CLEAN DEVELOPMENT MECHANISM

**CDM-SSCWG48-A08**

# Draft Small-scale Methodology

# AMS-III.U: Cable Cars for Mass Rapid Transit System (MRTS)

Version 02.0

Sectoral scope(s): 07



United Nations
Framework Convention on
Climate Change

# COVER NOTE

## 1. Procedural background

1. The Executive Board of clean development mechanism (CDM) (hereinafter referred as the Board) at sixty-eighth meeting mentioned that approved methodologies are eligible for application in a programme of activities (PoA) irrespective of whether it includes guidance on how to translate the relevant requirements into eligibility criteria.

2. The small-scale working group (SSC WG) has previously reviewed PoA requirement in all Type *i* and Type II small-scale methodologies and noted that all these methodologies are applicable for PoA.

3. To continue working on this mandate the SSC WG analysed Type-III small-scale methodologies and noted that further guidance on application for PoA is required in the few Type-III small-scale methodologies.

## 2. Purpose

4. The draft revision to this methodology is proposed under the on-going work by the SSC WG in addressing the Board's guidance to make all methodologies applicable to PoAs.

## 3. Key issues and proposed solutions

5. The SSC WG noted that the issues related to leakage estimation were already addressed under the leakage section of the methodology and thus further guidance is not required in case application of this methodology for PoA. The section providing guidance on PoA application is revised accordingly.

6. The revised draft of the methodology also consists of changes due to transferring the methodology into new methodology template and also addresses consistency issues.

## 4. Impacts

7. The revision to this methodology will enhance its usability for PoAs.

## 5. Subsequent work and timelines

8. The methodology is recommended by the SSC WG for consideration by the Board at its eighty-fifth meeting. No further work is envisaged.

## 6. Recommendations to the Board

9. The SSC WG recommends that the Board adopt this methodology, to be made effective at the time of the Board's approval.

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# 1. Introduction

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

**Table 1. Methodology key elements**

| | |
|---|---|
| **Typical project(s)** | Construction and operation of cable cars for urban transport of passengers substituting traditional road-based transport trips. Extensions of existing cable cars are not allowed. |
| **Type of GHG emissions mitigation action** | • Energy efficiency;<br>• Fuel switch:<br>Displacement of more-GHG-intensive vehicles |

# 2. Scope, applicability, and entry into force

## 2.1. Scope

2. This category comprises cable cars substituting traditional road-based transport trips.

3. The calculation of baseline and project emissions is based on total emissions from trip origin (O) to trip destination (D) using distinctive modes of transport[1,2].

## 2.2. Applicability



4. The methodology is applicable to project activities that reduce emissions through the construction and operation of new cable cars for passenger transport wherein the passenger performs partial or total trip on the cable car. Extensions of existing cable cars are not eligible under this methodology.

5. Cable cars are established as a means of mass transit. The cable car must be built in an area that is accessible by road, i.e. ~~(~~origin and final destination of the cable car~~)~~;

6. ~~The methodology is applicable if~~ ~~f~~Fuels used in the baseline and or project case are electricity, gaseous or liquid fossil fuels. If Bio fuel blends are used as liquid fuels, the specific fuel consumption value and emission factors used for determining baseline and project emissions shall be adjusted accordingly.

7. ~~The methodology is applicable if~~ ~~t~~The analysis of possible baseline scenario alternatives leads to the baseline scenario of ~~result that a~~ continuation of the current public transport system ~~is the scenario~~ that reasonably represents the anthropogenic emissions by

[1] Modes of transport refer to vehicle categories that passengers use for transit purposes. No sub-categories apply, i.e. buses and water-based urban transport means are not differentiated according to size. Also no differentiation is made according to fuel type used.

