CLEAN DEVELOPMENT MECHANISM

CDM-MP63-A03

Draft Methodological tool

Baseline emissions for modal shift measures in urban passenger transport

Version 01.0

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP), at its sixth session, decided that Parties, project participants, as well as international industry organizations or admitted observer organizations through the host country's designated national authority (DNA), may submit proposals for standardized baselines applicable to new or existing methodologies, for consideration by the Executive Board (hereinafter referred to as the Board) of the clean development mechanism (CDM).

2. In this context, the Board, at its sixty-second meeting, adopted the "Guidelines for the establishment of sector specific standardized baselines" (the SB guidelines) and at its sixty-fifth meeting, agreed to the "Work programme on standardized baselines" that included the element of expanding the SB guidelines to CDM projects in the transport sector.

3. In response to the mandate given by the Board to the secretariat on the expansion of the SB guidelines to CDM projects in the transport sector, the secretariat: (i) conducted an elaborate analysis of approaches to standardization of baseline setting in the transport sector; (ii) hired a consultant and scrutinized the report developed by the consultant; (iii) and conducted consultations on the report and approaches to standardization with external experts, the Methodologies Panel (Meth Panel) and the Small-Scale Working Group (SSC WG). After an elaborate analysis and extensive consultations, the secretariat came to the conclusion that there are fundamental limits to the standardization of baseline setting in the transport sector and described these challenges in a concept note presented to the Board at its sixty-ninth meeting.

4. At its sixty-ninth meeting, the Board considered the concept note on the challenges and options for work on the development of guidelines on standardized baselines for the transport sector, provided feedback and requested the secretariat to submit a concept note for the Board's consideration at a future meeting, with a detailed analysis of the following elements:

   (a) Background information and rationale for the key challenges for the standardized baselines for transport sector projects, as presented in the concept note as per annex 12 to the annotated agenda of the sixty-ninth meeting of the Board;

   (b) Rationale for the options suggested on standardization and scaling-up of CDM in the transport sector;

   (c) Benefits of and efforts required for the options suggested.

5. At its seventy-second meeting, the Board considered a concept note on the challenges and opportunities for standardization and simplification in the context of the transport sector and requested the secretariat to develop guidelines on standardized baselines for the transport sector covering standardization at the following levels:

(a) Standardized parameters or approaches that are country-specific or region-specific;

(b) The development of the draft guidelines should be done in consultation with the Meth Panel and the SSC WG, for consideration of the Board at its seventy-fifth meeting.

6. The Board also requested the Meth Panel to develop, where suitable, standardized parameters or approaches that can be applied at the global level in the form of a methodological tool, for the Board's consideration at its seventy-fifth meeting. These tasks were included in the approved work plan of the Board for 2013 which contained the product "Development and implementation of the guideline on standardized baselines for transportation projects" under project 110 on standardized baselines.

7. At its seventy-fifth meeting, the Board considered the draft guideline "Establishment of standardized baselines in the transport sector" and agreed that the document should be a methodological tool to ensure its immediate use by project participants and other stakeholders in the development of standardized baselines. The Board requested the Meth Panel to revise the draft, taking into account the inputs provided by the Board, for the consideration of the Board at a future meeting.

8. At its sixty-second meeting, the Methodologies Panel agreed on the draft tool and decided to launch a call for public inputs. There were no public inputs received in response to the call. At its sixty-third meeting, the Methodology Panel agreed to recommend this tool to the Board for approval.

2. Purpose

9. The purpose is to propose a new regulatory document to regulate a new area: a methodological tool that provides methodological approaches for estimating baseline emissions for modal shift measures in urban passenger transport. The tool can be used by both, DNAs to establish standardized baselines to be used by a number of project activities, and project participants to estimate baseline emissions for individual project activities.

3. Key issues and proposed solutions

10. Not applicable.

4. Impacts

11. The draft tool provides methodological approaches to estimate baseline emissions for modal shift in passenger transport that, according to international literature, offer the largest mitigation potential.

5. Subsequent work and timelines

12. The draft methodological tool is recommended by the Methodologies Panel to be considered by the Board at its seventy-ninth meeting. No further work is envisaged.

