BIKES FOR THE PLANET - BRAZIL

Document prepared by ZSCORE S. A.

Project Title	Bikes for the Planet - Brazil
Version	1.0
Date of Issue	02-Apr-2019
Monitoring Period	01-Jan-2018 to 28-Feb-2019
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1 PROJECT DETAILS

1.1 Summary Description of the Project and its Implementation Status

The primary objective of Bikes for the Planet – Brazil Program is to promote alternative mobility by constructing and/or expanding the existing bicycle lanes, parking areas and sharing programs.

Urban centres face many problems related to transport and traffic. Enhance mobility while reducing congestion and pollution becomes a key issue for urban life. In Brazil, the greenhouse gas (GHG) emissions from transportation represent 46% of emissions from the energy sector[1]. In this context, the strategic plan for Brazil's Nationally Determined Contribution (NDC) establishes 4.9 $MtCO_2e$ reduction target for transportation in line with Paris Agreement approved on September 21st, 2016 by the government. Brazil has committed to reduce emissions by 1.3 $GtCO_2e$ in 2025 and 1.2 $GtCO_2e$ by 2030, corresponding to 37% and 43% reduction based on 2005 levels[2].

Bikes for the Planet – Brazil Program emerges as a contribution for pursuing the goals proposed by the government. The program is developed as a Grouped Project within the Brazilian boundaries. Thus, the expansion of a project activity subsequent to project validation is allowed and each project activity instance shall follow the program eligibility criteria for its inclusion as established in section 1.13. In the absence of the program, the baseline scenario is the continuation use of the existing transportation modes.

The proposed project activity instance (project activity instance 01) consists of the expansion of the existing bicycle-sharing program through the addition of approximately 250 bicycle sharing stations, corresponding to 2,500 new bicycles (type 4 of "AMS-III.BM, version 01.0", hereafter referred to simply as "AMS-III.BM").

The program implementation results in avoided negative environmental impacts and may contribute to better mobility and, consequently, in better quality of life as it:

- Reduces demand on fossil fuel based vehicles;
- Reduces traffic in rush hour and increases the offer on non-motorized options;
- Reduces GHG emissions (GHG emission free) and improves air quality.
- Although the Program does not have alone a major relevant impact in the Host Country given its mobility restrictions (few or non-existent cycle routes connected to public transportation, climate, physical conditioning, etc), it is part of a greater idea. The program contributes to sustainable development since it reduces fossil fuel consumption, traffic congestion, ghg emissions and other air pollutants as well as increases well-being. Therefir it meets the needs of the present without compromising the ability of future generations to meet their own needs, as defined by the Brundtland Commission (1987).

[1] WRI Brasil (2017). *A estratégia do Brasil na área de transportes para colocar em prática o Acordo de Paris.* Retrieved from http://bit.ly/2Dugqf7 (access on 23/Jan/2019).

[2] UNFCCC's INDCs as communicated by Parties; Brazilian INDC submitted on 28/Sep/2015; retrieved from http://bit.ly/2DuU6C0 (access on 23/Jan/2019).

1.2 Sectoral Scope and Project Type

Bikes for the Planet – Brazil is a Grouped Project.

Sectoral scope 7: Transport as established by the Clean Development Mechanism (CDM).

Methodologies approved under CDM are applicable under the Voluntary Carbon Standard (VCS) as stated at http://verra.org/methodologies/.

1.3 Project Proponent

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1.4 Other Entities Involved in the Project

Not applicable.

1.5 Project Start Date

According to the Program Definitions: VCS version 3, the project start date is the “date on which the project began generating GHG emission reductions or removals”.

Therefore, the project starting date is 27-Jan-2018, when the first bike sharing stations where made available to the public and started operation (first registered bike rental on 27-Jan-2018 at 11h03min).

1.6 Project Crediting Period

The program will have a maximum of 10 years of crediting period (which can be renewed two times), as follows:

- Crediting period start, 27-Jan-2018
- Crediting period end, 26-Jan-2028

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	X
Large project	

Year[3]	Estimated GHG emission reductions or removals (tCO_2e)
Year 1 – 2018	128.5
Year 2 – 2019	127.3
Year 3 – 2020	126.0
Year 4 – 2021	124.7
Year 5 – 2022	123.5
Year 6 – 2023	122.2
Year 7 – 2024	121.0
Year 8 – 2025	119.8
Year 9 – 2026	118.6
Year 10 – 2027	117.4
Total estimated ERs	1,229.1
Total number of crediting years	10.0
Average annual ERs	122.9

1.8 Description of the Project Activity

Applicable technologies and measures are all types of projects that shift the mode of transport of urban passengers to mechanical bicycles, tricycles, e-bikes or e-tricycles eligible under methodology AMS-III.BM (see Table 2).

[3] Chronologically "year 1" will run from 27-Jan-2018 to 26-Jan-2019.

Since the program will be implemented in the context of a Grouped Project, if one or more measures described in Table 2 above have already been implemented within the project boundary (e.g. within the same city as the proposed project activity), it shall be ensured that these measures are identified and taken into account when determining the baseline.

If multiple measures are implemented as part of the project activity instance, it shall be ensured that any interactive effects between the measures are identified and taken into account to avoid double counting. The project proponent should make an analysis of the interactive effects and account for them following the provisions from the applicable version of the "Guidelines for the consideration of interactive effects for the application of multiple CDM methodologies for a programme of activities", considering that interactive effects could occur, for example, in the following situations:

(a) When there is an overlap in users between different measures of the project; or

(b) When several measures rely on the same information when estimating emission reductions; or

(c) When relying on default factors for setting the baseline.

Instance type 4 of AMS-III.BM is applicable in the case of the proposed project activity.

1.9 Project Location

The proposed project activity instance is located in the city of Sao Paulo, Brazil.

Bikes for the Planet – Brazil Program is implemented within the geographical area of Brazil. All the project activity instance will be implemented taking into consideration all applicable national and/or sectoral policies and regulations.

1.10 Conditions Prior to Project Initiation

The baseline scenario is the same as the conditions existing prior to the project initiation.

Please refer to section 2.4.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project activity is in compliance with all laws and regulations, on the contrary, permissions and licenses would not be issued.

Relevant local law and regulations are presented in Table 1.

Table 1 – National applicable legislation

Date	Regulation	Regulator	Description
19/06/2018	Law #13,683	Federal	It changes Law 13,089/2015 and Law 12,587/2012
12/01/2015	Law #13,089	Federal	It establishes the City Statute for planning, management and execution of public functions of common interest in metropolitan regions and in

			urban agglomerations instituted by the State
03/01/2012	Law #12,587	Federal	It establishes guidelines for the National Policy on Urban Mobility
08/05/2009	Resolution #315	National Traffic Council (CONTRAN)	It regulates the necessary requirements from cycle-electric to mopeds vehicles for driving in public roads open to circulation
22/04/2004	Resolution #160	CONTRAN	It approves Annex II of the National Traffic Code, which includes signaling on bicycle lanes
29/05/2003	Decree #4,711	Federal	It establishes the National Traffic System coordination
23/09/1997	Law #9,503	Federal	It establishes the National Traffic Code

Each project activity instance shall follow all local/municipal regulations regarding bicycle lanes, parking areas and sharing programs.

1.12 Ownership and Other Programs

1.12.1 Project Ownership

ZSCORE S. A.

1.12.2 Emissions Trading Programs and Other Binding Limits

Not applicable.

1.12.3 Other Forms of Environmental Credit

The program does not receive another form of GHG-related environmental credit.

1.12.4 Participation under Other GHG Programs

The project does not participate nor seek registration under any other GHG Programs.

1.12.5 Projects Rejected by Other GHG Programs

Not applicable, as the project did not request registration/participation in any other GHG program.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

Grouped projects shall include one or more sets of eligibility criteria for the inclusion of new project activity instances. At least one set of eligibility criteria for the inclusion of new project activity

instances shall be provided for each combination of project activity and geographic area specified in the project description.

The set of eligibility criteria follows:

1) Meet the applicability conditions set out in the methodology applied to the project

   Each project activity instance shall follow methodology and applicable tools described in section 2.1. ✓

2) Use the technologies or measures specified in the project description

   Each project activity instance shall apply one of the project types described in section 2.2. ✓

3) Apply the technologies or measures in the same manner as specified in the project description

   Each project activity instance shall apply technologies or measures in the same manner as specified in section 1.1 ✓

4) Are subject to the baseline scenario determined in the project description for the specified project activity and geographic area

   Each project activity instance shall apply the baseline scenario described in section 2.4 and calculation of emission reductions defined in section 3. ✓

5) Have characteristics with respect to additionality that are consistent with the initial instances for the specified project activity and geographic area. For example, the new project activity instances have financial, technical and/or other parameters (such as the size/scale of the instances) consistent with the initial instances, or face the same investment, technological and/or other barriers as the initial instances

   Each project activity instance shall assess additionality as described in section 2.5. ✓

6) Apply methods and procedures for baseline emission calculation following AMS-III.BM

   Each project activity instance shall calculate the baseline emissions following the options described in section 3.1 ✓

7) Comply with laws, statutes and any other regulatory frameworks, including environmental assessment and stakeholder consultation, if required

   Each project activity instance shall be implemented in accordance with regulations presented in section 1.11 and comply with all applicable local regulations regarding bicycle lanes, parking areas and sharing programs, including environmental assessment and stakeholder consultation. ✓

Leakage Management

Not applicable.

Commercially Sensitive Information

Not applicable.

Sustainable Development

Not applicable.

Further Information

Not applicable.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

Small-scale methodology: AMS-III.BM - lightweight two and three-wheeled personal transportation, version 01.0. The methodology also refers to the following tools:

- TOOL05 - Methodological tool - Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation, version 03.0;
- TOOL11 - Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period, version 03.0.1;
- TOOL18 - Methodological tool - Baseline emissions for modal shift measures in urban passenger transport, version 01.0;
- TOOL19 - Methodological tool – Demonstration of additionality of microscale project activities, version 08.0;
- TOOL21 - Demonstration of additionality of small-scale project activities, version 12.0;
- TOOL23 - Additionality of first-of-its-kind project activities, version 03.0.

The standard “Sampling and surveys for CDM project activities and programme of activities” may also be used when applying option 1 of AMS-III.BM.

2.2 Applicability of Methodology

In accordance with AMS-III.BM, Table 2 below illustrates which types of project activities are eligible under this methodology.