[2] Vehicle categories are the vehicles used for passenger transport in the baseline or the project case including *inter alia* buses (sub-categories of buses might exist in the city; sub-categories are made according to bus carrying capacity of passengers, i.e. bus size), passenger cars, taxis, motorcycles, motorized rickshaws, bikes, rail-based transport systems (metro, urban rail, LTR, tram etc.) or urban water-based transport (different sub-categories might apply). Vehicle categories are differentiated according to fuels used (electricity, gaseous fuels (LPG, CNG, and LNG), gasoline and diesel.

sources of greenhouse gases (GHG), that would occur in the absence of the proposed project activity ~~(i.e. the baseline scenario)~~.

8. Measures are limited to those that result in emission reductions of less than or equal to 60 kt $CO_2e$ annually.

### 2.3. Entry into force

9. The date of entry into force is the date of the publication of the EB 85 meeting report on 24 July 2015.

## 3. Normative references

10. This methodology is based on the submission NM0006 “Cable Cars for Public Transit” submitted by Gruetter Consulting.

11. Project participants shall take into account the general guidance to the methodologies, information on additionality, abbreviations and general guidance on leakage provided at <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html>.

12. This methodology refers to the latest version of the following methodologies and tools[3] mutatis mutandis:

(a) “AMS-I.D: Grid connected renewable electricity generation”;

(b) “Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion”;

(c) “Tool to determine project emissions from flaring gases containing methane”;

(d) Methodological tool “Demonstration of additionality of small-scale project activities”.



## 4. Definitions

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

## 5. Baseline methodology

### 5.1. Project Boundary

14. The spatial extent of the project boundary is the geographical area of trips of passengers using the cable car.

15. If electricity is sourced from an interconnected grid for the operation of the transport system, the project boundary also includes the power plants physically connected to the grid supplying power to the project. In this regard the guidance in “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” shall be followed.

[3] Please refer to: <https://cdm.unfccc.int/Reference/index.html>.

16. Only $CO_2$ emissions from liquid fuels are considered for calculation of project and baseline emissions while for gaseous fuels $CH_4$ is included in addition to $CO_2$. $N_2O$ emissions are not included in this methodology.

## 5.2. Baseline Emissions

17. The baseline is determined by assessing alternatives to public transport in the project region including *inter alia* a continuation of the current situation and the project realized without the CDM.

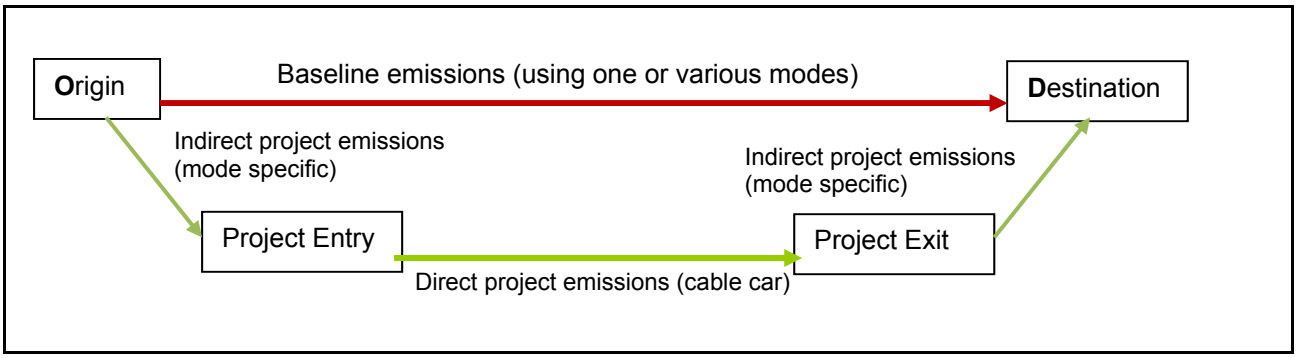
18. GHG emission reductions are achieved through an improved efficiency of transporting passengers with the cable car compared to the traditional transport mode that passengers would have used in absence of the project activity. The indicator used to demonstrate and calculate emission reduction is emissions per passenger-kilometer (pkm), i.e. ~~That is~~, the project emissions per pkm are compared to the baseline emissions per pkm.

