

CDM-EB102-A08

Small-scale Methodology

AMS-III.BN.: Efficient operation of public transportation

Version 01.0

Sectoral scope(s): 07



United Nations
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1. Introduction

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

Table 1. Methodology key elements

Typical projects	Implementation of measures to improve the operation of buses used for public transportation such as ITS (Intelligent Transportation Systems) and changes/improvements in bus routes, without reducing the level of service
Type of GHG emissions mitigation action	Energy efficiency: Reduction in the consumption of fossil fuels per passenger transported

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology applies to project activities that implement measures that improve the efficiency of operation of public transportation by buses, such as use of Intelligent Transportation System (ITS) measures and/or improve bus routes (e.g., re-design of routes, implementation of priority bus lanes that are not part of a Bus Rapid Transit (BRT) system, use of high quality pavement, construction of viaducts/tunnels, express service connecting only high demand stops during peak hours). The project activity results in emission reductions due to more efficient operation of the buses which may also improve the ridership of buses.

2.2. Applicability

3. The methodology is applicable for implementing one or more of the following measures (stand-alone or in combination) to one or more existing bus routes:
 - (a) Implementation of ITS measures to improve the operation of buses;
 - (b) Changes/improvements in bus routes that allow for a more efficient journey between the origin and final destination. The interventions can be:
 - (i) Re-design of bus routes;
 - (ii) Construction of viaducts, tunnels or other improvements for the purpose of improving the infra-structure of dedicated bus lanes that are not part of a BRT system, eliminating traffic lights or roundabouts and improving the traffic flow of buses;
 - (iii) Implementation of priority bus lanes that are not part of a BRT system;
 - (iv) Implementation of an express service connecting high demand stops by reducing the number of intermediate stops during peak hours;
 - (v) Implementation of a bus queue jump lane;

- (vi) Rehabilitation of the pavement of the existing dedicated bus routes/lanes with high-quality pavement.
- 4. The project activity shall not reduce the number of passengers travelling on the affected bus route(s), as compared to the baseline. The number of passengers that are travelling during the crediting period are monitored and used for the purpose.
- 5. Under this methodology the Emission Reduction Factor for the route k (ERF_k) is a key parameter that needs to be estimated as per equation 2. This methodology is applicable, where the data can be collected for the same cohort of buses from which ERF_k was calculated, to determine the specific energy consumed per passenger-kilometer in the baseline route k -BL ($SEC_{PKM,k-BL}$) and the specific energy consumed per passenger-kilometer in the project route k ($SEC_{PKM,k}$).
- 6. Under this methodology, measures which impact the occupancy of buses that are different from the measures included in the project activity shall not be implemented before the parameter $SEC_{PKM,k}$ is determined.
- 7. During the crediting period, buses may be replaced by more efficient buses or by buses with a higher capacity, and the methodology assumes that this change would also happen in the baseline scenario.
- 8. The methodology is not applicable to project activities implementing a new BRT or expanding an existing BRT by creating new lanes.
- 9. The applicability conditions included in the tools referred to below shall also apply.
- 10. The methodology is not applicable to buses operating on BRTs.
- 11. Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO₂ annually.

2.1. Entry into force

- 12. The date of entry into force is the date of the publication of the EB 102 meeting report on 28 March 2019.

2.2. Applicability of sectoral scopes

- 13. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology, application of sectoral scope 07 is mandatory.

3. Normative references

- 14. The methodology also refers to the latest approved version of the following methodological tools, standards and guidelines:
 - (a) "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation";
 - (b) "TOOL07: Tool to calculate the emission factor for an electricity system";

- (c) “TOOL11: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period”;
 - (d) “TOOL21: Demonstration of additionality of small-scale project activities”;
 - (e) “Standard: Sampling and surveys for CDM project activities and programme of activities”;
 - (f) “Guideline: Sampling and surveys for CDM project activities and programmes of activities”.
15. For more information regarding the approved methodologies and the tools as well as their consideration by the Executive Board (hereinafter referred to as the Board) of the clean development mechanism (CDM) please refer to <<http://cdm.unfccc.int/goto/MPappmeth>>.

