,y} \times DD_{FB,y}\right)\right] \times 10^{-6} \quad \text{Equation (4)}$$

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). Calculated through equations (5) or (6) 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/km). Calculated through equations (5) or (6) below
$DD_{FB,y}$	=	Total distance driven by feeder buses in year *y* (km)

44. $EF_{km,TB,y}$ and $EF_{km,FB,y}$ are determined based on the 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

$$EF_{km,j,y} = \sum_n \left[SFC_{j,n,y} \times NCV_n \times \left(EF_{CO2,n} + GWP_{CH4} \times EF_{CH4,n}\right)\right] \times 10^{-3} \quad \text{Equation (5)}$$

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* (g/km)
NCV_n	=	Net calorific value of the fuel type *n* (TJ/Gg)
$EF_{CO2,n}$	=	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)

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

$$EF_{km,j,y} = \sum_n \left[SFC_{j,n,y} \times NCV_n \times \rho_n \times \left(EF_{CO2,n} + GWP_{CH4} \times EF_{CH4,n}\right)\right] \times 10^3 \quad \text{Equation (6)}$$

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)

5.4.2. Project emissions from electricity consumption

45. The methodology also provides two alternatives to determine project emissions from electricity consumption by electric buses (trunk or feeder buses), 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 electricity consumption or data monitored by the bus company managing the units. For both alternatives, specific electricity 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.

5.4.2.1. Alternative A: Use of electricity consumption data

46. This alternative is based on the total electricity consumed by electric trunk buses and electric feeder buses. Project emissions shall be estimated using the latest approved version of the TOOL05, where the parameter $PE_{EC,j,y}$ in Equation 1 of the tool corresponds to the project emissions from the project transport system that uses electricity in year *y*.

5.4.2.2. Alternative B: Use of specific electricity consumption and distance data

47. Total project emissions under alternative B are calculated applying Equation 1 from the TOOL05, where the parameter $EC_{PJ,j,y}$ is determined as the product between the specific electricity consumed by the project vehicles and the distance driven by the project vehicles:

$$EC_{PJ,j,y} = \sum_{n} SEC_{j,n,y} \times DD_{j,n,y} \times 10^{-3} \qquad \text{Equation (7)}$$

Where:

$EC_{PJ,j,n,y}$	=	Electricity consumed by the project vehicle *n* from the electricity consumption source *j* in year *y* (MWh)
$SEC_{j,n,y}$	=	Specific electricity consumed by the project vehicle *n* from the electricity consumption source *j* in year *y* (kWh/km)

$DD_{j,n,y}$ = Total distance driven by vehicle *n* year *y* (km)

48. For both electric and fossil fuel buses, the 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 and electricity 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 by the project vehicles 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. Potential sources of leakage emissions from a BRT project are listed below and are calculated based on Equation 8:

(a) Changes in occupancy of the baseline transport system, that is, the project may potentially increase or decrease the occupancy rate of the baseline vehicles (i.e. buses and taxis);

(b) Reduced congestion in remaining roads (because passengers shifted from cars and motorcycles to the BRT project, resulting in higher average speed of baseline vehicles), plus a rebound effect; and

(c) Upstream emissions of gaseous fuels, if the project vehicles consume more gaseous fuels than baseline vehicles.

$$LE_y = LE_{LF,Z,y} + LE_{LF,T,y} + LE_{CONG,y} + LE_{UP,y}$$ Equation (8)

Where:

LE_y = Leakage emissions in 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)

$LE_{UP,y}$ = Leakage emissions due to upstream emissions of gaseous fuels in year *y* (tCO_2)

51. 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 $LE_y = 0$.

52. 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. Leakage due to the change in load factor of baseline vehicles

53. The decrease in the occupancy of baseline vehicles (i.e. taxis and the remaining conventional bus fleet) results in a higher CO_2 emission factor per passenger-kilometer. However, this leakage source is only included if the load factor of buses or taxis observed through surveys changes by more than 10 per cent, as certain variations in the load factor caused by external circumstances are normal.