19. The methodology assumes that the passengers do not change origin and destination of their trip except in the case of induced trips[4], which would not have occurred in absence of the project. Latter is taken into consideration with the survey described in the annex. However, the project may change trip structures including the modes used or the total trip distance.

20. Baseline emissions are those that would have been caused by passengers using the cable car using baseline modes of transport. The baseline emissions include total trip emissions of project passengers from their trip origin to their trip destination.



**Figure 1. Baseline and Project Emissions**




21. To calculate baseline emissions, the relevant vehicles categories (e.g. buses, taxis, motorcycles) in the baseline have to be identified in a first step. Vehicle categories not common in the project boundary can be excluded. In the next step, the emission factor per passenger kilometer for each vehicle category is determined. This is calculated *ex ante* and includes a fixed technology-improvement factor per vehicle category.

22. GHG emission per kilometer for each vehicle category is calculated *ex ante* and remains fixed for the project period. It is a value based on specific fuel consumption data of the respective category and it is annually updated according to the technology improvement

[4] Passengers ~~(such as tourists)~~ that may have been induced to travel because of the existence of the project activity and those trips are seasonal.

factor per vehicle category[5].

**~~Equation (1): Emission factor per Kilometre per vehicle category~~**

$$EF_{KM,i} = \sum_{x}\left[SFC_{x,i} \times NCV_{x} \times EF_{CO_2,x} \times \frac{N_{x,i}}{N_i}\right] \times IR_i^t \quad \text{Equation (1)}$$

Where:

| | | |
|---|---|---|
| $EF_{KM,i}$ | = | Emission factor per kilometer of vehicle category *i* ($grCO_2/km$) |
| $SFC_{x,i}$ | = | Specific fuel consumption of vehicle category *i* using fuel type *x* prior project start (gr/km) |
| $NCV_x$ | = | Net calorific value of fuel *x* (J/gr) |
| $EF_{CO_2,x}$ | = | Carbon emission factor for fuel type *x* ($grCO_2/J$) |
| $N_{x,i}$ | = | Number of vehicles of category *i* using fuel type *x* prior project start (units) |
| $N_i$ | = | Number of vehicles of category *i* prior project start (units) |
| $IR_i^t$ | = | Technology improvement factor for the vehicle of category *i* per year *t*. The improvement rate is applied to each calendar year. The default value of the technology improvement factor for all vehicle categories is fixed as 0.99 |
| *t* | = | Year counter for the annual improvement (dependent on age of data per vehicle category) |



23. If various sub-categories of buses exist (e.g. small, medium, large units) the emission factor is calculated per sub-category and total distance driven by each sub-category ($DD_B$) is monitored.

24. For vehicles using electricity, the associated emissions ($BE_{EL}$) shall be estimated in accordance with "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" based on the electricity consumed by the baseline system ($EC_R$) and emission factor ($EF_{Grid}$).

25. The emission factor for each mode of transport, i.e. emissions per pkm should be reassessed for each new crediting period. This may require studies or reliable up to date literature data (e.g. specific fuel consumption and occupancy~~tion~~ rate studies) in order to reflect the new situation in the corresponding city.

[5] Introduction of technology improvement factor is due to the fact that under business as usual conditions emission factors per vehicle category per fuel type may change due to: a) Vehicles are replaced with more efficient ones; b) Vehicles in stock tend to increase emissions based on wear and tear.