Table 2 - Types of projects eligible under this methodology

Type of project	Description
Type 1	Construction of new bicycle lanes
Type 2	Extension of the existing bicycle lanes
Type 3	Implementation of new bicycle sharing program (through dockless bicycles or sharing stations)
Type 4	Expansion of an existing bicycle sharing program (through increasing the

	number of dockless bicycles and/or through increasing the size or number of bicycle sharing stations)
Type 5	Construction of new bicycle parking areas. These parking areas may be connected to public transport (subway stations, bus stops, light-rail train stations, etc.) or activity hubs (office towers, shopping centers, markets, venues, etc.)
Type 6	Expansion of the existing bicycle parking areas
Type 7	Introduction of e-bikes
Type 8	Implementation of a new transportation service or expansion of an existing one based on tricycles

2.3 Project Boundary

In accordance with AMS-III.BM, the project boundary is the area in which the users of the infrastructure and/or the promoted bicycles, tricycles, e-bikes or e-tricycles travel between origins and destinations.

If the project involves the use of e-bikes or e-tricycles, the project boundary also includes the electric grid and all physically connected power plants that supply electricity to the grid used to recharge the battery from e-bikes or e-tricycles.

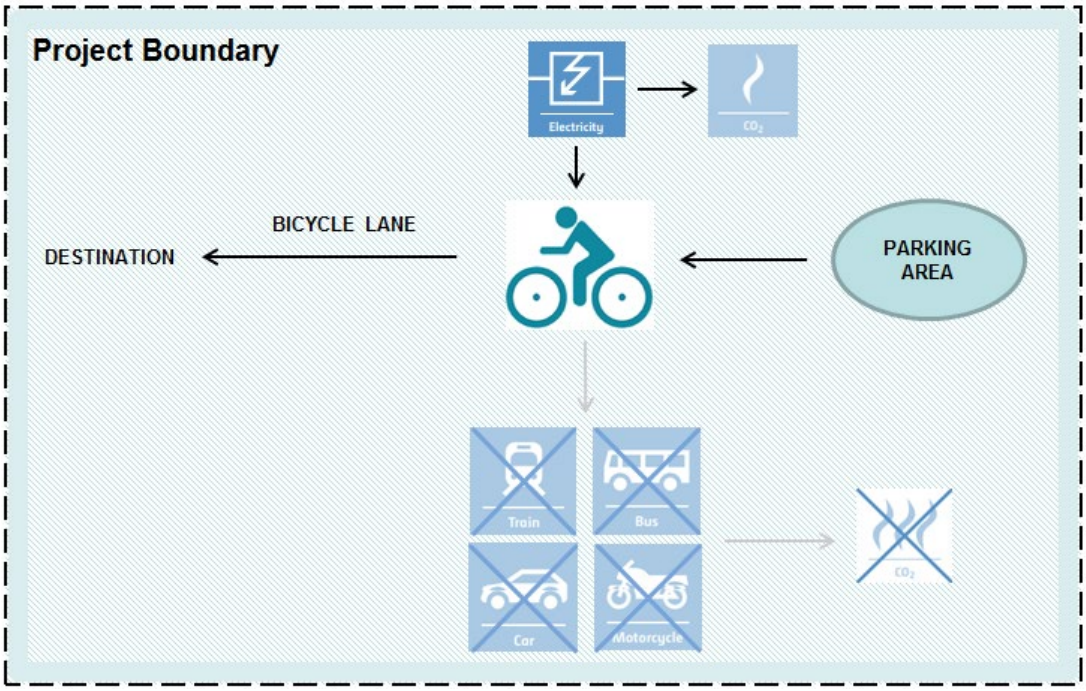

Figure 1. Flow diagram of the project boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Different modes of transport that users would have taken in the absence of the project	CO_2	Yes	Main emission source
		CH_4	No	These emissions are not significant
		N_2O	No	These emissions are not significant
Project	Electricity consumption (e.g. to recharge the batteries in the case of e-bikes or e-tricycles)	CO_2	Yes	Main emission source
		CH_4	No	These emissions are not significant
		N_2O	No	These emissions are not significant

2.4 Baseline Scenario

According to AMS-III.BM, the baseline scenario is assumed to be the continuation of the use of existing modes of transport in the absence of the CDM project activity.

2.5 Additionality

I. Activities that are automatically additional

The following measures, alone or in combination, are automatically additional:

(a) Type 1 and Type 2 (*i.e.* construction of new bicycle lanes and extension of the existing bicycle lanes);

(b) Type 3 and Type 4 (*i.e.* implementation of new or expansion of existing bicycle sharing programs), if the value paid when renting the bicycle is fully refundable upon return to the sharing station;

(c) Type 5 and Type 6 (*i.e.* construction of new or expansion of existing bicycle parking areas), if no charges are applied to park the bicycles.

Projects satisfying conditions above are automatically additional; otherwise, the following steps shall be satisfied.

II. Other activities

Other activities that do not satisfy the conditions in item I above are additional if:

(a) The project activity complies with the criteria for demonstrating additionality of microscale project activities (TOOL19)

In this case, GHG emissions reductions shall be no more than 20 $ktCO_2e$/yr and one of the following conditions shall be satisfied according to §10 of the tool:

- The geographic location of the project activity is an LDC/SIDS or SUZ of the host country as identified by the government[4]; OR
- The project activity is an emission reduction activity with both conditions (i) and (ii) below satisfied:

  (i) Each of the independent subsystems/measures in the project activity achieves an estimated annual emission reduction equal to or less than 600 tCO_2e per year; and

  (ii) End users of the subsystems or measures are households / communities / SMEs.

According to TOOL19, for CPAs[5] applying microscale thresholds at the unit level rather than at the aggregate level of the CPA, the term 'project activities' shall be read as 'units'. If each of the units contained in the CPA fulfil the condition to qualify as a 'microscale CDM unit', then the coordinating/managing entity is not required to demonstrate compliance of the CPA with the microscale or small-scale thresholds at the aggregate level of the CPA. In such cases, the requirements related to debundling stated in paragraphs 13 and 16 of the tool do not apply either.

(b) The first-of-its-kind barrier is demonstrated as per the methodological tool "Additionality of first-of-its-kind project activities" (TOOL23)

According to TOOL23, a proposed project activity is the first of its kind in the applicable geographical area if:

- The project is the first in the applicable geographical area that applies a technology that is different from technologies that are implemented by any other project, which are able to deliver the same output and have started commercial operation in the applicable geographical area before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of the proposed project activity, whichever is earlier;
- The project implements one or more of the measures;
- The project participants selected a crediting period for the project activity that is "a maximum of 10 years with no option of renewal".

Definitions of TOOL23 shall be considered when applying this option.

(c) Activities that are type 7 (i.e. introduction of e-bikes) and the share (penetration) of e-bikes in bicycle in use in the city is below or equal to 5% based on number annual bicycle trips undertaken in the city or based on market share

National and regional statistics, published reports and surveys may be used to determine trips or market share.

[4] SUZ is a region in the host country (zone, municipality or any other designated official administrative unit) identified by the government in official notifications for development assistance including for planning, management, and investment satisfying any one of the conditions established in §8 of TOOL19, while using the most recent data available.

[5] In this context, "CPA" (component project activity) means "project activity instance".

(d) *It is demonstrated, through the application of the methodological tool "Demonstration of additionality of small-scale project activities" (TOOL21), that at least one barrier would prevent the implementation of the project activity*

In this case, GHG emissions reductions shall be no more than 60 $ktCO_2e/yr$.

When assessing the investment barrier, the investment analysis should be undertaken from the perspective of the operator/investor of the bike parking areas or bicycle sharing stations, reflecting the costs and revenues from the perspective of the operator/investor – meaning that the revenues from the parking fees and other sources (e.g. advertising) and the costs associated with the rent and maintenance of the parking area and/or the bicycle sharing station, security and personnel and the land cost and/or opportunity cost of land and/or fair value of the land shall be considered when conducting the investment analysis.

In the case of the proposed project activity instance, it will generate less than 600 tCO2e per year (see section 3) and, therefore, it complies with the criteria for demonstrating additionality of microscale project activities and is automatically additional.

2.6 Methodology Deviations

Not applicable, as no methodological deviations have occurred.

3 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

Baseline emissions are the emissions resulting from transportation of passengers in the absence of the project activity. It is differentiated per baseline modes of transport (relevant travel modes) that the project activity users would have used in the absence of the project activity. One of the options below shall be applied:

Option I: Ex-post survey of baseline travels models

Option II: Baseline emissions based on public transportation (excluding cars, taxis and motorcycles) as benchmark

Option III: Based on survey of users of e-bikes and users of bicycle sharing programs

Table 3. Types of projects eligible under this methodology

Type of project	Description	Baseline options applicable (as per AMS-III.BM, section 5.4)		
		Option 1	Option 2	Option 3
Type 1	Construction of new bicycle lanes	✓	✓	

Type 2	Extension of the existing bicycle lanes	✓	✓	
Type 3	Implementation of new bicycle sharing program	✓		✓
Type 4	Expansion of an existing bicycle sharing program	✓		✓
Type 5	Construction of new bicycle parking areas. These parking areas may be connected to public transport	✓	✓	
Type 6	Expansion of the existing bicycle parking areas	✓	✓	
Type 7	Introduction of e-bikes	✓		✓
Type 8	Implementation of a new transportation service or expansion of an existing one based on tricycles	✓		

While applying Option 1, steps from 1 to 4 of TOOL18 shall be applied; while applying Option 2, steps from 1 to 3 of TOOL18 as described in Appendix A.

Option 1: Ex post survey of baseline travel modes

Under this option, baseline emissions cover the emissions, which would have been caused by the user of the bicycle-sharing program in absence of the project from origin (O) to destination (D), where the O and D points of the trip are assumed equal for both the baseline and the project scenarios.

Baseline emissions are determined by applying Steps 1 to 4 from the latest approved version of the methodological tool "Baseline emissions for modal shift measures in urban passenger transport" (TOOL18) as presented in Appendix A, using parameters estimated based on data collected during the survey[6] in the year 1 and optionally in the year 4 of the crediting period:

The vehicle categories index i indicated in Step 1 of TOOL18 shall be included, and "cycling" and "walking" should be considered as potential baseline "vehicle categories" with an emission factor of zero. If some vehicle categories are not explicitly identified or do not fit into the categories from the tool, they should be included in the survey as "others" and baseline emissions of this category are counted as zero. The survey shall be undertaken at locations of the project infrastructure and origin/destination of the cycling trip shall be substituted for "entry/exit station" in the TOOL18. The survey may be conducted with a sample of users in the case of the bicycle sharing program or new tricycles, e-bikes or e-tricycles.