54. To address the changes in load factors of taxis and buses, surveys are conducted at the end of years 1 and 4 of the crediting period.

55. The result of the survey conducted at the end of year 1 shall be applied for year 1, 2 and 3 of the crediting period, and the result of the survey conducted at the end of year 4 shall be applied from year 4 until the end of the crediting period

56. Leakage emissions from changes in load factors of baseline vehicles is calculated as the ratio between the observed occupancy of the vehicle and the capacity of the vehicle, as illustrated by the equation below:

$$ROC_{i,y} = \frac{OC_{i,y}}{CV_{i,y}} \quad \text{Equation (9)}$$

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. Use *Z* for buses and *T* for taxis

57. For conventional buses, the occupancy rate is measured in relation to the bus capacity as bus sizes may change over time or before/after the project starts its operations. Data for the $ROC_{Z,y}$ calculation shall be monitored directly through visual surveys.

$$LE_{LF,Z,y} = max\left[EF_{km,Z,y} \times VD_{Z,x} \times N_{Z,y} \times \left(1 - \frac{ROC_{Z,y}}{ROC_{Z,x}}\right) \times 10^{-6}; 0\right] \quad \text{Equation (10)}$$

Where:

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

$EF_{km,Z,y}$	=	Emission factor per kilometer for buses in year *y* (gCO_2e/km)
$VD_{Z,x}$	=	Annual distance driven per vehicle for buses in year *x* (km). Calculated through equation (11) 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 buses in year *y* (percentage). Calculated through equation (9) above
$ROC_{Z,x}$	=	Average occupancy rate relative to capacity of buses in year *x* (percentage). Calculated through equation (9) above
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

$$VD_{Z,x} = \frac{\sum_i DD_{i,S,x} + DD_{i,M,x} + DD_{i,L,x}}{\sum_k N_{Z,k,x}} \quad \text{Equation (11)}$$

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 of size k 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

58. 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).

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

$$LE_{LF,T,y} = max\left[EF_{BL,km,T,x} \times VD_{T,x} \times N_{T,y} \times \left(1 - \frac{ROC_{T,y}}{ROC_{T,x}}\right) \times 10^{-6}; 0\right] \quad \text{Equation (12)}$$

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* ($g\ CO_2e/km$)
$VD_{T,x}$	=	Average distance driven by taxi in year *x* (km)

$N_{T,y}$	=	Number of taxis operating in year *y*
$ROC_{T,y}$	=	Average occupancy rate of taxi in year *y* (passengers only: Driver not counted)
$ROC_{T,x}$	=	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

60. If $ROC_{T,x} - ROC_{T,y} \leq 0.1$ 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.

61. 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. Leakage due to reduced congestion on remaining roads

62. The implementation of a BRT project may have the following overall impacts on congestion:

    (a) 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;

    (b) 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; as a consequence, the number of vehicles that will travel on the affected roads will be reduce, resulting in reduced congestion. In this case, reduced congestion may have the following impacts relevant for GHG emissions:

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

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

63. 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 at the end of years 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]

64. 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

[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.

reduction of traffic flow due to the withdrawal of conventional public transport units as a result of the project activity.

65. The equation below shall be applied to determine 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*:

$$ARS_y = \sum \frac{BSCR_y}{N_{Z,x}} \times SRS_x - \frac{RS_x - RS_y}{RS_x} \quad \text{Equation (13)}$$

Where:

ARS_y	=	Additional road space available in year *y* (in percentage)
$BSCR_y$	=	Cumulative bus units 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 (14) 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* (lane-kilometers)
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

66. The equation below is required to determine SRS_x if no recent and good quality study is available:

$$SRS_x = \frac{DD_{Z,x} \times 2.5}{DD_{Z,x} \times 2.5 + DD_{T,x} + DD_{C,x}} \quad \text{Equation (14)}$$

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, then the roady capacity in that year was reduced and leakage emissions due to increased congestion as a result of the reduced road capacity due to the project activity ($LE_{CONG,y}$) shall be quantified based the equation below. If ARS_y is positive, $LE_{CONG,y}$ is assumed to be zero and no monitoring is required in this case.

$$LE_{CONG,y} = max\left[\left(LE_{REB,y} + LE_{SP,y}\right); 0\right] \quad \text{Equation (15)}$$

Where:

$LE_{CONG,y}$	=	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)

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

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

(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;

(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.