26. Two alternatives are proposed to determine specific fuel consumption (in the order of preference):

(a) Alternative 1: Determination of fuel consumption data using the data from the entire fleet, e.g. the data from bus or taxi companies or from a representative sample for the respective vehicle category and fuel type. Sampling units per category and fuel should be representative of the below core characteristics to ensure that the sample is as close as possible to the actual vehicle composition of the city;

(i) Vehicle sub-categories if relevant (e.g. Jeeps, Pick-Ups);

(ii) Vehicle age and motorization[6];

(iii) To be conservative, fuel consumptions based on samples shall be based on the lower end of uncertainty band at a 95% confidence level, i.e. with 95% probability that the actual average fuel consumption is equal to or higher than the value used by the project;

(b) Alternative 2: Use of fixed values based on national or international literature. The literature data shall be either based on measurements of similar vehicles in comparable surroundings (e.g. from comparable cities of other countries) or based on identification of the vehicle age and technology of representative vehicles circulating in the project city and then matching the identified categories with the most appropriate IPCC default values. The most important proxy to identify vehicle technologies is the average age of vehicles used in the zone of influence of the project. To determine if US, Japanese or European default factors apply, either the local vehicle manufacturer information can be used (if a domestic motor vehicle industry with significant market share is prevalent) or the information from the source of origin of vehicle imports is used.



**Table 2. Default Emission Factors for $CH_4$ Emissions of Vehicles Using Gaseous Fuels ($grCO_2e$ per km)**

| Vehicle category | $grCO_2e$ per km | Source |
|---|---|---|
| **Buses CNG up to Euro 4** | 113 | IPCC 2006 table 3.2.5 |
| **Buses CNG Euro 4 or later** | 19 | IPCC 2006 table 3.2.5 |
| **Light duty vehicles CNG** | 10 | IPCC 2006 table 3.2.4 (average of upper and lower level) |
| **Light duty vehicles LPG** | 2 | IPCC 2006 table 3.2.5 (urban cycle) |

27. The emissions per passenger for each vehicle category are determined as per the below guidance. All data used is determined ex-ante. A change in the average occupancy rate of the identified vehicles is registered as leakage of the project.

~~**Equation (2): Emissions per pkm**~~

[6] Vehicle age and technology (related often to emission standards such as Euro standards) are factors, which influence to a significant extent the fuel consumption. This is recognized, e.g. by IPCC default factors which are characterized according to age and technology.

(a) For fuel based transport system

$$EF_{PKM,i} = \frac{EF_{KM,i}}{OC_i}$$ Equation (2)

Where:

| | | |
|---|---|---|
| $EF_{PKM,i}$ | = | Emission factor per passenger-kilometer of vehicle category *i* ($grCO_2$/pkm) |
| $EF_{KM,i}$ | = | Emission factor per kilometer of vehicle category *i* ($grCO_2$/km) |
| $OC_i$ | = | Average occupancy~~tion~~ rate of vehicle category *i* prior project start (passengers)[7] |

(b) For electricity based transport system

$$EF_{PKM,i} = \frac{BE_{EL,i}}{PR_i \times TD_{PR}}$$ Equation (3)

Where:

| | | |
|---|---|---|
| $EF_{PKM,i}$ | = | Emission factor per passenger-kilometer of electricity based transit system *i* ($grCO_2$/pkm) |
| $BE_{EL,i}$ | = | Baseline emissions due to operation of electricity based transit system *i* (t $CO_2$) |
| $PR_i$ | = | Total passengers transported by baseline electricity based transit system *i* in year y |
| $TD_{PR}$ | = | Average trip distance of urban electricity based transport system *i* |

28. The baseline emissions for all passengers transported by the project are calculated using following steps:

### 5.2.1. Step 1: Survey

29. Baseline emissions cover the entire emissions, which would have been caused by the project passenger in absence of the project from his trip origin to his trip destination using potentially various modes of transport for segments of his trip. A representative sample survey of passengers using the project transport system shall be conducted four times a year (once every quarter) to capture potential seasonal effects of passenger transport. The average value of the four (4) surveys is taken. The surveys should commence no later than six months from the commissioning of the project. The surveys are conducted only for one year and are not repeated yearly. The principles for conducting the survey as well as a default survey template are found in the annex. The key objective of the survey is to identify how project passengers would have made the trip in absence of the project, i.e. what mode(s) of transport they would have used over the distances to reach their trip destination. The origin (O) and destination (D) of the trip

[7] In the case of taxis the driver is not included.

is assumed to be equal in the baseline and in the project case with the exception of induced traffic which is included only as project trip contributing to project emission but not included in the baseline trips. The trip distance and the modes used between 'O' and 'D' are however different in the baseline than in the project case. To fully capture all potential changes, the methodology thus compares emissions per O-D trip of the baseline with emissions per O-D trip of the project.