4. Definitions

16. The definitions contained in the Glossary of CDM terms shall apply.
17. For the purpose of this methodology the following definitions apply:
- (a) **Baseline route** - the route driven by buses before the implementation of the project. For project activities that involve the re-design of bus routes, the baseline route is the former bus route that was replaced by the project route. For project activities that implement other measures, the baseline route is the project route itself before the implementation of the measures;
 - (b) **Bus rapid transit (BRT) system** - is a bus-based urban or sub-urban passenger transit service system that uses dedicated bus lanes as trunk routes with busways and stations- often aligned to the center of the road-, off-board fare collection, and operates at high levels of performance, especially with regard to travel times and passenger carrying capacity;
 - (c) **High-quality pavement** - a pavement with a minimum thirty-year life span that can be of asphalt, jointed plain concrete pavement (JPCP) or continuously reinforced concrete pavement (CRCP);
 - (d) **Intelligent Transportation System (ITS)** - ITS is an operational system of technologies that, when combined and managed, improve the operating capabilities of the overall system (e.g. sensors installed in buses and in roads that detect buses approaching a crossroad and gives a traffic light priority for the buses);
 - (e) **Priority lane for buses** - lanes implemented on roads for the dedicated use of buses. These lanes can operate through the day or during peak-hours only. Differently from a BRT, these lanes do not serve as trunk routes;
 - (f) **Project route** - the route driven by buses after the implementation of the project. Depending on the type of measure implemented, the project route may be longer than, equal to or shorter than the baseline route;
 - (g) **Queue jump lane** - reserved bus lanes located at intersections with a dedicated traffic light that allow buses to move before other vehicles, avoiding long queues;

- (h) **Viaduct** – a bridge that carries a road over another road or railway, in order to reduce disturbances to vehicle flow.

5. Baseline methodology

5.1. Project boundary

18. The project boundary includes the routes in which measures are implemented.
19. CO₂ emissions from the buses (fossil fuel and/or electric) that operate in the baseline and project routes are included. N₂O and CH₄ emissions are excluded from the project boundary as the amount of these emissions is considered not significant.

5.2. Baseline scenario

20. The baseline scenario is assumed to be the continued operation of the buses in the baseline route(s) without the implementation of the project activity.

5.3. Demonstration of additionality

21. The project activity is additional if it is demonstrated, through the application of “TOOL21: Demonstration of additionality of small-scale project activities”, that at least one barrier would prevent the implementation of the project.

5.4. Emission Reductions

22. Emission reductions are determined by summing the emission reductions in each project route k included in the project boundary, calculated by multiplying the number of passengers- travelling in the project route k , the average distance travelled by passengers in the project route k , a CO₂ emission factor in the project scenario and an emission reduction factor from the specific measure(s) that is(are) implemented under the project activity, as indicated in the equation below¹.

$$ER_y = \sum_k P_{k,y} \times AVD_{k,y} \times EF_{CO_2,PKM,k,y} \times ERF_k \quad \text{Equation (1)}$$

Where:

ER_y = Emission reductions in year y (tCO₂)

¹ An approach based on vehicle-kilometer (VKM) instead of PKM could also be a plausible alternative under this methodology for emission reduction calculations. This approach would exclude induced/rebound effect and the effects of other measure not implemented by the project on the occupancy rate of vehicles. An approach based on PKM is chosen here as a simplified approach, assuming a standardized emission factor corresponding to the public transportation system for new passengers that travel with the project vehicles as a result of the project activity and would otherwise use other modes of transportation. This simplified approach avoids resource intensive but more accurate methods to determine an emission factor based on avoided use of cars, taxis, two wheelers, bicycles, walking. Project participants are invited to propose viable methods based on VKM as a revision to this methodology.