71. The monitoring is undertaken through measurements of traffic flows and distance driven by passenger cars and taxis on the affected roads at the end of years 1 and 4 of the crediting period, when applicable.

72. 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”.

73. 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.

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

$$LE_{REB,y} = \sum_i \left[TD_{i,y} \times EF_{km,i,y} \times \left(N_{i,y} - N_{i,x} + N_{i,S,y}\right)\right] \times 10^{-6} \quad \text{Equation (16)}$$

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 (17) 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

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

$$N_{i,S,y} = \frac{S_{i,y} \times P_y}{OC_{i,x}} \quad \text{Equation (17)}$$

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

76. 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.

5.5.2.2. Determination of emissions due to changes in vehicle speed ($LE_{SP,y}$)

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

$$LE_{SP,y} = \sum_i \left[N_{i,y} \times TD_{i,y} \times \left(EF_{km,VP,i,y} - EF_{km,VB,i,x}\right)\right] \times 10^{-6} \quad \text{Equation (18)}$$

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

78. The project speed on the affected roads is monitored at the end of years 1 and 4 of the crediting period. Vehicle speed is monitored under moving conditions. The same method should be used for determining the baseline and project speed.

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

80. 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.

$$\frac{EF_{km,VP,i,y}}{EF_{km,VB,i,x}} = \left(\frac{V_{P,y}}{V_{B,x}}\right)^{-0.7} \quad \text{Equation (19)}$$

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

81. $V_{B,x}$ 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 ($LE_{UP,y}$)

82. 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 (20)

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

83. 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 in the 4th year of the previous crediting period.

84. The parameters below 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):

(a) Percentage or share of vehicle-kilometers or vehicles in vehicle category *i* using fuel type *n* in year *y*; and

(b) $N_{i,n,y}/N_{i,y}$, 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*.

85. Furthermore, project participants shall apply the latest approved version of the TOOL11.

5.8. Data and parameters not monitored

86. 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:	$DD_{i,S,x}$, $DD_{i,M,x}$, $DD_{i,L,x}$
Data unit:	km
Description:	$DD_{i,S,x}$: Total distance driven by small (S) buses *i* in year *x* $DD_{i,M,x}$: Total distance driven by medium (M) buses *i* in year *x* $DD_{i,L,x}$: 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 $SFC_{i,n,x}$ and $P_{i,x}$ in the TOOL18
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 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

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 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):	-
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
Measurement procedures (if any):	As per the "Data/Parameter table 8" from the TOOL18
Any comment:	Vehicle category *i* represents taxi (T) when determining the parameter $ROC_{T,x}$ in equation (12), or represents buses (Z) when determining the parameter $ROC_{Z,x}$ in equation (10)

Data / Parameter table 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 6.

Data / Parameter:	RS_x,
Data unit:	Lane-km
Description:	Total road space available 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 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)

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 13 again), or request a Post Registration Change to incorporate or eliminate the leakage calculation

Data / Parameter table 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 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 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 11.

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2/tCH_4
Description:	Global Warming Potential of methane
Source of data:	IPCC
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

87. 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.

88. 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. 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.

89. 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 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.

90. 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.

91. 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

92. 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

93. For both electric and fossil fuel buses, the 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.

94. 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

95. 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

6.3.2. Details of survey to identify mode of transport

96. 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.

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

98. The survey is conducted at the end of years 1 and 4 of the crediting period 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.

99. 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.

100. Equation (1) of the TOOL18 is used to calculate transport emissions factor per kilometer of vehicle category.

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

101. 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)

102. **Alternative 1:** Measurement of fuel consumption data using a representative sample for the respective category and fuel type.

103. **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.

104. 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

105. 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 for electricity based transport system and fuel based transport system such as passenger cars, taxis, motorcycles, and buses.