When applying Step 4 of TOOL18, the following provisions shall apply:

(a) Parameter P_y (Number of passengers travelled by the project system in year y) should be considered as number of trips on the new infrastructure / service per year as measured by counting, if necessary relying on sampling (sampling in accordance with the standard "Sampling and surveys for CDM project activities and programme of activities");

(b) Parameter D_i (Average trip distance travelled by passengers) may be determined:

i. from the survey with the users in the project;

[6] The survey shall be conducted with the users of the infrastructure, bicycle sharing program.

ii. as an average value for bicycle, tricycle, e-tricycle or e-bike trips (as relevant) from official data or studies at the city level; or

iii. by applying the default conservative value of 2.5 km for bicycle or tricycle trips and 5 km for e-bike or e-tricycle trips.

Sampling may be used following Appendix B.

Option 2: Baseline emissions based on public transportation (excluding cars, taxis and motorcycles) as benchmark

This option is suitable for Type 1 and Type 2 (i.e. construction of new or extension of existing bicycle lanes) and Type 5 and Type 6 (i.e. construction of new or expansion of existing bicycle parking areas).

Under this option, the modal shares of the public transportation in the city (excluding travels using passenger cars, motorcycles and taxis) and the corresponding CO_2 emissions are determined before the implementation of the project, using statistics from the transport authority or other credible studies. Steps 1 to 3 of the methodological tool "Baseline emissions for modal shift measures in urban passenger transport" (TOOL18) may be applied to complement existing data, if necessary. Also, the number of cycling trips prior to installation of the new infrastructure ($N_{bicycles,BL}$) shall be determined ex ante.

The baseline emissions are calculated considering the number of cycling trips after installation of the new infrastructure and the distance travelled by the users of the infrastructure.

$$BE_y = 0.9 \times \left(N_{bicycles,y} - N_{bicycles,BL}\right) \times ADT_{u,y} \times EF_{BL,benchmark} \quad \textbf{Equation 1}$$

Where:

BE_y = Baseline emissions in year *y* (tCO_2)

0.9 = Net-to-gross adjustment factor to account for 'walking' in the baseline

$N_{bycicles,y}$ = Number of bicycles trips travelling through the bicycle infrastructure in year y

$N_{bycicles,BL}$ = Number of bicycle trips travelling through the location of the new bicycle infrastructure prior to implementation of the project activity

$ADT_{u,y}$ = Average distance travelled per trip by the user u of the infrastructure in year y (km)

$EF_{BL,benhcmark}$ = Weighted average CO_2 emission factor per passenger-kilometer corresponding to public transportation-mix in the city (excluding travels by using passenger cars, motorcycles and taxis) (tCO_2/pkm), before the implementation of the project, using statistics from the transport authority or credible studies

Option 3: Based on a survey of users of e-bikes and users of bicycle sharing programs

Under this option, the baseline emission factor is determined through a survey of users of e-bike promotion programs or bicycle sharing programs (EFBL,CO2,survey) and the distance travelled will be monitored for each user of the programs (DTu,y).

Baseline emissions are determined through the equation below:

$$BE_y = EF_{BL,CO2,survey} \times \sum_u DT_{u,y}$$ **Equation 2**

Where:

BE_y = Baseline emissions in year *y* (tCO_2)

$EF_{BL,CO2,survey}$ = Average CO_2 emission factor per passenger-kilometer based on survey conducted with users of e-bike promotion programs or bicycle sharing programs (tCO_2/pkm)

$DT_{u,y}$ = Total distance travelled by the individual user *u* of the bicycle sharing program and/or of the promoted e-bikes in year *y* (km)

In the case of the proposed project activity instance, option 2 (baseline emissions based on public transportation) is used.

3.2 Project Emissions

Project emissions are determined based on the amount of electricity consumed to recharge the batteries of e-bikes or e-tricycles ($EC_{PJ,y}$) using Equation (1) from the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (TOOL05).

The electricity consumed to recharge the batteries ($EC_{PJ,y}$) may be determined:

(a) By directly measuring the electricity consumed by all e-bikes or e-tricycles included in the project; or

(b) Alternatively, assuming a default consumption of 0.015 kWh/km travelled[7]. In this situation, the electricity consumed is determined according to the equation below:

$$EC_{PJ,y} = 0.015 \times \sum_u DT_{u,y}$$ **Equation 3**

Where:

$EC_{PJ,y}$ = Quantity of electricity consumed to recharge the batteries of e-bikes or e-tricycles in year *y* (kWh)

$DT_{u,y}$ = Total distance travelled by the individual user *u* of the bicycle sharing program and/or of the promoted e-bikes in year *y* (km)

[7] This parameter depends on a number of factors, such as terrain, level of assistance from batteries to offset pedaling set by the cyclist, weight of the cyclist, weight of the bicycle, outside temperature, direction and speed of the wind, type of battery, efficiency of the motor. Typically, a standard 36V and 10Ah e-bike consumes between 7.5 – 15 Wh/km.

3.3 Leakage

In accordance with AMS-III.BM, leakage does not have to be considered.

3.4 Estimated Net GHG Emission Reductions and Removals

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \textbf{Equation 4}$$

Where:

ER_y = Emission reductions in year y (tCO_2)

BE_y = Baseline emissions in year y (tCO_2)

PE_y = Project emissions in year y (tCO_2)

In the case of the proposed activity instance, option 1 (ex-post survey of baseline travel modes) will applied for the baseline emission calculation.

From TOOL18, the following steps were applied:

Step 1: Determine relevant vehicle categories

Considered vehicle categories include:

(a) Bus;

(b) Minibus ("lotação"[8]);

(c) Car (private and taxis);

(d) Motorcycle;

(e) Metrô (rail-based urban mass transit, mainly subway/underground railway, operated by "Metrô - Companhia do Metropolitano de Sao Paulo");

(f) CPTM (rail-based urban mass transit, mainly surface railway, operated by "CPTM - Companhia Paulista de Trens Metropolitanos");

(g) Bicycle;

(h) Walking.

Step 2: Determine the emission factor per kilometre for each relevant road-based vehicle category

Differentiate relevant fuel types for each of the relevant road-based vehicle categories identified in Step 1. Vehicles in a vehicle category using diesel, gasoline, biofuel, biofuel blend, electricity or gas (compressed natural gas (CNG) or liquefied petroleum gas (LPG)) should be listed separately.

Estimating emission factor per kilometer based on the fraction of vehicles using a specific fuel type, the consumption of each fuel type and CO2eq emissions per unit of fuel consumed:

8 "Lotação" is a mode of transport which falls between taxicabs and buses. These vehicles for hire are typically smaller than buses ("transporters") and usually take passengers on a fixed or semi-fixed route without timetables. They may stop anywhere to pick up or drop off passengers.

Step 3: Determine the emission factor passenger-kilometre

Because the actual survey will be carried out ex-post (year 1 and optionally year 4), emission factors per passenger kilometer (PKM) for the example ex-ante calculation are sourced from the literature (for full references and calculations, see the emission reduction spreadsheet, submitted as annex):

Table 4 - Emission factor per passenger-kilometer (g CO_2/PKM)

$EF_{PKM,bus,2015}$ =	78.30
$EF_{PKM,lotação,2015}$ =	173.09
$EF_{PKM,car,2015}$ =	53.45
$EF_{PKM,taxi,2015}$ =	120.22
$EF_{PKM,motorcycle,2015}$ =	107.22
$EF_{PKM,Metro,2014}$ =	5.00
$EF_{PKM,CPTM,2016}$ =	5.00
$EF_{PKM,bicycle,2018}$ =	0.00
$EF_{PKM,walking,2018}$ =	0.00

Step 4: Determine baseline emissions

Option 2. Determining baseline emissions based on the share of passenger-kilometers shifted from baseline vehicle categories i.

$$BE_y = \left[\sum_i \left[(IR_i)^{t+y-1} \times EF_{PKM,i,x} \times SD_i\right]\right] \times PD_y \times 10^{-6} \qquad \textbf{Equation 5}$$

Where:

BE_y = Baseline emissions in year *y* (tCO_2eq)

IR_i = Technology improvement factor[9] for vehicle category *i* per year (ratio)

T = Time difference (in years) between the year for which data is available for vehicle category *i* and the year of establishing standardized baseline or start date of CDM project in case the tool is used to determine baseline emissions of CDM project

$EF_{PKM,i,x}$ = Emission factor per passenger-kilometer for electricity-based or road-based vehicle category *i* in year *x* (g CO_2eq/PKM)

[9] Since, according to current requirements, data for standardized baselines need to be updated every three years, after such an update, technology improvement factor can be calculated based on country specific data and used in calculations instead of the default value. Relevant provisions in the recent approved "Procedure for development, revision, clarification and update of standardized baselines" shall be applied when this parameter is calculated for establishing standardized baselines.

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

P_y = Number of passengers travelled by the project system in year *y*

S_i = Share of passengers who shifted from electricity-based or road-based vehicle category *i* (%)

I = Vehicle categories (such as passenger car (C), bus (B), motorcycle (M), rail-based urban transit (R), etc.)

Y = Crediting year when emissions reductions are estimated

Table 5 – Baseline calculation[10]

Vehicle Categories	Fuel Type		Emission Factor ($kgCO_2/TJ$)	Emission Factor ($kgCO_2/km$)	Share (ratio)	Occupancy rate (passengers)	Emission Factor (gCO_2/pkm)	Technology improvement factor (ratio)	Time Diff. (years)	Avg. Distance (km)	Passengers	Baseline emissions, year 1 ($tCO_2/year$)
Parameter	***N***	***unit***	$EF_{CO2,n/x}$		$N_{i,n,x}$ / $N_{i,x}$	$OC_{i,x}$	$EF_{PKM,x}$	IR_i	T_i	D_i	P_y	BE_y
Bus	Diesel oil	liters	74,067	1.25	30.9%	16	78.30	0.99	2	2	563,509	48.2
Minibus	Diesel oil	liters	74,067	0.69	6.3%	4	173.09	0.99	2	2	115,263	21.8
Metro	Electricity	kWh	-		11.9%	200	5.00	0.99	2	2	217,719	1.2
CPTM	Electricity	kWh	-		4.6%	200	5.00	0.99	2	2	83,246	0.5
Car (private)	Gasoline	liters	69,300	0.20	0.0%	2	53.45	0.99	2	2	-	42.2
	Ethanol	liters	70,767	0.00				0.99	2	2		
Taxi	GNV	m3	54,256	0.17	0.0%	1.1	120.22	0.99	2	2	-	4.2
	Gasoline	liters	69,300	0.20				0.99	2	2		
	Ethanol	liters	70,767	0.00				0.99	2	2		
Motorcycle	Gasoline	liters	69,300	0.20	0.0%	1.5	107.22	0.99	2	2	-	7.5
	Ethanol	liters	70,767	0.00				0.99	2	2		
Bicycle	N/A	-	0	0	1.4%	-	0.00	0.99	2	2	25,614	-
Walking	N/A	-	0	0	44.9%	-	0.00	0.99	2	2	819,649	-
yearly total					100.0%						1,825,000	125.53

Based on the results of

Table 5, the proposed project activity instance is expected to generate the following emission reductions during the crediting period.