$P_{k,y}$	=	Total passengers transported by the buses in the project route k in year y (passengers)
$AVD_{k,y}$	=	Average distance travelled by the passengers in the project route k in year y (km)
$EF_{CO_2,PKM,k,y}$	=	CO ₂ emission factor per passenger-kilometre of the project route k (tCO ₂ /pkm)
ERF_k	=	Emission reduction factor of the project route k (fraction)

5.4.1. Determination of ERF_k

23. ERF_k captures the savings in the fuel consumed in each route k as a result of the specific measure(s) that is(are) implemented under the project activity relative to the baseline. It is determined by comparing the energy consumed per passenger-kilometer, in the baseline route $k-BL$ ($SEC_{PKM,k-BL}$) with that in the project route k ($SEC_{PKM,k}$), as indicated in the equation below:

$$ERF_k = \frac{SEC_{PKM,k-BL}}{SEC_{PKM,k}} - 1 \quad \text{Equation (2)}$$

Where:

$SEC_{PKM,k-BL}$	=	Specific energy consumed per passenger-kilometre from the baseline route $k-BL$ that is replaced by the project route k (GJ/pkm), determined as per section 5.4.2 below.
$SEC_{PKM,k}$	=	Specific energy consumed per passenger-kilometre from the project route k (GJ/pkm), determined as per section 5.4.3 below.

24. An alternative option to calculate the parameter ERF_k is based on the relative fuel consumption savings sourced from published literature, official reports or statistics published by independent third party or studies carried out by project proponents and validated by designated operational entities (including transportation modelling). Under this alternative, the parameter ERF_k is determined based on the equation below:

$$ERF_k = \frac{F_k}{1 - F_k} \quad \text{Equation (3)}$$

F_k	=	Relative fuel consumption savings (fraction) of the route k between the baseline and the specific measure that is implemented under the project activity
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5.4.2. Determination of $SEC_{PKM,k-BL}$

25. The parameter $SEC_{PKM,k-BL}$ may be determined either using historical data or through a baseline campaign using the options as described below:

5.4.2.1. Option 1: Historical Data

26. Under this option, the specific energy consumption is calculated using the most recent three years of historical data² based on the number of passenger-kilometres transported on each baseline route k -BL, type and quantity of fossil fuels consumed by the buses travelling in each baseline route k -BL, and quantity of electricity consumed by the buses travelling on the baseline route k -BL.

$$SEC_{PKM,k-BL} = \frac{\sum_i (FC_{i,k-BL} \times NCV_i) + \frac{EC_{k-BL} \times 3.6}{(1 - TDL_{grid,BL})}}{PKM_{k-BL}} \quad \text{Equation (4)}$$

Where:

$SEC_{PKM,k-BL}$	=	Specific energy consumed per passenger-kilometer from the baseline route k -BL that is replaced by the project route k (GJ/pkm)
$FC_{i,k-BL}$	=	Total amount of fossil fuel type i consumed by the buses driving in the baseline route k -BL in the three years 2 prior to the start date of the project activity (mass or volume units)
NCV_i	=	Net calorific value of the fuel type i (GJ/mass or volume units)
PKM_{k-BL}	=	Total passenger-kilometres transported in the baseline route k -BL by both electric and fossil-fuel buses in the three years 2 prior to the start date of the project activity (passenger-kilometres)
EC_{k-BL}	=	Total electricity consumed by electric buses driving on the baseline route k -BL in the three years 2 prior to the start date of the project activity (MWh)
$TDL_{grid,BL}$	=	Average technical transmission and distribution losses for providing electricity to grid in the baseline (%)

5.4.2.2. Option 2: Baseline Campaign

27. This option shall be used only where it can be demonstrated that one full year of historical data is not available.
28. Under this option, the specific energy consumed per passenger-kilometre for the baseline route k -BL is calculated using Equation 4 above, where the parameters PKM_{k-BL} , $FC_{i,k-BL}$ and EC_{k-BL} are determined through a sampling following the latest version of the “Standard: Sampling and surveys for CDM project activities and programme of activities” and the “Guideline: Sampling and surveys for CDM project activities and programmes of activities”.
29. The baseline campaign shall be conducted through an entire week that corresponds neither to a public holiday nor school vacations, and shall be representative of the typical demand for transport services, and the fuel consumption of the baseline route k -BL in the considered year³.

² A minimum of one year of data may be used if three years of operational data are not available.

³ E.g., by taking into account road and weather conditions, traffic, as well as variations in occupancy and trip distances etc. related to e.g. school year, vacation period, weekends.