6. Recommendations to the Board

13. The Methodologies Panel recommends that the Board approve the draft methodological tool.

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1. Introduction

1. The tool provides methodological guidance to estimate baseline emissions for transport projects implementing modal shift measures in urban passenger transport.

2. Scope, applicability, and entry into force

2.1. Scope

2. This tool includes approaches for estimating baseline emissions for project activities that implement modal shift measures in urban passenger transport.

2.2. Applicability

3. The tool is applicable to project activities in urban passenger transport that implement a measure or a group of measures aimed at a modal shift to urban public transit such as metro, bus rapid transit (BRT), light rail and trams.[1]

4. This tool can be used by designated national authorities (DNAs) for establishing standardized baselines. The tool is also applicable for estimating baseline emissions for individual CDM project activities.

2.3. Entry into force

5. The date of entry into force of the tool is the date of the publication of the EB 79 meeting report on 1 June 2014.

3. Normative references

6. When the tool is used for establishing standardized baselines, relevant provisions from the latest approved versions of the following documents shall be applied:

   (a) "Guidelines for quality assurance and quality control of data used in the establishment of standardized baselines";

   (b) "Procedure for development, revision, clarification and update of standardized baselines";

   (c) "Standard for data coverage and validity of standardized baselines";

   (d) "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

4. Definitions

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

8. For the purpose of this tool, the following definitions apply:

[1] DNAs, project participants and other stakeholders may propose revisions that further expand the applicability of the tool to include other approaches and measures.

(a) **Measure (for emission reduction activities)** - a broad class of greenhouse gas (GHG) emission reduction activities possessing common features e.g. modal shift, fuel switch or energy efficiency improvement;

(b) **Level of aggregation** - the level of aggregation and geographical scope is linked to the type of measure implemented. For modal shift in urban passenger transport, only modes operating in an urban context need to be taken into account when the respective baseline emissions are estimated;

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

(d) **Bus lane (or trunk route)** - a segregated lane where only buses are allowed to operate. Private vehicles are not allowed to use the bus lane. Exceptions, such as for emergency vehicles, can apply. Bus lanes need not necessarily be physically separated from other traffic lanes. If no physical separation is put in place, then it must be ensured that enforcement takes place to prevent the use of the bus lane by other vehicles. It is not a requirement that 100 per cent of the route is a bus-only lane as buses might share part of the lanes with other modes of transport, for example at traffic crossings, bridges, tunnels, in narrow parts or on roads with limited traffic, for example in suburban parts of the city. However, to qualify as a bus lane, more than half of the included bus route must be a bus-only lane.

5. Methodological steps to establish the baseline

9. Baseline emissions from urban passenger transport are calculated based on the number of passengers transported under a project activity and the average emission factor per baseline mode of transport, from which project passengers shifted.

5.1. Step 1. Determine relevant vehicle categories

10. 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.

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

11. 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.

12. Estimating emission factor per kilometre based on the fraction of vehicles using a specific fuel type, the consumption of each fuel type and CO_2eq emissions per unit of fuel consumed:

$$EF_{KM,i,x} = \left[\sum_{n} [SFC_{i,n,x} \times NCV_{i,n} \times EF_{CO2,n} + SEC_{i,x} \times EF_{CO2,x}] \times \frac{N_{i,n,x}}{N_{i,x}}\right] \quad \text{Equation (1)}$$

Where:

$EF_{KM,i,x}$	=	Emission factor per kilometre of vehicle category *i* in year *x* (g CO_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-kilometres vehicle category *i* using fuel type *n*[2] driven in year *x* (VKM) or number of vehicles in vehicle category *i* using fuel type *n*[3] in year *x* (units)
n	=	Fuel types used by vehicle category *i* in year *x*
i	=	Road-based vehicle categories (passenger car (C), bus (B), motorcycle (M), etc.
x	=	Most recent calendar year for which data is available. Data not older than three years

13. Note 1: for taxis, personal cars and motorcycles, instead of estimating the emission factor $EF_{KM,i,x}$ a default emission factor for new vehicles can be obtained from the source provided in the table in section “Data and Parameters not monitored”.

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

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

14. Note 2: instead of the two parameters $N_{i,n,x}$ and $N_{i,x}$, it is possible to use one parameter $N_{i,n,x}/N_{i,x}$ 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 "Data and parameters" section for further guidance on data requirements). This is the preferred option;

    (b) **Approach 2.** In case data on vehicle-kilometres 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.