### 5.2.2. Step 2: Determine Average Trip Distance per Mode of Transport

30. Calculate the average trip distance for each mode of transport. To ensure a conservative approach, the average trip distance per mode shall be at the lower end of uncertainty band at a 95% confidence level[8]. All calculations are made separately for each survey.

### 5.2.3. Step 3: Total baseline emissions per year

31. Total baseline emissions are determined by multiplying the average trip distance per mode with the respective emission factor for this mode multiplied with the number of passengers who would have used the respective mode.

~~**Equation (3): Total Baseline Emissions**~~

$$BE_y = \frac{\sum_s \sum_i P_{BL,i,s,y} \times TD_{BL,i,s,y} \times EF_{PKM,i}}{10^6}$$ Equation (4)



Where:

$BE_y$ = Baseline emissions in the year *y* (t CO2e)

$P_{BL,i,s,y}$ = Passengers transported by the project in the quarter *s* of the year *y* who would have used mode *i* in the baseline (passengers)

$TD_{BL,i,s,y}$ = Average trip distance of passengers who would have used mode *i* in the baseline in the quarter *s* of the year *y* (kilometer)

$EF_{PKM,i}$ = Emission factor per passenger-kilometer of vehicle category *i* ($grCO_2$/pkm)

$\sum_s$ = Sum of the four (4) surveys realized

32. ~~Equation (4):~~ Baseline Passengers per mode are determined as per following equation.

$$P_{BL,i,s,y} = P_{s,y} \times SP_{BL,i,s,y}$$ Equation (5)

Where:

$P_{BL,i,s,y}$ = Passengers transported by the project in the quarter *s* of the year *y* who would have mode *i* in the baseline (passengers)

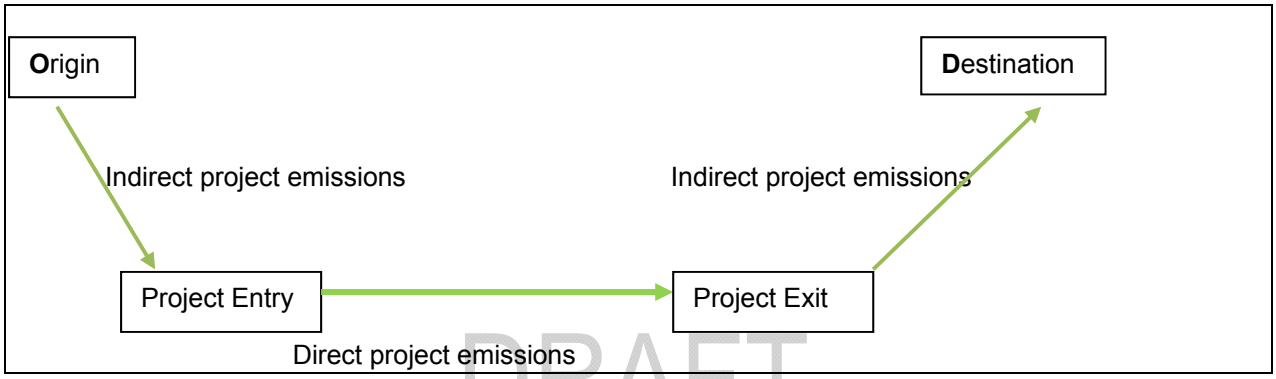
[8] This means there is 95% probability that the actual average trip distance per mode is equal to or higher than the value used by the project

| | | |
|---|---|---|
| $P_{s,y}$ | = | Passengers transported by the project in the quarter *s* of the year *y* (passengers) |
| $SP_{BL,i,s,y}$ | = | Share of passengers transported by the project in the quarter *s* of the year *y* who would have used mode *i* in the baseline (%) |

## 5.3. Project ~~activity~~ emissions

33. Project emissions are based on the fuel and/or electricity consumed by the project multiplied with the respective GHG emission factor. Indirect emissions caused by project passengers from their trip origin to the project entry station and from the project exit station to the final trip destination are taken into account.