5.4.3. Determination of $SEC_{PKM,k}$

30. The parameter $SEC_{PKM,k}$ may be determined either using data measured through a project campaign or data monitored during the first year of the crediting period⁴ using the options as described below:

5.4.3.1. Option 1: Data monitored during the first year of the crediting period

31. Under this option, the parameter $SEC_{PKM,k}$ is determined using monitored data during the first year of the crediting period, covering the number of passenger transported on project route k , the average distance travelled by passengers in the project route k , type and quantity of fossil fuels consumed by the buses travelling in project route k and quantity of electricity consumed by buses travelling on the route k .

$$SEC_{PKM,k} = \frac{\sum_i (FC_{i,k,1} \times NCV_i) + \frac{EC_{k,1} \times 3.6}{(1 - TDL_{grid,1})}}{P_{k,1} \times AVD_{k,1}} \quad \text{Equation (5)}$$

Where:

$FC_{i,k,1}$	=	Total amount of fossil fuel type i consumed by the buses driving in the project route k during the first year of the crediting period (mass or volume units)
NCV_i	=	Net calorific value of the fuel type i (GJ/mass or volume units)
$P_{k,1}$	=	Total passenger transported in the project route k by both electric and fossil-fuel buses during the first year of the crediting period (passenger)
$AVD_{k,1}$	=	Average distance travelled by passengers in project route k during the first year of the crediting period (km)
$EC_{k,1}$	=	Total electricity consumed by electric buses driving on the project route k during the first year of the crediting period (MWh)
$TDL_{grid,1}$	=	Average technical transmission and distribution losses for providing electricity to grid during the first year of the crediting period (%)

5.4.3.2. Option 2: Project Campaign

32. This option shall be used only if one full year of relevant project data is not available because of concomitant replacement of the existing bus fleet with more efficient or higher capacity vehicles⁵.
33. Under this option, the specific energy consumed per passenger-kilometre for the baseline route k is calculated using Equation 5 above, where the parameters $P_{k,1}$, $AVD_{k,1}$, $FC_{i,k,1}$ and $EC_{m,k,1}$ are determined through a project campaign that shall be conducted through an entire week that corresponds neither to a public holiday nor school vacations, and shall

⁴ A one year period is sufficient to absorb the increase in the passenger demand resulted from the implementation of the project activity.

⁵ This requirement prevents that other measures not included by the methodology affect the calculation of emission reductions (e.g. the replacement of fleet by more efficient or higher capacity vehicles reduces the value of $SEC_{PKM,k}$, which results in an increase in the ERF_k and, consequently, in an increase in the final calculation of emission reductions).

be representative of the typical demand for transport services, and the fuel consumption of the project route k during the first year of the crediting period.³

5.4.4. Determination of $EF_{CO2,PKM,k,y}$

34. The parameter $EF_{CO2,PKM,k,y}$ is determined for every year of the crediting period, using monitored data of the number of passengers transported on each project route k , type and quantity of fossil fuels consumed by the buses travelling in each project route k , and quantity of electricity consumed by the buses travelling on the project route k , and survey results of average distance travelled by passengers (conducted in years 1 and 4 of the crediting period).

$$EF_{CO2,PKM,k,y} = \frac{\sum_i (FC_{i,k,y} \times NCV_i \times EF_{CO2,i}) + \frac{EC_{k,y} \times EF_{grid,CO2}}{(1 - TDL_{grid,y})}}{P_{k,y} \times AVD_{k,y}} \quad \text{Equation (6)}$$

Where:

$FC_{i,k,y}$	=	Total amount of fossil fuel type i consumed by the buses driving in the project route k in year y (mass or volume units)
NCV_i	=	Net calorific value of the fuel type i (GJ/mass or volume units)
$P_{k,y}$	=	Total passenger transported in the project route k by both electric and fossil-fuel buses in year y (passenger)
$AVD_{k,y}$	=	Average distance travelled by the passengers in the project route k in year y (km). Determined through surveys conducted in years 1 and 4 of the crediting period
$EC_{k,y}$	=	Total electricity consumed by electric buses driving on the project route k in year y (MWh)
$TDL_{grid,y}$	=	Average technical transmission and distribution losses for providing electricity to grid in the baseline in year y (%)

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

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

5.6. Data and parameters not monitored

36. In addition to the parameters listed in the tables below, the provisions on data and parameters not monitored in the tools referred to in this methodology apply.

Data / Parameter table 1.