5.3. Step 3. Determine the emission factor per passenger-kilometre

15. The emission factors per passenger kilometre (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:

$$EF_{PKM,i,x} = \frac{TE_{EL,i,x}}{P_{EL,i,x} \times D_{EL,i,x}} \times 10^6 \qquad \text{Equation (2)}$$

Where:

$EF_{PKM,i,x}$	=	Emission factor per passenger-kilometre 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)
$D_{EL,i,x}$	=	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

16. The total emissions $TE_{EL,i,x}$ 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 $TE_{EL,i,x}$ corresponds to parameter $BE_{EC,y}$ in the tool. When applying this tool, parameter $EC_{BL,k,y}$ 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 $P_{EL,i,x}$ passengers along the average distance $D_{EL,i.x}$.[4] Parameter $EF_{CO2,x}$ should be used

[4] 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.

instead of parameter $EF_{EL,k,y}$ in the above referred tool, that is monitored according to monitoring requirements stipulated in the monitoring table below.

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

$$EF_{PKM,i,x} = \frac{EF_{KM,i,x}}{OC_{i,x}} \quad \text{Equation (3)}$$

Where:

$EF_{PKM,i,x}$	=	Emission factor per passenger-kilometre of vehicle category *i* in year *x* (g CO_2/PKM)
$EF_{KM,i,x}$	=	Emission factor per kilometre 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))
x	=	Most recent calendar year for which data is available. Data not older than three years

5.4. Step 4. Determine baseline emissions

18. **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:

$$BE_y = \left(\sum_i (IR_i)^{t+y-1} \times EF_{PKM,i,x} \times D_i \times S_i \right) \times P_y \times 10^{-6} \quad \text{Equation (4)}$$

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2eq)
IR_i	=	Technology improvement factor[5] 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

[5] 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.

$EF_{PKM,i,x}$	=	Emission factor per passenger-kilometre 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) or rail based urban transit (R)
y	=	Crediting year when emissions reductions are estimated

19. The share of passengers S_i (%) 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 $D_{i,y}$ 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).

20. 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 $D_{i,y}$ (ii) the vehicle category from which each surveyed passenger had shifted to determine the share of passengers S_i (%) 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.

21. The total number of passengers shall be monitored annually, which when multiplied by the shares of passengers S_i (%) who have shifted from electricity-based or road-based vehicle categories, respective trip distances on these vehicle categories $D_{i,y}$ and emission factors per passenger-kilometre $EF_{PKM,i,x}$ are used in equation (4) to calculate baseline emissions.

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

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

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2eq)
IR_i	=	Technology improvement factor[6] 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 for determine baseline emissions of CDM project
$EF_{PKM,i,x}$	=	Emission factor per passenger-kilometre for electricity-based or road-based vehicle category *i* in year *x* (g CO_2eq/PKM)
PD_y	=	Number of passenger-kilometres travelled by the project system in year *y* (PKM)
SD_i	=	Share of passenger-kilometres who shifted from electricity-based or road-based vehicle category *i* (%)
i	=	Vehicle categories (such as passenger car (C), bus (B), motorcycle (M) or rail based urban transit (R)
y	=	Crediting year when emissions reductions are estimated

23. The share of passenger-kilometres SD_i (%) 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).

24. 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 SD_i (%) 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.

25. The total number of passenger-kilometers shall be monitored annually, which when multiplied by the shares of passengers SD_i (%) who have shifted from electricity-based or road-based vehicle categories, and emission factors per passenger-kilometre $EF_{PKM,i,x}$ are used in equation (4) to calculate baseline emissions.

[6] 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.

6. Data and parameters

6.1. Data and parameters not monitored

Data / Parameter table 1.

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
Measurement procedures (if any):	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 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 default values (See table below). **Table 1 Specific fuel consumption for vehicle category** **Specific fuel consumption** / **Value** / **Unit** Gasoline car (personal car and taxi) / 6 / l/100 km Diesel car (personal car and taxi)) / 5 / l/100 km Motorcycle / 2 / l/100 km
Any comment:	-

Data / Parameter table 2.