106. 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

107. The baseline emissions for all passengers transported are calculated using the TOOL18, 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

108. Changes in load factor of the remaining conventional buses and taxis shall be monitored at the end of years 1 and 4 of the crediting period. If the load factor reduces less than 10 per cent, no leakage is included. If the load factor reduces by more than 10 per cent 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

109. 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.

110. 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 12.

Data / Parameter:	$FC_{PJ,n,y}$
Data unit:	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 13.

<table>
<tr><td>Data / Parameter:</td><td>$EF_{CO2,n}$</td></tr>
<tr><td>Data unit:</td><td>kgCO_2/TJ</td></tr>
<tr><td>Description:</td><td>CO_2 emission factor for 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>
<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 14.

Data / Parameter:	$EF_{CH4,n}$
Data unit:	$kgCH_4/TJ$
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. 15.

Data / Parameter:	$SFC_{j,n,y}$
Data unit:	g/km or L/km
Description:	Specific 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:	-
Any comment:	Used when Alternative B from section 5.4.1 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.

<table>
<tr><td>Data / Parameter:</td><td>ρ_n</td></tr>
<tr><td>Data unit:</td><td>t/L</td></tr>
<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 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 from section 5.4.1 is applied

Data / Parameter table 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 from section 5.4.1 is applied

Data / Parameter table. 19.

Data / Parameter:	$SEC_{j,n,y}$
Data unit:	kWh/km
Description:	Specific electricity consumed by the project vehicle *n* from the electricity consumption source *j* in year *y*
Source of data:	Based on company records
Measurement procedures (if any):	Based on specific studies or calculated based on total electricity consumed and total distance driven per bus size sub-category. If based on studies, the specific electricity 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, 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:	-
Any comment:	Used when Alternative B from section 5.4.2 is applied

Data / Parameter table 20.

Data / Parameter:	$DD_{j,n,y}$
Data unit:	km
Description:	Total distance driven by vehicle *n* 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 from section 5.4.2 is applied

Data / Parameter table 21.

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:	At the end of years 1 and 4 of the crediting period
QA/QC procedures:	See appendix 4 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 (10), the vehicle category *i* represents buses (Z). When applying equation (12), the vehicle category *i* represents taxis (T)

Data / Parameter table 22.

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:	At the end of years 1 and 4 of the crediting period
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 23.

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:	At the end of years 1 and 4 of the crediting period
QA/QC procedures:	See appendix 4 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 24.

Data / Parameter:	$BSCR_y$
Data unit:	units
Description:	Cumulative bus units displaced by the BRT on the trunk lanes 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 relocated to another part of the network

Data / Parameter table 25.

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:	At the end of years 1 and 4 of the crediting period
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 26.

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
Measurement procedures (if any):	Determined based on equation (1) from the TOOL18
Monitoring frequency:	Determined based on equation (1) from the TOOL18 for the year 1 and 4 of the crediting period
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 27.

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 at the end of years 1 and 4 of the crediting period
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 (10), the vehicle category *i* represents buses (Z). When applying equation (12), the vehicle category *i* represents taxis (T)

Data / Parameter table28.

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: at the end of years 1 and 4. Second and third crediting periods of a renewable crediting period: st the end of years 1 and 4
QA/QC procedures:	See appendix 4 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 table29.

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 30.

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

Data / Parameter table 31.

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 at the end of years 1 and 4 of the crediting period
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 32.

Data / Parameter:	$LE_{UP,y}$
Data unit:	tCO_2
Description:	Leakage upstream emissions of gaseous fuels during the year
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) Geographical coverage;

   (f) Sample frequency;

   (g) Sample size;

   (h) Using the size and result of a pilot test survey;

   (i) Selection method of the sample;

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

   (k) Survey realization;

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

   (m) 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	The main parameters that must be determined from the survey are: • Share of passengers who shifted from electricity-based or roadbased vehicle category *i* (parameter S_i from TOOL18); and • Average trip distance travelled by passengers who shifted from electricity-based or road-based vehicle category *i* (parameter D_i from TOOL18).
Target population	Passengers over 12 years using the BRT
Sample frame	Passenger flow in selected stations of the BRT

Sample design	Two stage probabilistic design:
	• **First stage:** Stratified – Simple Random Sampling (SRS);
	  ○ Main strata: Group of Stations based on passenger flow; stations sampled from within such strata;
	  ○ Sub-strata: Ranges of hours; an hour interval sampled from within such sub-strata;
	• **Second stage:** Systematic Sampling of passengers in selected hour intervals.