[10] Assuming 400 bicycles, each used twice a day (two trips), each trip 2km long (total of 1,600 km per day and 584,000km per year for the system). For full references and calculations, see the emission reduction spreadsheet, submitted as annex.

Table 6 – Estimated net GHG emission reductions

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net emission reductions or removals (tCO_2e)
Year 1 – 2019	128.5	-	-	128.5
Year 2 – 2020	127.3	-	-	127.3
Year 3 – 2021	126.0	-	-	126.0
Year 4 – 2022	124.7	-	-	124.7
Year 5 – 2023	123.5	-	-	123.5
Year 6 – 2024	122.2	-	-	122.2
Year 7 – 2025	121.0	-	-	121.0
Year 8 – 2026	119.8	-	-	119.8
Year 9 – 2027	118.6	-	-	118.6
Year 10 – 2028	117.4	-	-	117.4
Total estimated ERs	1,229.1	-	-	1,229.1
Total number of crediting years	10.0			
Average annual ERs	122.9	-	-	122.9

4 MONITORING

According to AMS-III.BM, the monitoring methodology will require the monitoring of different parameters depending on the approach selected to calculate the baseline emissions:

(a) If the project participants decide to calculate baseline emissions based on section 5.4.1, the relevant parameters indicated in the methodological tool "Baseline emissions for modal shift measures in urban passenger transport" (TOOL18) shall be measured for years 1 and optionally on year 4 of the crediting period. In doing so, the guideline "Sampling and surveys for CDM project activities and programmes of activities" shall be followed;

(b) For the other options, the monitored parameters are indicated in the tables from AMS-III.BM.

In addition to the parameters listed in AMS-III.BM, the provisions on data and parameters monitored in the tools referred to in this methodology apply.

4.1 Data and Parameters Available at Validation

Data /parameter table 1

Data / Parameter	$EF_{BL,benchmark}$
Data unit	tCO_2/pkm
Description	Average CO_2 emission factor per passenger-kilometer corresponding to public transportation-mix in the city (excluding travels using passenger cars, motorcycles and taxis)
Source of data	Official statistics from the transport authority or published studies conducted by a third party
Value applied	It depends on the option used for the determination of the baselines

	emissions of the additional instance of the project activity. The parameter will be used when applying option 2 of the methodology for the determination of the baseline emissions. Not applicable here as the example project will apply option 1.
Justification of choice of data or description of measurement methods and procedures applied	Steps 1 to 3 of the methodological tool "Baseline emissions for modal shift measures in urban passenger transport" (TOOL18) may be applied to complement existing data. If the data from the statistics or from the studies only allow the determination of the activity levels in terms of pkm (passenger-kilometer), a conservative default value of 50 gCO_2/pkm for buses and 0.1 kWh/pkm for metro can be used (both values based on the performance analysis benchmarks from ACM0016). If the average CO_2 emission factor per passenger-kilometer determined is significantly higher than 50 gCO2/pkm for buses and 0.1 kWh/pkm for metro, these values shall be further justified in accordance with the guidance in section 4.7 "Data and parameters" of the "General guidelines for SSC CDM methodologies"
Purpose of Data	Calculation of baseline emissions
Comments	Parameter used when applying option 2 of the methodology.

Data /parameter table 2

Data / Parameter	$N_{bicycles,BL}$
Data unit	Number of bicycle trips
Description	Number of bicycle trips travelling through the location of the new bicycle infrastructure (Type 1 or Type 2) or parked in the area of influence e.g. surroundings of new bicycle parking area the (Type 5 or Type 6) prior to implementation of the project activity in a year
Source of data	Measured directly and/or based on a sample basis
Value applied	It depends on the option used for the determination of the baselines emissions of the additional instance of the project activity. The parameter will be used when applying option 2 of the methodology for the determination of the baseline emissions. Not applicable here as the example project will apply option 1.
Justification of choice of data or description of	In direct measurement method, this parameter is determined through sensors installed in the location that counts the number of bicycles riding

measurement methods and procedures applied	in the lane or the number of bicycles parked in the parking area. In a sampling-based method, visual counting methods or camera-based methods may also be applied. Any sampling-based methods shall be in accordance with the standard "Sampling and surveys for CDM project activities and programme of activities"
Purpose of Data	Calculation of baseline emissions
Comments	Parameter used when applying Option 2 of the methodology.

Data /parameter table 3

Data / Parameter	$EF_{BL,CO2,survey}$
Data unit	tCO_2/pkm
Description	Average CO_2 emission factor per passenger-kilometer in the baseline
Source of data	Survey with users of e-bike promotion programs and bicycle sharing programs
Value applied	It depends on the option used for the determination of the baselines emissions of the additional instance of the project activity. The parameter will be used when applying option 3 of the methodology for the determination of the baseline emissions. Not applicable here as the example project will apply option 1.
Justification of choice of data or description of measurement methods and procedures applied	The survey's questionnaire shall be designed to determine the users travel modes and trip length prior to the project activity in terms of average emissions per passenger-kilometer (gCO_2/pkm). Sampling shall be in accordance with the standard "Sampling and surveys for CDM project activities and programme of activities". The survey shall be conducted in the year 1 and optionally in the year 4 of the crediting period
Purpose of Data	Calculation of baseline emissions
Comments	Parameter used when applying Option 3 of the methodology. The emission factor is determined by applying Steps 1 to 3 from the latest approved version of the methodological tool "Baseline emissions for modal shift measures in urban passenger transport", using parameters estimated based on data collected during the survey. See description of the procedure in paragraph I.5 (Establishment and description of baseline scenario).

	Average CO_2 emission factor per passenger-kilometer in the baseline determined through the survey as above shall be cross checked with values of typical share of travel modes and trip length reported in literature (e.g. published reports, studies pertaining to the project region). If local studies are not available, values reported in Appendix 5 of the "Manual for Calculating Greenhouse Gas Benefits of Global Environment Facility Transportation Projects" prepared by the ITDP and available at <https://www.thegef.org/publications/manual-calculating-ghg-benefits-gef-transportation-projects> may be used for cross-checking. If the the mode shares and trip length determined through the survey is conservative or comparable to literature values, no further action is required, otherwise project proponent shall demonstrate that the outcomes of the survey is representative and reliable explaining the factors that lead to differences (e.g. based on sample based checks of evidences such as fuel receipts of cars, or travel tickets for bus or metro).

From TOOL18 - Methodological tool - Baseline emissions for modal shift measures in urban passenger transport

Data /parameter table 4

Data / Parameter	$SFC_{i,n,x}$
Data unit	Mass or volume units of fuel/km
Description	Specific fuel consumption of vehicle category *i* using fuel type *n* in year *x*
Source of data	In decreasing order of preference: 1. Local measured data (studies, e.g. performed by universities, other institutions or ordered by project proponent); 2. National or international data from studies; 3. IPCC default values for the respective vehicle categories (latest IPCC report) 4. Design data for relevant vehicle categories 5. Globally applicable default values
Description of measurement methods and procedures to be applied	The following alternatives are proposed to determine specific fuel consumption (in order of preference). In case one of the alternatives does not provide required values for all categories, the combination of these alternatives can be used and justification for the use of combination should be provided. **Alternative 1:** Measurement of fuel consumption data using total data (if available e.g. from bus or taxi companies) or a representative sample for the respective category and fuel type. Sampling per category and fuel should include, as core characteristics, vehicle age and motorization to ensure that the sample is as close as possible to the actual vehicle

<table>
<tr><td></td><td>composition in the urban area(s) of the region for which the baseline is established. Vehicle age and technology (related often to emission standards such as Euro standards) are factors which influence, to a significant extent, the fuel consumption. To be conservative, specific fuel consumptions based on samples shall be based on the lower limit of the uncertainty band at a 95 per cent confidence level.

Alternative 2: Use of fixed values based on 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 urban area(s) of the region for which the baseline is established 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 urban area(s) of the region for which the baseline is established, to determine whether either US, Japanese or European default factors apply, or 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).

Alternative 3: latest IPCC default values reported matching the respective vehicle category, age, vehicle origin and technology.

Alternative 4. Design data for relevant vehicle categories.

Alternative 5. Globally applicable specific fuel consumption for vehicle category default values (Table 7).

<table>
<tr><th>Table 7 - Specific fuel consumption</th><th>Value</th><th>Unit</th></tr>
<tr><td>Gasoline car (personal and taxi)</td><td>6</td><td>l/100 km</td></tr>
<tr><td>Diesel car (personal and taxi)</td><td>5</td><td>l/100 km</td></tr>
<tr><td>Motorcycle</td><td>2</td><td>l/100 km</td></tr>
</table>
</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>At the survey in year 1 and optionally in the year 4 when applying option 1 or continuous when applying option 3.</td></tr>
<tr><td>Value applied</td><td>Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.</td></tr>
<tr><td>Monitoring equipment</td><td>N/A</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Following provisions established in the standard “Sampling and surveys for CDM project activities and programme of activities” and TOOL18.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions.</td></tr>
<tr><td>Calculation method</td><td>Parameter used when applying Option 1 or 2 of the methodology.</td></tr>
<tr><td>Comments</td><td>-</td></tr>
</table>

Data /parameter table 5

Data / Parameter	$SEC_{i,x}$
Data unit	kWh/km
Description	Specific electricity consumption of vehicle category *i* using electricity in year *x*
Source of data	In decreasing order of preference: 1. Local measured data (studies, e.g. performed by universities, other institutions or ordered by project proponent); 2. National or international data from studies; 3. IPCC default values for the respective vehicle categories (latest IPCC report) 4. Design data for relevant vehicle categories 5. Globally applicable default values (See Table 8).
Description of measurement methods and procedures to be applied	The following alternatives are proposed to determine specific electricity consumption (in order of preference). In case one of the alternatives does not provide required value for all categories, the combination of these alternatives can be used and justification for the use of combination should be provided. **Alternative 1:** Measurement of electricity consumption data using total data (if available e.g. from bus or taxi companies) or a representative sample for the respective category. Sampling per category should include, as core characteristics, vehicle age and technology to ensure that the sample is as close as possible to the actual vehicle composition in the urban area(s) of the region for which the baseline is established. To be conservative, specific electricity consumptions based on samples shall be based on the lower limit of the uncertainty band at a 95 per cent confidence level. **Alternative 2:** Use of fixed values based on 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 urban area(s) of the region for which the baseline is established 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 urban area(s) of the region for which the baseline is established, to determine whether either of US, Japanese or European default factors apply, or local vehicle manufacturer information can be used (in the case of having a substantial domestic vehicle motor industry or source of origin