**Figure 2. Direct and Indirect Project Emissions**






34. Direct project emissions (DPE) are calculated as per the procedures of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", based on the electricity consumption of the cable car ($EC_{PJ}$).

35. Indirect project emissions (IPE) are those caused by passengers from their origin point up to the project entry station and from the project exit station up to the final trip destination. The survey realized identifies the origin, project entry station, project exit station and the final destination of the passenger plus the modes used between the different points, e.g. bike from origin to project entry station and metro from project exit station to final destination. The distances between origin and entry and between exit and destination are calculated based, e.g. on electronic maps and GPS (identical to baseline trip determination) or on actual trip routes of modes of transport used (e.g. bus routes, metro routes).

36. The following steps are followed to calculate the indirect project emissions:

### 5.3.1. Step 1: Survey

37. A representative sample survey of passengers using the project transport system shall be conducted four times a year (once every quarter) to capture potential seasonal effects of passenger transport and the average value of the four (4) surveys is taken. The surveys should commence no later than six months from the commissioning of the project. The surveys are conducted only for one year and are not repeated yearly. The principles for conducting the survey as well as a default survey template are found in the annex. The survey objective is to identify what modes of transport passengers actually

used from trip origin to project entry station and from project exit station to trip destination as well as the determination of the distances involved. The origin and destination of the trip is assumed to be equal for the baseline as for the project case with exception of induced traffic which is included only as a project trip and not included as baseline trip.

### 5.3.2. Step 2: Indirect trip distance per mode per passenger surveyed

38. Calculate the average indirect project trip distance for each mode of transport. To ensure a conservative approach, the average indirect project trip distance per mode shall be at the higher end of uncertainty band at a 95% confidence level[9].

### 5.3.3. Step 3: Total indirect project emissions

~~**Equation (5): Indirect Project Emissions**~~

$$IPE_y = \frac{\sum_s \sum_i P_{PJ,i,s,y} \times TD_{PJ,i,s,y} \times EF_{PKM,i}}{10^6}$$ Equation (6)

Where:

| | | |
|---|---|---|
| $IPE_y$ | = | Indirect project emissions in the year *y* (t CO2e) |
| $P_{PJ,i,s,y}$ | = | Number of passengers transported by the project in the quarter *s* of the year *y* using mode *i* for trips to and from the project system (passengers) |
| $TD_{PJ,i,s,y}$ | = | Average trip distance of passengers using mode *i* in the quarter *s* of the year *y* to and from the project system (kilometer) |
| $EF_{PKM,i}$ | = | Emission factor per passenger-kilometer of vehicle category *i* ($grCO_2$/pkm) |
| $\sum_s$ | = | Sum of the four (4) quarterly surveys realized |

39. Passengers per mode are determined as per following equation.~~**Equation (6):**~~

$$P_{PJ,i,s,y} = P_{s,y} \times SP_{PJ,i,s,y}$$ Equation (7)

Where:

| | | |
|---|---|---|
| $P_{PJ,i,s,y}$ | = | Passengers transported by the project in the quarter *s* of the year *y* using mode *i* for trips to and from the project system (passengers) |
| $P_{s,y}$ | = | Passengers transported by the project in the quarter *s* of the year *y* (passengers) |
| $SP_{PJ,i,s,y}$ | = | Share of passengers transported by the project in the quarter *s* of the year *y* using mode *i* to and from the project systems (%) |

[9] This ensures that there is 95% probability that the actual average indirect project trip distance per mode is lower than or equal to the value used by the project.