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 2 below)

Measurement procedures (if any):	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 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. (See table 2 below). **Table 2. Specific electricity consumption for vehicle category** **Specific fuel consumption** | **Value** | **Unit** Electric vehicles | 0.12 | kWh/km
Any comment:	-

Data / Parameter table 3.

Data / Parameter:	**$N_{i,x}$**
Data unit:	VKM or units
Description:	Number of vehicle-kilometers of category *i* driven in year *x* or number of vehicles of category *i* 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

Measurement procedures (if any):	-
Any comment:	Used for all vehicle categories identified as relevant. 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 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 on informal transport. For electrical vehicles fuel type *n* represents electricity

Data / Parameter table 4.

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
Measurement procedures (if any):	-
Any comment:	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

Data / Parameter table 5.

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
Measurement procedures (if any):	For buses it should be based on urban units as urban buses often use a different fuel type than inter-urban units
Any comment:	Used for all relevant vehicle categories

Data / Parameter table 6.

<table>
<tr><td>Data / Parameter:</td><td>$NCV_{i,n}$</td></tr>
<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>The following data sources may be used if the relevant conditions apply:
Table 3. Data sources and conditions for their usage
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>(a) National default values</td><td>This source can only be 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 Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td></td></tr>
</table></td></tr>
<tr><td>Measurement procedures (if any):</td><td>-</td></tr>
<tr><td>Monitoring frequency:</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>QA/QC procedures:</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>Any comment:</td><td>Vehicle owners or operators can buy fuel from a variety of sources (fuel stations). Therefore, in practice it is considered to be simpler to determine the parameter using options (a) or (b)</td></tr>
</table>

Data / Parameter table 7.

Data / Parameter:	**IR_i**
Data unit:	-
Description:	Technology improvement factor for vehicle category *i* per year
Source of data:	-
Measurement procedures (if any):	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; When the tool is used for estimating emission for standardized baselines, the technology improvement factor is 1 for the first validity period of standardized baseline. However for subsequent years improvement factor shall be calculated based on historical trend of at least three years
Any comment:	According to current requirements, standardized baselines need to be updated after its validity expires. The validity of standardized baseline is based on criteria established in the latest approved standard for coverage of data and validity of standardized baseline. For the application during the validity period of standardized baseline from the second version of the standardized baseline, technology improvement factor shall be calculated based on historical trend (minimum three years) of country specific data and used in calculations instead of the technology improvement factor of 1

Data / Parameter table 8.

<table>
<tr><td>Data / Parameter:</td><td>$OC_{i,x}$ or $OC_{B,x}/OC_{T,x}/OC_{C,x}/OC_{MR,x}$</td></tr>
<tr><td>Data unit:</td><td>Passengers</td></tr>
<tr><td>Description:</td><td>Average occupancy rate of vehicle category i in year x (e.g.,buses (B), taxis (T), passenger cars (C), motorized rickshaws (MR)</td></tr>
<tr><td>Source of data:</td><td>Option 1.Municipal transit authorities or specific studies. Vintage maximum three years.
Option 2. The following default values can be applied:

Table 4. Average occupancy as per vehicle type
<table>
<tr><td></td><td colspan="2">Average occupancy</td><td></td></tr>
<tr><td></td><td>World</td><td>South Asia</td><td>Unit</td></tr>
<tr><td>Car</td><td colspan="2">2</td><td>Person (including the driver)</td></tr>
<tr><td>Taxi</td><td colspan="2">1.1</td><td>Person (excluding the driver)</td></tr>
<tr><td>Motorcycle</td><td colspan="2">1.5</td><td>Person (including the 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>Measurement procedures (if any):</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>Any comment:</td><td>-</td></tr>
</table>

Data / Parameter table 9.