<table>
<tr><td></td><td>of vehicle imports).
Alternative 3: latest IPCC default values reported matching the respective vehicle category, age, vehicle origin and technology.
Alternative 4. Design data for relevant vehicle categories.
Alternative 5. Globally applicable default values. (Table 8).
<table>
<tr><th>Table 8 - Specific electricity consumption</th><th>Value</th><th>Unit</th></tr>
<tr><td>Electric vehicles</td><td>0.12</td><td>kWh/km</td></tr>
</table>
</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>At the survey in year 1 and optionally in the year 4 when applying option 1 or continuous when applying option 3.</td></tr>
<tr><td>Value applied</td><td>Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.</td></tr>
<tr><td>Monitoring equipment</td><td>N/A</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Following provisions established in the standard “Sampling and surveys for CDM project activities and programme of activities” and TOOL18.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Calculation method</td><td>Parameter used when applying Option 1 or 2 of the methodology.</td></tr>
<tr><td>Comments</td><td>-</td></tr>
</table>

Data /parameter table 6

Data / Parameter	$N_{i,n,x}$
Data unit	VKM or units
Description	Number of vehicle-kilometres vehicle category *i* using fuel type *n* driven in year *x* or number of vehicles in vehicle category *i* using fuel type *n* in year *x*
Source of data	Municipal transit authorities based on vehicle registration statistics from the respective city or data from vehicle control stations (technical and emission control stations). If no city/municipal data is available, regional data (canton, state) or, as a last option, national data can be used
Description of measurement methods and procedures to be applied	Used for all vehicle categories identified as relevant vehicle categories. In the cases of buses and taxis, informal or illegal units may operate. While estimates on the number of informal units may be available, these are by their nature not trustworthy. For both categories it is thus recommended to only include formally registered units. For consistency, it is important that transported passengers are also based on the official records thus not including passenger trips of informal units. For electrical vehicles fuel type *n* represents electricity

Frequency of monitoring/recording	At the survey in year 1 and optionally in the year 4 when applying option 1 or continuous when applying option 3.
Value applied	Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.
Monitoring equipment	N/A
QA/QC procedures to be applied	Following provisions established in the standard "Sampling and surveys for CDM project activities and programme of activities" and TOOL18."
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying Option 1 or 2 of the methodology.
Comments	-

Data /parameter table 7

Data / Parameter	$N_{i,n,x}$ / $N_{i,x}$
Data unit	Percentage or share
Description	Percentage or share of vehicle-kilometers or vehicles in vehicle category i using fuel type n in year x
Source of data	National transport statistics based on vehicle registration statistics, company data (for buses) or surveys
Description of measurement methods and procedures to be applied	For buses it should be based on urban units as urban buses often use a different fuel type than inter-urban units
Frequency of monitoring/recording	At the survey in year 1 and optionally in the year 4 when applying option 1 or continuous when applying option 3.
Value applied	Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.
Monitoring equipment	N/A
QA/QC procedures to be applied	Following provisions established in the standard "Sampling and surveys for CDM project activities and programme of activities" and TOOL18.
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying Option 1 or 2 of the methodology.
Comments	Used for all relevant vehicle categories

Data /parameter table 8

Data / Parameter	$NCV_{i,n}$

<table>
<tr><td>Data unit</td><td>Energy/mass or volume units of fuel type n</td></tr>
<tr><td>Description</td><td>Net calorific value of fuel n used in vehicle category i</td></tr>
<tr><td>Source of data</td><td>Data sources in Table 9 may be used if the relevant conditions apply.
Table 9 – Data sources and conditions for their usage
<table>
<tr><td>Data sources</td><td>Conditions for using the data source</td></tr>
<tr><td>(a) National default values</td><td>This source can be only used for liquid fuels and should be based on well documented reliable sources (such as national energy balances)</td></tr>
<tr><td>(b) IPCC default values at the lower limit of the uncertainty at a 95 per cent confidence interval as provided in table 1.2 of chapter 1 of volume 2 (energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td></td></tr>
</table></td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>Following provisions established in TOOL18.</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>For (a): review the appropriateness of the values annually.
For (b): any future revision of the IPCC Guidelines should be taken into account.</td></tr>
<tr><td>Value applied</td><td>Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.</td></tr>
<tr><td>Monitoring equipment</td><td>N/A</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Verify whether the values under (a) and (b) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range, collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in (a) should have ISO17025 accreditation or demonstrate that they can comply with similar quality standards</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Calculation method</td><td>Parameter used when applying Option 1 or 2 of the methodology.</td></tr>
<tr><td>Comments</td><td>Vehicle owners or operators can buy fuel from a variety of sources (fuel</td></tr>
</table>

	stations). Therefore, in practice it is considered to be simpler to determine the parameter using options (a) or (b)

Data /parameter table 9

Data / Parameter	IR_i
Data unit	-
Description	Technology improvement factor for vehicle category *i* per year
Source of data	-
Description of measurement methods and procedures to be applied	When the tool is used for estimating baseline emissions for individual CDM project activities or Programmes of Activities, the default technology improvement factor is 0.99 for all vehicle categories.
Frequency of monitoring/recording	At the survey in year 1 and optionally in the year 4 when applying option 1 or continuous when applying option 3.
Value applied	Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.
Monitoring equipment	N/A
QA/QC procedures to be applied	Following provisions established in the standard "Sampling and surveys for CDM project activities and programme of activities" and TOOL18.
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying Option 1 or 2 of the methodology.
Comments	

Data /parameter table 10

Data / Parameter	***OCi,x or OCB,x / OCT,x / OCC,x / OCMR,x***
Data unit	Passengers
Description	Average occupancy rate of vehicle category i in year x (e.g.,buses (B), taxis (T), passenger cars (C), motorized rickshaws (MR)
Source of data	Option 1. Municipal transit authorities or specific studies. Vintage maximum three years. Option 2. The following default values can be applied: Table 10 – Average occupancy as per vehicle type

	Average occupancy		
	World	South Asia	Unit

<table>
<tr><td></td><td>
<table>
<tr><td>Car</td><td colspan="2">2.0</td><td>Person (including driver)</td></tr>
<tr><td>Taxi</td><td colspan="2">1.1</td><td>Person (excluding driver)</td></tr>
<tr><td>Motorcycle</td><td colspan="2">1.5</td><td>Person (including driver)</td></tr>
<tr><td>Bus</td><td>40%</td><td>80%</td><td>Total capacity</td></tr>
</table>
Option 3.
Survey of occupancy of individual motorized transport (motorcycles, personal cars, taxis) in the urban area for which the baseline is established. The obtained occupancy rates can be used as default values for these vehicle categories at a country level, as variation in occupancy rates of individual motorized transport used in the urban context is relatively low.
Survey of occupancy rates of public transport (bus, light rail, tram, metro, BRTs, etc.) in the urban area for which the standardized baseline is established. If standardized baselines for multiple cities in a country are established, these cities need to be grouped in categories of similar cities (based on population size, population density, etc.) and surveys on occupancy rates of public transport of sample cities need to be conducted. If there is no big variation in occupancy rates of the same mode in the cities of the same category, then surveyed occupancy rates of public transport can be used as defaults for the rest of the cities in the same category</td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>Based on visual occupation studies for all vehicle categories.
For buses the occupation rate is based on boarding-alighting studies, electronic smart tickets or on visual occupation studies with expansion factors for routes served to determine the average occupation rate along the entire route. As an alternative for buses, the occupancy rate can be based on average trip distance of bus passengers, total passengers and total distance driven by buses.
For taxis (including motorized rickshaws), the driver should not be counted</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>At the survey in year 1 and optionally in the year 4 when applying option 1 or continuous when applying option 3.</td></tr>
<tr><td>Value applied</td><td>Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.</td></tr>
<tr><td>Monitoring equipment</td><td>N/A</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Following provisions established in the standard “Sampling and surveys for CDM project activities and programme of activities” and TOOL18.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
</table>

Calculation method	Parameter used when applying Option 1 or 2 of the methodology.
Comments	-

Data /parameter table 11

Data / Parameter	$EF_{CO2,n}$
Data unit	g CO2/J
Description	Emission factor for fuel type n
Source of data	Data sources in Table 9 may be used if the relevant conditions apply. Note: In case biofuels or biofuel blends are used, the CO2 emission factor for the share of biofuels used as pure or in blends is equal to zero
Description of measurement methods and procedures to be applied	Following provisions established in TOOL18.
Frequency of monitoring/recording	For (a): review the appropriateness of the values annually. For (b): Latest available IPCC Guidelines should be taken into account.
Value applied	Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.
Monitoring equipment	N/A
QA/QC procedures to be applied	Following provisions established in the standard “Sampling and surveys for CDM project activities and programme of activities” and TOOL18.
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying Option 1 or 2 of the methodology.
Comments	-

Data /parameter table 12

Data / Parameter	$EF_{CO2,x}$
Data unit	g CO2/kWh
Description	Emission factor for electricity in year x (g CO2/kWh)
Source of data	Official source of data
Description of measurement methods and procedures to be applied	TOOL05 shall be applied.
Frequency of monitoring/recording	In accordance with TOOL05

Value applied	Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.
Monitoring equipment	N/A
QA/QC procedures to be applied	Procedures in the latest approved version of the "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (TOOL05) shall be followed.
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying Option 1 or 2 of the methodology.
Comments	-

Data /parameter table 13

Data / Parameter	$EF_{KM,i,x}$
Data unit	g CO2/km
Description	Emission factor per kilometer of vehicle category i in year x (g CO2/km)
Source of data	Official source of data
Description of measurement methods and procedures to be applied	Emission factor for new vehicles.
Frequency of monitoring/recording	At the survey in year 1 and optionally in the year 4 when applying option 1 or continuous when applying option 3.
Value applied	Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.
Monitoring equipment	N/A
QA/QC procedures to be applied	Following provisions established in TOOL18.
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying Option 1 or 2 of the methodology.
Comments	This option is available for taxis, personal cars and motorcycles. Depending on the regions from which the cars are purchased (the US, European Union, Japan, domestic car industry, etc.) respective emission factors for new cars manufactured in these regions shall be used.