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 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	At the end of years 1 and 4 of the crediting period, through an entire week
Method of information collection	The information will be obtained through the face-to-face application of the established questionnaire on a random base

2. Survey objective

3. The survey objective is to determine input parameters needed to calculate 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.

4. Sample frame

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

5. Sample design

6. A two staged probabilistic design is applied:

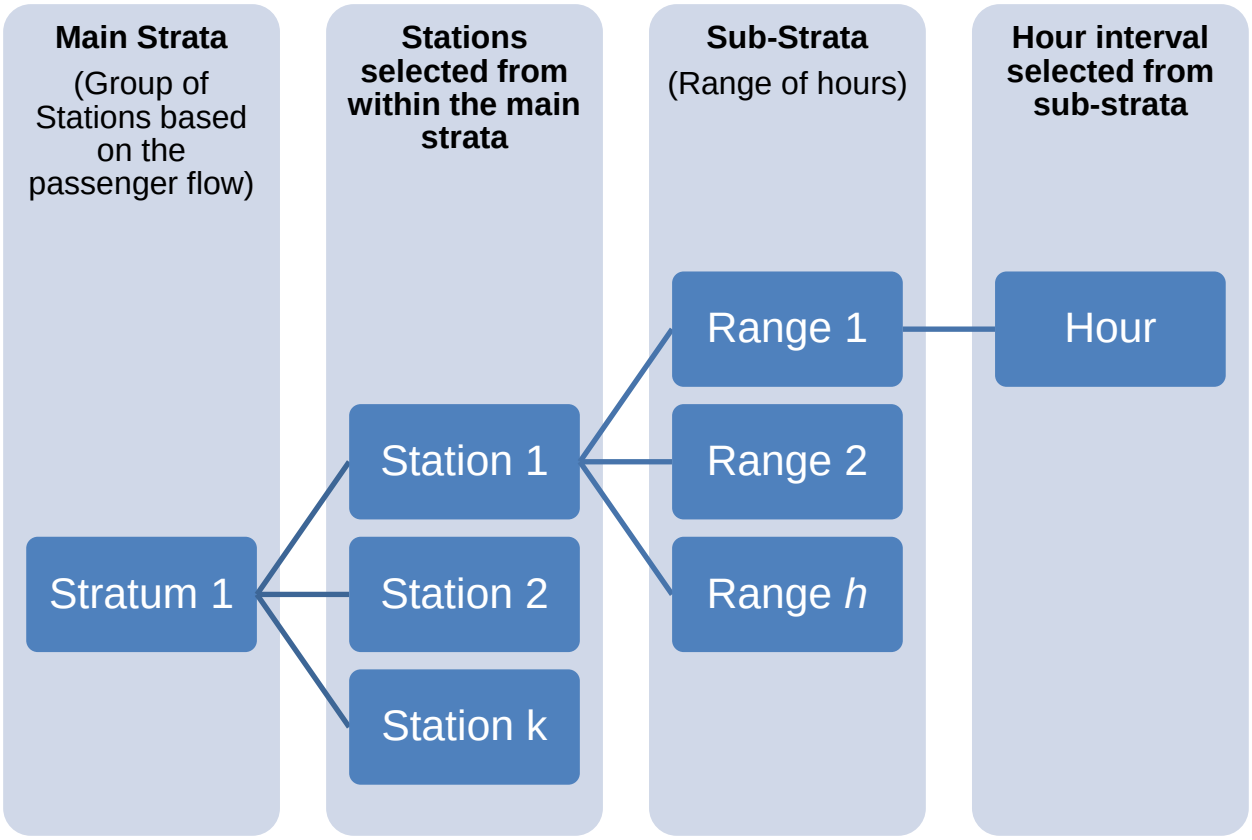
   (a) **First stage:** Stratified – Simple Random Sampling (SRS) to identify the BRT stations and the hours interval when the survey will be conducted, where:

      (i) Main strata: Group of Stations. Stations are grouped depending on the passenger flow per station to provide information for busier stations and less frequented stations. In practical terms, three groups of stations could be 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;

The stations where the survey will be conducted are selected from main strata. The selected stations shall remain fixed through the survey week;

(ii) Sub-strata: Ranges of hours. In BRTs, there are generally periods of heterogeneous passenger flow (e.g. morning peak, evening peak, /off-peak hours). Such ranges of hours are to be determined for the 7 days of the survey week, and an hour selected from each range.

Figure 1. Stratification model for sample design



(b) **Second stage**: Systematic sampling of passengers in selected stations within the selected hours.

6. Geographical coverage

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

7. Sample frequency

8. Two surveys shall be conducted during the crediting period: at the end of the 1st and 4th years of the crediting period.

9. The survey shall take place during an entire week that does not correspond to a public holiday or holiday season, and shall be representative for the average demand for transport services in the considered year.

8. Sample size

10. To ensure that the input parameters estimate are sufficiently precise (where precision is quantified via a 95% confidence interval for a parameter), the sample size for estimating the input parameters below is to be considered at the planning stage:

    (a) S_i ("Share of passengers who shifted from electricity-based or road-based vehicle category *i*");

    (b) D_i ("Average trip distance travelled by passengers who shifted from electricity-based or road-based vehicle category *i*").

11. Following the "Standard: Sampling and surveys for CDM project activities and programmes of activities", sample size determination should be based on 95/10 confidence/precision for large-scale CDM project activities. The sample size selected shall be the highest among the values determined for each input parameter.

9. Use of a pilot survey

12. Data obtained from a similar transport system may 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 may be used as a reference.

10. Selecting the sample

13. The method to select stations, hours and passengers for applying the survey has to guarantee a random and non-biased selection process, which is especially important in face-to-face interviews.

10.1. Selection of stations and evaluation hours

14. Given that there is a complete list of stations, the selection of stations within main strata is conducted according to a Simple Random Sampling design.

15. Similarly, a specific hour interval is selected from within each sub-stratum, that is, the range of hours (e.g. morning peak, evening peak, off peak) by simple random sampling.

10.2. Selection of passengers

16. 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 a systematic sampling design within each selected hour and considering the following steps:

    (a) A random starting point is generated between 1 and n;

    (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 20th that enters the station, the 2nd n+20 and thus successively every nth passenger.

11. Methodology for information collection and estimation of the parameters

11.1. General considerations on information collection

17. The information will be obtained through the face-to-face application of the questionnaire provided in Appendix 5.

18. According to the selected stations and hour intervals, 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.

19. 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.

20. Photos or graphs with an amplified size can be used to clarify to the interviewee the issue or to which modes of transport the question refers to, e.g. when any of the modes of transport to which the survey refers no longer exist or simply to guarantee the correct interpretation of the question.

12. Survey realization

21. 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 BRT stations when people wait for the BRT-boarding. It should be avoided to realize the survey with people de-boarding the BRT as the latter will not want to invest time in a survey thus potentially giving wrong answers.

12.1. Preparation phase

22. 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.

(i) 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 BRT 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.

(ii) 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.

12.2. Validation process of the information

23. 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.

13. Calculation of trip distance in the survey

24. 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.

25. A default questionnaire to be used is included in Appendix 5. 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.

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*
08.0	27 May 2021	EB 110, Annex 3 Revision to align the requirements of sampling and survey of passengers with the "Standard: Sampling and surveys for CDM project activities and programmes of activities" and the "Guideline: Sampling and surveys for CDM project activities and programmes of activities".
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.

Version	*Date*	*Description*
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; • 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

Version	*Date*	*Description*
		The methodology was revised to include project activities that use more gaseous fuels in the project activity than in the baseline scenario
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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