Data / Parameter:	F_k
Data unit:	Fraction
Description:	Relative fuel consumption savings (fraction) the route k between the baseline and the specific measure(s) that is(are) implemented under the project activity
Source of data:	Published literature, official reports or statistics published by independent third party or studies carried out by project proponents (including transportation modelling) and validated by designated operational entities
Measurement procedures (if any):	N/A
Any comment:	This factor shall remain fixed for the entire project lifetime.

Data / Parameter table 2.

Data / Parameter:	$FC_{i,k-BL}$
Data unit:	Mass or volume units.
Description:	Total amount of fossil fuel type i consumed by the buses driving on the baseline route $k-BL$ in the three years ² prior to the start date of the project activity.
Source of data:	If Option 1 - Historical Data is selected, the data shall be the total fuel consumed prior to the start date of the project activity (3 years or minimum of 1 year) and shall be sourced from official statistics or from the bus operator. If Option 2 - Baseline Campaign is selected the data sourced shall be the total fuel consumed during the campaign.
Measurement procedures (if any):	If Option 2 - Baseline Campaign is selected, the latest version of the "Standard: Sampling and surveys for CDM project activities and programme of activities" and the "Guideline: Sampling and surveys for CDM project activities and programmes of activities" shall be followed.
Any comment:	The information shall be cross-checked against fuel purchase receipts.

Data / Parameter table 3.

Data / Parameter:	EC_{k-BL}
Data unit:	MWh
Description:	Total electricity consumed by the electric buses driving in the baseline route $k-BL$ in the three years ² prior to the start date of the project activity.
Source of data:	If Option 1 - Historical Data is selected, the data shall be the total electricity consumed prior to the start date of the project activity (3 years or minimum of 1 year) and shall be sourced from official statistics or from the bus operator. If Option 2 – Baseline Campaign is selected the data sourced shall be the total electricity consumed during the campaign.

Measurement procedures (if any):	If Option 2 – Baseline Campaign is selected, the latest version of the “Standard: Sampling and surveys for CDM project activities and programme of activities” and the “Guideline: Sampling and surveys for CDM project activities and programmes of activities” shall be followed.
Any comment:	The data source are electric charging records of the electricity charging station. The information shall be cross-checked against specific electricity consumption and distance travelled or against invoices from electricity charging station.

Data / Parameter table 4.

Data / Parameter:	PKM_{k-BL}
Data unit:	Passenger-kilometres.
Description:	Total passenger-kilometres transported in the baseline route $k-BL$ by both electric and fossil-fuel buses in in the three years ² prior to the start date of the project activity.
Source of data:	If Option 1 – Historical Data is selected, the data shall be the total number of passenger-kilometres travelling in the baseline route prior to the start date of the project activity (3 years or minimum of 1 year) and shall be sourced from official statistics or from the bus operator. If Option 2 – Baseline Campaign is selected the data sourced shall be the total passengers-kilometres transported during the campaign.
Measurement procedures (if any):	If Option 2 – Baseline Campaign is selected, the latest version of the “Standard: Sampling and surveys for CDM project activities and programme of activities” and the “Guideline: Sampling and surveys for CDM project activities and programmes of activities” shall be followed.
Any comment:	The information shall be cross-checked against electronic ticketing system or other official record. An alternative to determine this parameter based on historical data is by multiplying the number of passengers transported on both electric and fossil-fuel busses by the average distance travelled by each passenger. The passengers transported and the average distance travelled shall be determined based on electronic ticketing system or other official records or statistics.

Data / Parameter table 5.

Data / Parameter:	$TDL_{grid,BL}$
Data unit:	%
Description:	Average technical transmission and distribution losses for providing electricity to grid in the baseline (%)
Source of data:	As per “TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”.
Measurement procedures (if any):	As per “TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”.
Any comment:	-

6. Monitoring Methodology

37. In addition to the parameters listed in the tables below, the provisions on data and parameters monitored in the tools referred to in this methodology apply.

Data / Parameter table 1.