<table>
<tr><td>Data / Parameter:</td><td>$EF_{CO2,n}$</td></tr>
<tr><td>Data unit:</td><td>g CO_2/J</td></tr>
<tr><td>Description:</td><td>Emission factor for fuel type n</td></tr>
<tr><td>Source of data:</td><td>The following data sources may be used, if the relevant conditions apply:

Table 5. Data sources and conditions for their usage
<table>
<tr><th>Data source</th><th>Conditions for using the data</th></tr>
<tr><td>(a) National default values</td><td>This source can only be 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 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td></td></tr>
</table>

Note: In case biofuels or biofuel blends are used, the CO_2 emission factor for the share of biofuels used as pure or in blends is equal to zero</td></tr>
<tr><td>Measurement procedures (if any):</td><td>-</td></tr>
<tr><td>Monitoring frequency:</td><td>For (a): review the appropriateness of the values annually.
For (b): Latest available IPCC Guidelines should be taken into account</td></tr>
<tr><td>QA/QC procedures:</td><td>-</td></tr>
<tr><td>Any comment:</td><td>-</td></tr>
</table>

Data / Parameter table 10.

Data / Parameter:	**$EF_{CO2,x}$**
Data unit:	g CO2/kWh
Description:	Emission factor for electricity in year *x* (g CO_2/kWh)

Source of data:	Procedures in the latest approved version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" shall be followed
Measurement procedures (if any):	"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" shall be applied
Any comment:	-

Data / Parameter table 11.

Data / Parameter:	**$EF_{KM,i,x}$**
Data unit:	g CO_2/km
Description:	Emission factor per kilometre of vehicle category *i* in year *x* (g CO_2/km)
Source of data:	Emission factor for new vehicles
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	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 12

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. Data should be maximum three years old.-
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 13.

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.
Measurement procedures (if any):	-
Any comment:	-

6.2. Data and parameters monitored

Data / Parameter table 14.

Data / Parameter:	**D_i**
Data unit:	kilometres
Description:	Average trip distance travelled by passengers who shifted from electricity-based or road-based vehicle category *i*
Source of data:	Survey
Measurement procedures (if any):	Survey of the project passengers in year 1 and 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 (S_i)
Any comment:	-

Data / Parameter table 15.

Data / Parameter:	**S_i**
Data unit:	%
Description:	Share of passengers who shifted from shifted from electricity-based or road-based vehicle category *i*
Source of data:	Survey
Measurement procedures (if any):	Survey of the project passengers in year 1 and 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 ($D_{i,y}$). 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
Any comment:	-

Data / Parameter table 16.

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
Measurement procedures (if any):	Survey of the project passengers in year 1 and 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 SD_i (%) 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
Any comment:	-

Data / Parameter table 17.

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
Measurement procedures (if any):	Monitored annually
Any comment:	-

Data / Parameter table 18.

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.
Measurement procedures (if any):	Estimated annually. Can be estimated by transport operators based on surveys, occupancy rates at different points in the network.
Any comment:	-

Appendix. Key parameters for calculation of baseline emissions in urban passenger transport

Table 1. List of key parameters used for calculation of baseline emissions in urban passenger transport

Parameter	Level of aggregation and data sources
Relevant vehicle category	City level
Specific fuel consumption	1. City (local measurements); 2. National defaults; 3. International defaults (IPCC); 4. Design data for relevant vehicle categories
Net calorific value	1. National defaults; 2. International defaults (IPCC)
Fuel emission factor	1. National defaults; 2. International defaults(IPCC)
Emission factor	Emission factor for new cars (depending on the market to which the country is exposed, US, EU, Japanese, domestic car industry values can be used). This parameter can be used instead of specific fuel consumption, net calorific value and fuel emission factor, if the value in g CO_2/km is available
Occupancy rates of relevant vehicle modes	City level For motorcycles, cars, taxis: 1. Globally applicable default; 2. DNAs can conduct a survey to set a default at the country level; 3. DNAs can use available information in national statistics/studies to set a default at the country level. For public transport (bus, light rail, tram, metro, etc.) 1. Survey in the city; 2. Survey in multiple cities. Cities in the country should be grouped in categories of similar cities (population size and density, etc.). If there is no big variation within the group of cities, surveyed data on occupancy can be used to set defaults for occupancy for other cities in the same group of cities
Total number of passengers of the project system	City – project system. Data obtained by project participants (PPs), not DNAs

Parameter	Level of aggregation and data sources
% of people shifted from a specific mode	City – project system. Data obtained by PPs, not DNAs. Survey conducted once when the system is established (one year after its implementation)
Distance travelled on each relevant vehicle mode	City – project system. Data obtained by PPs, not DNAs. Survey to ask about entry/exit point in the project BRT and the mode from which the passenger shifted

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Document information

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