40. Total project emissions are the sum of indirect and direct project emissions.

~~**Equation (7): Total Project Emissions**~~

$$PE_y = DPE_y + IPE_y$$ Equation (8)

Where:

$PE_y$ = Project emissions in the year *y* (t CO2e)

$DPE_y$ = Direct project emissions in the year *y* (t CO2e)

$IPE_y$ = Indirect project emissions in the year *y* (t CO2e)

## 5.4. Leakage

41. For the sake of a conservative approach, leakage is only considered if the total annual effect is to reduce estimated emission reductions.

42. Any significant (10% or higher) change in the average occupancy rate of each of the vehicle category is considered as leakage of the project. See the monitoring section for the detailed guidance.

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



## 5.5. Emission reductions

44. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$ Equation (9)

Where:

$ER_y$ = Emission reductions in year *y* (t CO2e)

$BE_y$ = Baseline emissions in year *y* (t CO2e)

$PE_y$ = Project emissions in year *y* (t CO2e)

$LE_y$ = Leakage emissions in year *y* (t CO2e)

# 6. Monitoring methodology

## 6.1. Data and Parameters not monitored

**Data / Parameter table 1.**

| **Data / Parameter:** | $SFC_{x,i}$ |
|---|---|
| Data unit: | gr/km |
| Description: | Specific fuel consumed of vehicle category *i* of fuel type *x* |
| Source of data: | In the decreasing order of preference:<br>(a) Local measured data not elder than 3 years (studies e.g. conducted by the project proponent or conducted by reputed institutions including relevant department of Universities);<br>(b) National or international data from studies not elder than 3 years;<br>(c) IPCC default values for the respective vehicle categories (latest year). |
| Measurement procedures (if any): | Alternative 1: Determination of fuel consumption data using the data from the entire fleet, e.g. the data from bus or taxi companies or from a representative sample for the respective vehicle category and fuel type. Sampling units per category and fuel should be representative of the below core characteristics to ensure that the sample is as close as possible to the actual vehicle composition of the city:<br>(a) Vehicle sub-categories if relevant (e.g. Jeeps, Pick-Ups);<br>(b) Vehicle age and motorization[10];<br>(c) To be conservative, fuel consumptions based on samples shall be based on the lower end of uncertainty band at a 95% confidence level, i.e. with 95% probability that the actual average fuel consumption is equal to or higher than the value used by the project.<br><br>Alternative 2: Use of fixed values based on national or international literature. The literature data shall be either based on measurements of similar vehicles in comparable surroundings (e.g. from comparable cities of other countries) or based on identification of the vehicle age and technology of representative vehicles circulating in the project city and then matching the identified categories with the most appropriate IPCC default values. The most important proxy to identify vehicle technologies is the average age of vehicles used in the zone of influence of the project. To determine if US, Japanese or European default factors apply, either the local vehicle manufacturer information can be used (if a domestic motor vehicle industry with significant market share is prevalent) or the information from the source of origin of vehicle imports is used. |
| Any comment: | - |



[10] Vehicle age and technology (related often to emission standards such as Euro standards) are factors, which influence to a significant extent the fuel consumption. This is recognized, e.g. by IPCC default factors which are characterized according to age and technology.

**Data / Parameter table 2.**

| **Data / Parameter:** | $N_{x,i}$ |
|---|---|
| Data unit: | Vehicles |
| Description: | Number of vehicles of category *i* using fuel type 3 |
| Source of data: | (a) Municipal or road transport *t* authorities based on vehicle registration statistics from the respective city; or<br>(b) Data from vehicle control stations (technical and emission control stations);<br>(c) If no city/municipal data is available regional data (canton, state) or as the last option national data can be used. |
| Measurement procedures (if any): | - |
| Any comment: | Used for all vehicle categories included in the project.<br>For buses as well as for taxis informal sector (including vehicle not registered as per legal provisions) may be operating. While estimates on the number of informal units may be available these are due to their nature not trustworthy. For both categories it is thus recommended to only include formally registered units. As the methodology is based on emissions per pkm absolute numbers are not relevant for determining this parameter. It is however important that transported passengers are also based on the official records thus not including passenger trips of informal units. |