Data / Parameter:	$P_{k,y}$
Data unit:	Passengers
Description:	Total passengers transported in the project route k in year y .
Source of data:	Project system operator, based on electronic ticketing system or any other official records.
Measurement procedures (if any):	
Monitoring frequency:	Measured at the entry point of passengers on the buses travelling on the project route k . Data to be consolidated annually.
QA/QC procedures:	-
Any comment:	If this parameter is determined based on sampling, the latest version of the "Standard: Sampling and surveys for CDM project activities and programme of activities" and the "Guideline: Sampling and surveys for CDM project activities and programmes of activities" shall be followed.

Data / Parameter table 2.

Data / Parameter:	$P_{k,1}$
Data unit:	Passengers
Description:	Total passengers transported in the project route k by both electric and fossil-fuel buses during the first of the crediting period
Source of data:	Project system operator, based on electronic ticketing system or any other official records.
Measurement procedures (if any):	
Monitoring frequency:	Measured at the entry point of passengers on the buses travelling on the project route k . Data to be consolidated annually.
QA/QC procedures:	-
Any comment:	If $SEC_{PKM,k}$ is determined based on item 5.4.3.2, $P_{k,1}$ shall represent the total passengers transported during the campaign.

Data / Parameter table 3.

Data / Parameter:	$AVD_{k,y}$
Data unit:	km
Description:	Average distance travelled by passengers in the project route k in year y .
Source of data:	Survey.

Measurement procedures (if any):	Survey of the project passengers in year 1 and 4 of the first crediting period to determine the entry and exit bus stops on the project routes k through face-to-face interviews or by using other appropriate survey modes (e.g. using GPS data).
Monitoring frequency:	Year 1 and Year 4 of the crediting period.
QA/QC procedures:	-
Any comment:	

Data / Parameter table 4.

Data / Parameter:	$AVD_{k,1}$
Data unit:	km
Description:	Average distance travelled by passengers in project route k during the first year of the crediting period
Source of data:	Survey.
Measurement procedures (if any):	<p>If $SEC_{PKM,k}$ is calculated based on item 5.4.3.1, $AVD_{k,1}$ is determined using survey of the project passengers in year 1 of the first crediting period to determine the entry and exit bus stops on the project routes k through face-to-face interviews or by using other appropriate survey modes (e.g. using GPS data).</p> <p>If $SEC_{PKM,k}$ is calculated based on item 5.4.3.2, it is determined through a project campaign conducted through a representative sampling for an entire week.</p>
Monitoring frequency:	Year 1.
QA/QC procedures:	-
Any comment:	

Data / Parameter table 5.

Data / Parameter:	$FC_{i,k,y}$
Data unit:	Mass or volume units of fuel
Description:	Total amount of fossil fuel type i consumed by the buses driving in the project route k in year y
Source of data:	Operator of the bus
Measurement procedures (if any):	Based on fuelling station reports.
Monitoring frequency:	Measured when the buses are refuelling the tank.
QA/QC procedures:	The amount of fuel consumed shall be cross-checked against purchase receipts.
Any comment:	-

Data / Parameter table 6.

Data / Parameter:	$FC_{i,k,1}$
Data unit:	Mass or volume units of fuel
Description:	Total amount of fossil fuel type i consumed by the buses driving in the project route k during the first year of the crediting period
Source of data:	Operator of the bus
Measurement procedures (if any):	Based on fuelling station reports.
Monitoring frequency:	Measured when the buses are refuelling the tank.
QA/QC procedures:	The amount of fuel consumed shall be cross-checked against purchase receipts.
Any comment:	If $SEC_{PKM,k}$ is determined based on item 5.4.3.2, $FC_{i,k,1}$ shall represent the total fuel consumed during the campaign.

Data / Parameter table 7.

Data / Parameter:	NCV_i
Data unit:	GJ/mass or volume units
Description:	Net calorific value of the fuel type i
Source of data:	In order of preference: (a) Provided in invoices from the fuel supplier; (b) Measured using a sample of fuel stations, if (a) is not available; (c) Regional or national default values, if (a) is not available and only applicable for liquid fuels; (d) IPCC default values ⁶
Measurement procedures (if any):	For (a) and (b): measurements shall be undertaken in line with national or international fuel standards.
Monitoring frequency:	For (a) and (b): the NCV shall be obtained for each fuel delivery, from which weighted average annual values shall be calculated. For (c): review the appropriateness of the values annually. For (d): any future revision of the IPCC Guidelines shall be taken into account
QA/QC procedures:	Verify if the values under (a), (b) and (c) 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), (b) or (c) shall have ISO17025 accreditation or justify that they can comply with similar quality standards.
Any comment:	-

⁶ Use the lower bound of the 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.