Data /parameter table 14

Data / Parameter	$DE_{EL,i,x}$

Data unit	km
Description	Average trip distance travelled by passengers using electricity-based vehicle category *i* in year *x*
Source of data	Official statistics or data obtained from the system operator.
Description of measurement methods and procedures to be applied	Data should be maximum three years old. Following provisions established in TOOL18.
Frequency of monitoring/recording	At the survey in year 1 and optionally in the year 4 when applying option 1 or continuous when applying option 3.
Value applied	Not applicable here as the example project will be type 4, i.e., no e-bikes or e-tricycles.
Monitoring equipment	N/A
QA/QC procedures to be applied	Following provisions established in the standard "Sampling and surveys for CDM project activities and programme of activities" and TOOL18.
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying Option 1 or 2 of the methodology
Comments	-

Data /parameter table 15

Data / Parameter	$P_{EL,i,x}$
Data unit	Passengers
Description	Total number of passengers transported per annum by electricity-based vehicle category i in year x
Source of data	Official statistics or data obtained from the system operator. Data not older than three years.
Description of measurement methods and procedures to be applied	Following provisions established in TOOL18.
Frequency of monitoring/recording	At the survey in year 1 and optionally in the year 4 when applying option 1 or continuous when applying option 3.
Value applied	Not applicable here as the example project will be type 4, i.e., no e-bikes or e-tricycles.
Monitoring equipment	N/A
QA/QC procedures to be applied	-

Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying Option 1 or 2 of the methodology
Comments	-

4.2 Data and Parameters Monitored

From AMS-III.BM - lightweight two and three-wheeled personal transportation

Data /parameter table 16

Data / Parameter	$ADT_{u,y}$
Data unit	km
Description	Average distance travelled per trip by the user u of the infrastructure that would not have used the bicycle in the absence of the project in year y
Source of data	(a) Estimated via survey of the users of the infrastructure; or (b) Directly measured via GPS; or (c) As a conservative approach, the average distance travelled can be assumed as 2.5 km for bicycles and 5 km for e-bikes
Description of measurement methods and procedures to be applied	The survey shall be conducted with a representative sample of users of the bicycle lanes or bicycles parking areas, following the standard "Sampling and surveys for CDM project activities and programme of activities"
Frequency of monitoring/recording	The survey shall be conducted in the year 1 and optionally in the year 4 of the crediting period
Value applied	It depends on the option used for the determination of the baselines emissions of the additional instance of the project activity. The parameter will be used when applying option 2 of the methodology for the determination of the baseline emissions. Not applicable here as the example project will apply option 1.
Monitoring equipment	N/A
QA/QC procedures to be applied	Average distance travelled per trip by the user u when determined through a survey shall be cross checked with values of travel modes and trip length reported in literature (e.g. published reports, studies pertaining to the project region). If local studies are not available, values reported in Appendix 5 of the "Manual for Calculating Greenhouse Gas Benefits of Global Environment Facility Transportation Projects" prepared by the ITDP and available at https://www.thegef.org/publications/manual-calculating-

	ghg-benefits-gef-transportation-projects may be used for crosschecking. If the mode shares and trip length determined through the survey is conservative or comparable to literature values no further action is required, otherwise project proponent shall demonstrate that the outcome of the survey is representative and reliable explaining the factors that lead to differences (e.g. based on sample based checks of evidences such as fuel receipts of cars or travel tickets for bus or metro).
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying Option 2 of the methodology.
Comments	-

Data /parameter table 17

Data / Parameter	$N_{bicycles,y}$
Data unit	Number of bicycles trips
Description	Number of bicycles trips travelling through the bicycle infrastructure in year y or parked in the bicycle parking area
Source of data	Measured directly and/or based on a sample basis
Description of measurement methods and procedures to be applied	In direct measurement method, this parameter is determined through sensors installed in the location that counts the number of bicycles riding in the lane or the number of bicycles parked in the parking area. In a sampling-based method, visual counting methods or camera-based methods may also be applied. Any sampling-based methods shall be in accordance with the standard "Sampling and surveys for CDM project activities and programme of activities"
Frequency of monitoring/recording	Measured continuously and consolidated daily if direct measurement methods are used
Value applied	It depends on the option used for the determination of the baselines emissions of the additional instance of the project activity. The parameter will be used when applying option 2 of the methodology for the determination of the baseline emissions. Not applicable here as the example project will apply option 1.
Monitoring equipment	N/A

QA/QC procedures to be applied	N/A
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying option 2 of the methodology.
Comments	-

Data /parameter table 18

Data / Parameter	$DTU_{u,y}$
Data unit	km
Description	Total distance travelled by the individual user u of the e-bike promotion program or bicycle sharing program in year y
Source of data	(a) For programs that promoted e-bikes, data shall be sourced from mobile apps that record the distance travelled based on GPS; (b) For bicycle sharing programs, data shall be sourced from mobile apps that record the distance travelled based on GPS or from sensors installed in bicycles. (c) For bicycle sharing programs using docking spaces, if the data for (b) are not available, then trip distance may be conservatively assumed as the straight distance between the check-out and check-in docking spaces of the trip
Description of measurement methods and procedures to be applied	(a) When using mobile apps, the user shall turn on the app when starting the travel and turn off when the travel finishes; (b) When using sensors, the distance travelled shall be continuously measured
Frequency of monitoring/recording	The parameter shall be measured while travelling. The values shall be aggregated monthly for each individual user u
Value applied	It depends on the option used for the determination of the baselines emissions of the additional instance of the project activity. The parameter will be used when applying option 2 of the methodology for the determination of the baseline emissions. Not applicable here as the example project will apply option 1.
Monitoring equipment	N/A

QA/QC procedures to be applied	A unique identification number shall be assigned to each user at the time of registering with the e-bike or bicycle sharing program. The manager of the program shall implement measures to link the distance travelled by each of the users to its unique identification number. The records shall be made in a centralized database that allows the project proponent to have access to the information related to the users' travels.
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying option 2 of the methodology.
Comments	Data shall be controlled for outliers, e.g. trips with travel distances longer than three standard deviations above the mean shall be excluded Parameter used when applying Option 3 of the methodology.

Data /parameter table 19

Data / Parameter	$ECP_{j,y}$
Data unit	kWh
Description	Quantity of electricity consumed to recharge the batteries of e-bikes or e-tricycles in year y
Source of data	Continuous measurements
Description of measurement methods and procedures to be applied	As per the latest version of the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (TOOL05). When applying the tool, requirements for $EG_{PJ,grid,y}$ and/or $EG_{PJ,j,y}$ specified in the tool should apply to electricity consumed form the grid and electricity consumed from the captive power plant, whichever applicable.
Frequency of monitoring/recording	As per the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (TOOL05)
Value applied	Not applicable here as the example project will be type 4, i.e., no e-bikes or e-tricycles.
Monitoring equipment	As per the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (TOOL05)

QA/QC procedures to be applied	As per the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (TOOL05)
Purpose of data	Calculation of project emissions
Calculation method	As per the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (TOOL05)
Comments	If this parameter is determined through paragraph 33(b) of the methodology, only the parameter "Total distance travelled by the individual user u of the infrastructure and/or of the promoted e-bikes in year y" ($DT_{u,y}$) needs to be monitored.

From TOOL18 - Methodological tool - Baseline emissions for modal shift measures in urban passenger transport

Data /parameter table 20

Data / Parameter	***Di***
Data unit	kilometers
Description	Average trip distance travelled by passengers who shifted from electricity-based or road-based vehicle category i
Source of data	Survey
Description of measurement methods and procedures to be applied	Survey of the project passengers in year 1 and optionally in year 4 of the first crediting period asking about the entry and exit stations in the project system and noting electricity-based or road-based vehicle category i each surveyed passenger used prior to shifting to the project system (Si).
Frequency of monitoring/recording	At the survey in year 1 and optionally in the year 4 when applying option 1 or continuous when applying option 3.
Value applied	Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.
Monitoring equipment	N/A
QA/QC procedures to be applied	Following provisions established in the standard "Sampling and surveys for CDM project activities and programme of activities" and TOOL18.
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying Option 1 or 2 of the methodology
Comments	-

Data /parameter table 21

Data / Parameter	S_i
Data unit	%
Description	Share of passengers who shifted from electricity-based or road-based vehicle category *i*
Source of data	Survey
Description of measurement methods and procedures to be applied	Survey of the project passengers in year 1 and optionally in year 4 of the first crediting period asking about electricity-based or road-based vehicle category i each surveyed passenger used prior to shifting to the project system and noting the entry and exit stations in the project system (Di,y).
Frequency of monitoring/recording	At the survey in year 1 and optionally in the year 4 when applying option 1 or continuous when applying option 3.
Value applied	Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.
Monitoring equipment	N/A
QA/QC procedures to be applied	Following provisions established in the standard “Sampling and surveys for CDM project activities and programme of activities” and TOOL18.
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying Option 1 or 2 of the methodology
Comments	-

Data /parameter table 22

Data / Parameter	SD_i
Data unit	%
Description	Share of passenger-kilometres who shifted from electricity-based or road-based vehicle category *i* (%)
Source of data	Survey
Description of measurement methods and procedures to be applied	Survey of the project passengers in year 1 and optionally in year 4 of the first crediting period asking about electricity-based or road-based vehicle category i each surveyed passenger used prior to shifting to the project system and noting the entry and exit stations in the project system to determine the share of passenger-kilometers SDi (%) out of total number of passengers using the project system who have shifted from each relevant vehicle category.
Frequency of monitoring/recording	At the survey in year 1 and optionally in the year 4 when applying option 1 or continuous when applying option 3.