Data / Parameter table 8.

Data / Parameter:	$EF_{CO_2,i}$
Data unit:	tCO ₂ /GJ
Description:	CO ₂ emission factor of the fuel type <i>i</i>
Source of data:	In order of preference: (a) Provided in invoices from the fuel supplier; (b) Measured using a sample of fuel stations, if (a) is not available; (c) Regional or national default values, if (a) is not available and only applicable for liquid fuels; (d) IPCC default values ⁷
Measurement procedures (if any):	For (a) and (b): measurements shall be undertaken in line with national or international fuel standards. For (a): if fuel suppliers provide the NCV value and the CO ₂ emission factor on the invoices and these two values are based on measurements for this specific fuel, this CO ₂ factor shall be used. If another source for the CO ₂ emission factor is used or no CO ₂ emission factor is provided, options (b), (c) or (d) shall be used.
Monitoring frequency:	For (a) and (b): the CO ₂ emission factor shall be obtained for each fuel delivery, from which weighted average annual values shall be calculated. For (c): review the appropriateness of the values annually. For (d): any future revision of the IPCC Guidelines shall be taken into account.
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 9.

Data / Parameter:	$EC_{k,y}$
Data unit:	kWh
Description:	Total amount of electricity consumed by the electric buses driving in the project route <i>k</i> in year <i>y</i>
Source of data:	Electric charging records at the electricity charging station
Measurement procedures (if any):	As per the latest version of "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation". When applying the tool, requirements for $EC_{PJ,grid,y}$ specified in the tool shall apply to electricity consumed from the grid.
Monitoring frequency:	Measured when the buses are recharged.
QA/QC procedures:	As per "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"

⁷ Use the lower bound of the 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.

Any comment:	<p>The data source are the electric charging records of the electricity charging station.</p> <p>The information shall be cross-checked against specific electricity consumption and distance travelled or against invoices from electricity charging station.</p>
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Data / Parameter table 10.

Data / Parameter:	$EC_{k,1}$
Data unit:	kWh
Description:	Total electricity consumed by electric buses driving on the project route k during the first year of the crediting period
Source of data:	Electric charging records at the electricity charging station
Measurement procedures (if any):	<p>As per the latest version of "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".</p> <p>When applying the tool, requirements for $EC_{PJ,grid,y}$ specified in the tool shall apply to electricity consumed from the grid.</p>
Monitoring frequency:	Measured when the buses are recharged.
QA/QC procedures:	As per "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"
Any comment:	<p>The data source are the electric charging records of the electricity charging station.</p> <p>The information shall be cross-checked against specific electricity consumption and distance travelled or against invoices from electricity charging station.</p> <p>If $SEC_{PKM,k}$ is determined based on item 5.4.3.2, $EC_{k,1}$ shall represent the total electricity consumed during the campaign.</p>

Data / Parameter table 11.

Data / Parameter:	$EF_{grid,CO2}$
Data unit:	tCO2e/MWh
Description:	CO ₂ emission factor of the electric grid that supplies electricity to the electric bus m
Source of data:	Determined following the steps from the "TOOL07: Tool to calculate the emission factor for an electricity system".
Measurement procedures (if any):	As per the "TOOL07: Tool to calculate the emission factor for an electricity system".
QA/QC procedures:	As per the "TOOL07: Tool to calculate the emission factor for an electricity system".
Any comment:	Applicable if the monitoring option selected is ex-post.

Data / Parameter table 12.

Data / Parameter:	$TDL_{grid,y}$, $TDL_{grid,1}$
Data unit:	%
Description:	$TDL_{grid,y}$: Average technical transmission and distribution losses for providing electricity to the grid in year y . $TDL_{grid,1}$: Average technical transmission and distribution losses for providing electricity to grid during the first year of the crediting period
Source of data:	As per "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".
Measurement procedures (if any):	As per "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".
Monitoring frequency:	As per "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".
QA/QC procedures:	As per "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".
Any comment:	-

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