Value applied	Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.
Monitoring equipment	N/A
QA/QC procedures to be applied	Following provisions established in the standard "Sampling and surveys for CDM project activities and programme of activities" and TOOL18.
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying Option 1 or 2 of the methodology
Comments	-

Data /parameter table 23

Data / Parameter	P_y
Data unit	Passengers
Description	Number of passengers travelled by the project system in year *y*
Source of data	Project system operator. Electronic ticketing system or any other official records
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	Monitored annually
Value applied	Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.
Monitoring equipment	N/A
QA/QC procedures to be applied	Following provisions established in the standard "Sampling and surveys for CDM project activities and programme of activities" and TOOL18.
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying Option 1 or 2 of the methodology
Comments	-

Data /parameter table 24

Data / Parameter	PD_y
Data unit	PKM
Description	Number of passenger-kilometres travelled by the project system in year *y*

Source of data	Project system operator. Electronic ticketing system or any other official records.
Description of measurement methods and procedures to be applied	Estimated annually. Can be estimated by transport operators based on surveys, occupancy rates at different points in the network.
Frequency of monitoring/recording	Estimated annually
Value applied	Values applied with references/sources disclosed in the ER calculation spreadsheet, submitted as annex.
Monitoring equipment	N/A
QA/QC procedures to be applied	Following provisions established in the standard “Sampling and surveys for CDM project activities and programme of activities” and TOOL18.
Purpose of data	Calculation of baseline emissions
Calculation method	Parameter used when applying Option 1 or 2 of the methodology
Comments	-

4.3 Monitoring Plan

The majority of the data and parameters used in the emissions reduction calculations are not monitored and will be sourced from local measured data (published national or international studies by governmental, academic or private institutions or, if necessary, commissioned by the project participants).

Monitored data and parameters will depend on the baseline emissions option used for the calculation, but are all related to the use of the two and three wheeled personal transportation and will all be determined in surveys.

Surveys will be detailed at CPA level and in accordance with procedures from the Standard for Sampling and Surveys for CDM project activities and programme of Activities (version 7.0, May 2017), summarized in appendix B.

5 SAFEGUARDS

5.1 No Net Harm

Not applicable.

5.2 Environmental Impact

There is no national requirement for the preparation of environmental impact assessment due to the implementation of measure types identified in section 2.2. However, any new activity or public infrastructure requires license and permits, including the construction or expansion of bicycle lanes and parking areas, which is under municipality management.

Compliance with the requirements established in licenses and environmental impact assessments, if required, shall be evaluated for each project activity instance based on local legislation.

The Municipal Assembly of Sao Paulo recently approved Law number 16,885 on 16-April-2018, for the creation of the Sao Paulo Cycling System[11] ("SICLO") aiming the promotion of bicycle use. It also established the necessity of public hearings and technical and environmental studies for new bicycle lanes implementation.

In spite of this new regulation, there is no municipal requirement for measure type 4.

5.3 Local Stakeholder Consultation

There is no national requirement for local stakeholder consultation due to the implementation of measure types identified in section 2.2. However, any new activity or public infrastructure requires license and permits, including the construction or expansion of bicycle lanes and parking areas, which is under municipality management.

5.4 Public Comments

Not applicable.

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

The following description of achieved GHG emission reductions is related to project activity instance 01 of the grouped project. First stations started operation in 27-Jan-2018 and since then 239 bicycle-sharing stations started operation with approximately 2,500 bicycles (type 4 of AMS-III.BM).

In the following paragraphs, one can see data monitored from the operation of the project activity instance from 27-Jan-2018 to 28-Feb-2019.

6.1 Data and Parameters Monitored

From AMS-III.BM - lightweight two and three-wheeled personal transportation

Data /parameter table 15

Data / Parameter	$ADT_{u,y}$
Data unit	km
Description	Average distance travelled per trip by the user u of the infrastructure that would not have used the bicycle in the absence of the project in year y
Value applied	$ADT_{u,2018}$ = 3.81 $ADT_{u,2019}$ = 4.57
Comments	-

[11] Available at: <http://documentacao.camara.sp.gov.br/iah/fulltext/leis/L16885.pdf>

Data /parameter table 16

Data / Parameter	$N_{bicycles,y}$
Data unit	-
Description	Number of bicycles trips travelling through the bicycle infrastructure in year y or parked in the bicycle parking area
Value applied	$N_{bicycles,2018}$ = 1,109,800 $N_{bicycles,2019}$ = 372.948
Comments	-

6.2 Baseline Emissions

Project operator monitored the following information for all 1,482,748 bicycle-trips in the period from 27 January 2018 and 28 February 2019:

- Pickup station and time.
- Return station and time

With the above information, it is possible to calculate total km travelled and average distance travelled per trip.

Additionally, the following national and municipal transit authorities' studies are used to determine the Weighted average CO_2 emission factor per passenger-kilometre corresponding to public transportation-mix in the city:

- Metrô (20186). *Relatório de Sustentabilidade do Metrô de São Paulo.* Companhia do Metropolitano de São Paulo.
- Metrô (2018). *Pesquisa Origem Destino 2017 - Balanço da realização e os primeiros resultados da Pesquisa Origem e Destino 2017.* Companhia do Metropolitano de São Paulo.
- MMA (2014). Primeiro inventário nacional de emissões atmosféricas por veículos automotores rodoviários – relatório final. Ministério do Meio Ambiente.
- Cetesb (2018). Emissões veiculares no estado de São Paulo 2017. Companhia Ambiental do Estado de São Paulo.

For full references and calculations, see the emission reduction spreadsheet, submitted as annex.

6.3 Project Emissions

The present project instance is not related to the use of e-bikes or e-tricycles and, therefore, project emissions = 0 (zero).

6.4 Leakage

In accordance with AMS-III.BM, leakage does not have to be considered.

6.5 Net GHG Emission Reductions and Removals

Table 11 – Net GHG emission reductions and removals achieved in the monitoring period (27-Jan-2018 to 28-Feb-2019), project activity instance 01

Year/period	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
27-Jan-2018 to 31-Dec-2018	148.8	-	-	148.8
1-Jan-2019 to 28-Feb-2019	59.5	-	-	59.5
Total	208.3	-	-	208.3

7 APPENDIX A: APPLICATION OF TOOL18 FOR BASELINE EMISSION CALCULATION

In order to apply Option 1 or 2 of AMS-III.BM, the following steps of TOOL18 shall be followed:

Step 1 - Determine the relevant vehicle categories

Only vehicle categories that are relevant for urban transport shall be included. These may include but are not limited to the following vehicle categories:

(a) Buses, differentiating between large, medium and small buses if appropriate, as well as buses operating in conventional bus systems and buses operating on bus lanes or BRTs, which are in commercial operation at the time of determining baseline emissions. Emissions from a conventional bus system and BRT shall be determined separately;

(b) Passenger cars;

(c) Taxis;

(d) Motorcycles;

(e) Rail-based urban mass transit (metro, light rail transit, trams);

(f) Other vehicle categories such as para-transit.

Step 2 - Determine the emission factor per kilometre for each relevant road-based vehicle category

Differentiate relevant fuel types for each of the relevant road-based vehicle categories identified in Step 1. Vehicles in a vehicle category using diesel, gasoline, biofuel, biofuel blend, electricity or gas (compressed natural gas (CNG) or liquefied petroleum gas (LPG)) should be listed separately.

Estimating emission factor per kilometer based on the fraction of vehicles using a specific fuel type, the consumption of each fuel type and CO2eq emissions per unit of fuel consumed:

$$EF_{KM,i,x} = \left[\sum_{n}\left[SFC_{i,n,x} \times NCV_{i,n} \times EF_{CO2,n} + SEC_{i,x} \times EF_{CO2,x}\right] \times \frac{N_{i,n,x}}{N_{i,x}}\right] \quad \textbf{Equation 6}$$

Where:

$EF_{KM,i,x}$ = Emission factor per kilometer of vehicle category *i* in year *x* (gCO_2/km)

$SFC_{i,n,x}$ = Specific fuel consumption of vehicle category *i* using fuel type *n* in year *x* (mass or volume units of fuel/km)

$NCV_{i,n}$ = Net calorific value of fuel *n* used in vehicle category *i* (MJ/mass or volume units of fuel)

$EF_{CO2,n}$ = Emission factor for fuel type *n* ($g\ CO_2/MJ$)

$SEC_{i,x}$ = Specific electricity consumption of vehicle category *i* using electricity in year *x* (kWh/km)

$EF_{CO2,x}$ = Emission factor for electricity in year *x* ($g\ CO_2/kWh$)

$N_{i,x}$ = Number of vehicle-kilometers of category *i* driven in year *x* (VKM) or number of vehicles of category *i* in year *x* (units)

$N_{i,n,x}$ = Number of vehicle-kilometers vehicle category *i* using fuel type *n*[12] driven in year *x* (VKM) or number of vehicles in vehicle category *i* using fuel type *n*[12] in year *x* (units)

N = Fuel types used by vehicle category *i* in year *x*

I = Road-based vehicle categories (such as passenger car (C), bus (B), motorcycle (M), etc.)

X = Most recent calendar year for which data is available. Data not older than three years

Note 1: for taxis, personal cars and motorcycles, instead of estimating the emission factor EFKM,i,x a default emission factor for new vehicles can be obtained from the source provided in TOOL18, table in section "Data and Parameters not monitored".

Note 2: instead of the two parameters *Ni,n,x* and *Ni,x*, it is possible to use one parameter *Ni,n,x/Ni,x* which can be defined using the following options, which are described in the order of preference (see "Data and parameters" section for further guidance on data requirements):

(a) Approach 1. The share of vehicle-kilometers within vehicle category i that are driven by vehicles using fuel type n, if a reliable data source for this parameter exists (see TOOL18, "Data and parameters" section for further guidance on data requirements). This is the preferred option;

(b) Approach 2. In case data on vehicle-kilometers required in approach 1 is not available the share of vehicles within vehicle category i that use fuel type n should be used, if a reliable data source for this parameter exists.

Step 3 - Determine the emission factor per passenger-kilometre

The emission factors per passenger kilometer (PKM) are determined for each vehicle category as follows:

(a) Electricity based transport system. The emission factor per PKM for electricity-based transport systems (e.g. urban rail-based systems) is determined using the following equation:

$$EF_{PKM,i,x} = \frac{TE_{EL,i,x}}{P_{EL,i,x} \times D_{EL,i,x}} \times 10^6 \qquad \textbf{Equation 7}$$

Where:

$EF_{PKM,i,x}$ = Emission factor per passenger-kilometer for electricity-based vehicle category *i* in year *x* (g CO_2/PKM)

$TE_{EL,i,x}$ = Total emissions from electricity-based vehicle category *i* in year *x* (t CO_2)

$P_{EL,i,x}$ = Total number of passengers transported per annum by electricity-based vehicle category *i* in year *x* (passengers)

[12] For electrical vehicles fuel type *n* represents electricity only for variable $N_{i,n,x}$.

$D_{EL,i,x}$ = Average trip distance travelled by passengers using electricity-based vehicle category *i* in year *x* (km)

X = Most recent calendar year for which data is available. Data not older than three years

The total emissions TEEL,i,x from electricity-based vehicle category i should be calculated for each vehicle category i using the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" where parameter TEEL,i,x corresponds to parameter BEEC,y in the tool. When applying this tool, parameter ECBL,k,y in the tool should be taken as the amount of electricity used by electricity-based vehicle category i in year x, which shall be consistent with the year for data on transportation of PEL,i,x passengers along the average distance DEL,I,x[13]. Parameter EFCO2,x should be used instead of parameter EFEL,k,y in the above referred tool, that is monitored according to monitoring requirements stipulated in TOOL18.

(a) Fuel based transport system. Emission factors per PKM for fuel-based transport systems (e.g. road-based vehicles) should be calculated as follows:

$$EF_{PKM,i,x} = \frac{EF_{KM,i,x}}{OC_{i,x}} \qquad \textbf{Equation 8}$$

Where:

$EF_{PKM,i,x}$ = Emission factor per passenger-kilometer of vehicle category *i* in year *x* (g CO_2/PKM)

$EF_{KM,i,x}$ = Emission factor per kilometer of vehicle category *i* in year *x* (g CO_2/km)

$OC_{i,x}$ = Average occupancy rate of vehicle category *i* in year *x* (passengers)

I = Road-based vehicle categories (such as passenger car (C), bus (B), motorcycle (M), etc.)

X = Most recent calendar year for which data is available. Data not older than three years

Step 4 - Determine baseline emissions

Option 1. Determining baseline emissions based on the shares of passengers shifted from baseline vehicle categories i to the project urban public system(s) and an average trip distance on each relevant vehicle category. Baseline emissions are estimated as follows:

$$BE_y = \left[\sum_i \left[(IR_i)^{t+y-1} \times EF_{PKM,i,x} \times D_i \times S_i\right]\right] \times P_y \times 10^{-6} \qquad \textbf{Equation 9}$$

Where:

[13] The trip distance is only determined prior to estimating baseline emissions. The electricity consumed, and the passengers transported should be updated annually to track technological improvements in the rail-based system leading to changes in the emission factor per passenger transported.

BE_y = Baseline emissions in year *y* (tCO_2eq)

IR_i = Technology improvement factor[14] for vehicle category *i* per year (ratio)

T = Time difference (in years) between the year for which data is available for vehicle category *i* and the year of establishing standardized baseline or start date of CDM project in case the tool is used to determine baseline emissions of CDM project

$EF_{PKM,i,x}$ = Emission factor per passenger-kilometer for electricity-based or road-based vehicle category *i* in year *x* (g CO_2eq/PKM)

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

P_y = Number of passengers travelled by the project system in year *y*

S_i = Share of passengers who shifted from electricity-based or road-based vehicle category *i* (%)

I = Vehicle categories (such as passenger car (C), bus (B), motorcycle (M), rail-based urban transit (R), etc.)

Y = Crediting year when emissions reductions are estimated

The share of passengers Si (%) out of total number of passengers using the project system who have shifted from electricity-based or road-based vehicle categories i to the urban public system(s) established as CDM project activities as well as an average trip distance on each relevant vehicle category Di,y are determined from a survey of the project system by the project developers (note: in case of the development of a standardized baseline this parameter remains project specific and, therefore, project proponents, not DNAs, should collect these data).

Surveys conducted in year 1 and year 4 of the first crediting period shall be used to determine: (i) the entry and exit stations for each surveyed passenger to determine the average trip distance on each relevant vehicle category Di,y (ii) the vehicle category from which each surveyed passenger had shifted to determine the share of passengers Si (%) out of total number of passengers using the project system who have shifted from each relevant vehicle category. The data from the survey in year 1 shall be used for the first three years of the first crediting period while the data from the survey in year 4 shall be used until the end of the crediting periods of the project activity.

The total number of passengers shall be monitored annually, which when multiplied by the shares of passengers Si (%) who have shifted from electricity-based or road-based vehicle categories, respective trip distances on these vehicle categories Di,y and emission factors per passenger-kilometre EFPKM,i,x are used in Equation 9 to calculate baseline emissions.

Option 2. Determining baseline emissions based on the share of passenger-kilometers shifted from baseline vehicle categories i. Baseline emissions are determined based on the share of passenger-

[14] Since, according to current requirements, data for standardized baselines need to be updated every three years, after such an update, technology improvement factor can be calculated based on country specific data and used in calculations instead of the default value. Relevant provisions in the recent approved "Procedure for development, revision, clarification and update of standardized baselines" shall be applied when this parameter is calculated for establishing standardized baselines.

kilometers shifted from vehicle categories i and the passenger-kilometers travelled on the project system. Baseline emissions are estimated as follows:

$$BE_y = \left[\sum_i \left[(IR_i)^{t+y-1} \times EF_{PKM,i,x} \times SD_i\right]\right] \times PD_y \times 10^{-6} \quad \textbf{Equation 10}$$

Where:

BE_y = Baseline emissions in year *y* (tCO_2eq)

IR_i = Technology improvement factor[14] for vehicle category *i* per year (ratio)

T = Time difference (in years) between the year for which data is available for vehicle category *i* and the year of establishing standardized baseline or start date of CDM project in case the tool is used to determine baseline emissions of CDM project

$EF_{PKM,i,x}$ = Emission factor per passenger-kilometer for electricity-based or road-based vehicle category *i* in year *x* (g CO_2eq/PKM)

PD_y = Number of passenger-kilometers travelled by the project system in year *y* (PKM)

SD_i = Share of passenger-kilometers who shifted from electricity-based or road-based vehicle category *i* (%)

I = Vehicle categories (such as passenger car (C), bus (B), motorcycle (M), rail-based urban transit (R), etc.)

Y = Crediting year when emissions reductions are estimated

The share of passenger-kilometres *SDi* (%) out of total number of passengers using the project system who have shifted from electricity-based or road-based vehicle categories i to the urban public system(s) established as CDM project activities is determined from a survey of the project system by the project developers (note: in case of the development of a standardized baseline this parameter remains project specific and, therefore, project proponents, not DNAs, should collect these data).

Surveys conducted in year 1 and year 4 of the first crediting period shall be used to determine: (i) the entry and exit stations for each surveyed passenger to determine the average trip distance for this passenger; (ii) the vehicle category from which each surveyed passenger had shifted, to determine the share of passenger-kilometers *SDi* (%) out of total number of passengers using the project system who have shifted from each relevant vehicle category. The data from the survey in year 1 shall be used for the first three years of the first crediting period while the data from the survey in year 4 shall be used until the end of the crediting periods of the project activity.

The total number of passenger-kilometers shall be monitored annually, which when multiplied by the shares of passengers *SDi* (%) who have shifted from electricity-based or road-based vehicle categories, and emission factors per passenger-kilometer $EF_{PKM,i,x}$ are used in Equation 10 to calculate baseline emissions.

8 APPENDIX B: APPLICATION OF SAMPLING AND SURVEYS

In order to apply Option 1 of AMS-III.BM, the standard "Sampling and surveys for CDM project activities and programme of activities" may be applied.

The purpose of sampling is to obtain: (a) unbiased and (b) reliable estimates of the mean value of parameters used in the calculations of GHG emission reductions.

Where there is no specific guidance in the applied methodology, the project participants or the coordinating/managing entity shall use 90/10 confidence/precision as the criteria for the reliability of sampling efforts for small-scale CDM project activities. Where two or more project activities, CPAs or PoAs are grouped for undertaking a common survey it shall be ensured that a confidence/precision of 95/10 is achieved for each of the project activity, CPA or PoA that is included in the group for the survey. This reliability specification shall be applied to determine the sampling requirements for each individual parameter value determined through a sampling effort.

Precision of 10 per cent, that is, ± 10 per cent shall be interpreted:

(a) As a relative unit when the parameter of interest is a proportion (or a percentage). For instance, ± 10 per cent in relative units means that the interval around a proportion value of 70 per cent is 63 per cent to 77 per cent. A proportion can describe either of the two possible scenarios of the success rate (p) or the failure rate (1−p), for example (i) cookstove still operational or (ii) cookstove no longer operational. The project participants or the coordinating/managing entity may use the larger of the two proportions in the sample size calculation, that is p or (1−p), in any of the monitoring periods during the crediting period without having to revise the monitoring plan.

(b) As a relative term when the parameter of interest is a mean. For example, ± 10 per cent in relative terms means that the interval around a mean value of 4 is 3.6 to 4.4.

If the estimates from the actual samples fail to achieve the target minimum levels of precision from paragraph above (90/10 or 95/10), the project participants or the coordinating/managing entity shall either:

(a) Perform additional data collection that is a supplemental or new sample to reach the required precision level; or

(b) Apply a correction to the estimates using one of the two options below:

  (i) Discounting the emission reduction estimates by either:

    (a) Taking the lower or the upper bound, whatever is the more conservative, of the 90 or 95 per cent confidence interval, depending on the type of methodologies applied; or

    (b) Discounting by no less than three times (x3) the percentage precision points missed (e.g. if the required precision is 90/10 and the attained precision is 90/11 then the GHG emission reduction estimates are discounted by 3 per cent);

  (ii) Using a conservative default value included in the applied methodologies (e.g. 3.5 hours for lighting usage for AMS-II.J, default failure rates18 provided in equation 3 of AMS-II.J);

    (a) The option in subparagraph (b) above is only eligible for the application to the survey undertaken during the first two years of the crediting period of the CDM project activity or component project activities (CPAs) (if sampling is undertaken at the PoA level, the two-year limit applies from the start date of crediting to the PoA), and when

the attained confidence/precision from the actual samples is equal to or better than 90/15 for a small-scale CDM project activity and 95/15 for a large-scale CDM project activity.

When developing a sampling plan, the project participants or the coordinating/managing entity shall calculate the sample size required to achieve a required level of reliability. The sample size should be determined manually or using appropriate statistical software. The calculation is dependent on all of the following as well as the target level of confidence and the precision (e.g. 90/10 or 95/10):

(a) The type of parameter of interest, that is, mean value or proportion value;

(b) The target value, that is, the expected value of the parameter, which should be determined using the project participants' or the coordinating/managing entity's knowledge and experience;

(c) Expected variance (or standard deviation) for that measure in the sample, based on the results from similar studies including other similar CDM project activities or previous monitoring periods, pilot studies or from the project planner's own knowledge of the data.

If the sample size calculation returns a value of less than 30 samples, a minimum sample size of 30 shall be chosen when the parameter of interest is a proportion. If the parameter of interest is a numeric mean value (*i.e*. not a proportion or percentage) the Student's t distribution shall be used if the resulting sample size is less than 30.