**Data / Parameter table 3.**



| **Data / Parameter:** | $NCV_x$ |
|---|---|
| Data unit: | J/gr |
| Description: | Net calorific value of fuel *x* |

<table>
<tr><td>Source of data:</td><td>The following data sources may be used if the relevant conditions apply:<br><br>
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>(a) Values provided by the fuel supplier in invoices taken from a sample of gas stations in the city</td><td>This is the preferred source if the carbon fraction of the fuel is not provided</td></tr>
<tr><td>(b) Measurements by the project participants taken from a sample of gas stations in the city</td><td>If (a) is not available</td></tr>
<tr><td>(c) Regional or national default values</td><td>If (a) is not available<br>These sources 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>(d) IPCC default values at the upper limit of the uncertainty at a 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</td><td></td></tr>
</table>

</td></tr>
<tr><td>Measurement procedures (if any):</td><td>For (a) and (b): Measurements should be undertaken in line with national or international fuel standards.</td></tr>
<tr><td>Any comment:</td><td>The parameter is used for baseline as well as project emissions and vehicle owners or operators can buy fuel from a variety of sources (gas stations). In practice therefore it is considered as simpler to determine the parameter using options (c) or (d)</td></tr>
</table>

**Data / Parameter table 4.**

| **Data / Parameter:** | $EF_{CO2,x}$ |
|---|---|
| Data unit: | grCO2/J |
| Description: | $CO_2$ emission factor for fuel type x |

<table>
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</table>
</td></tr>
<tr><td>Measurement procedures (if any):</td><td>For (a) and (b): Measurements should be undertaken in line with national or international fuel standards.<br><br>For (a): If fuel suppliers provide the NCV value and the $CO_2$ emission factor on the invoices and these two values are based on measurements for this specific fuel, this $CO_2$ factor should be used. If another source for the $CO_2$ emission factor is used or no $CO_2$ emission factor is provided, options (b), (c) or (d) should be used</td></tr>
<tr><td>Any comment:</td><td>The parameter is used for baseline as well as project emissions and vehicle owners or operators can buy fuel from a variety of sources (gas stations). In practice therefore it is considered as simpler to determine the parameter using options (c) or (d)</td></tr>
</table>



**Data / Parameter table 5.**

| **Data / Parameter:** | $OC_i$ |
|---|---|
| Data unit: | Passengers |
| Description: | Average occupancy~~tion~~ rate of vehicle category i |
| Source of data: | Municipal transport authorities or specific studies done by the project proponent or a third party; Vintage maximum 3 years |

| | |
|---|---|
| Measurement procedures (if any): | Based on visual occupancy~~tion~~ studies for all vehicle categories.<br>For buses the occupancy~~tion~~ rate is based on boarding-alighting studies, electronic smart tickets or on visual occupancy~~tion~~ studies with expansion factors for routes served to determine the average occupancy~~tion~~ rate along the entire route. |
| Any comment: | In the case of taxis the driver is not counted |

**Data / Parameter table 6.**

| **Data / Parameter:** | $DD_B$ |
|---|---|
| Data unit: | ~~Kilometres~~ km |
| Description: | Total distance driven of buses of various sub-categories prior project start ~~(kilometer)~~ |
| Source of data: | Data from bus companies (company records), municipal transport authorities or specific studies done by the project proponent or a third party.<br>Vintage maximum 3 years |
| Measurement procedures (if any): | Distance driven of buses is often recorded by bus companies based on odometer reading. Preferable is GPS or other electronic means, however this is not yet common practice with bus companies.<br>Data can also be based on sample measurements based on daily distance driven (measured by odometer or GPS) plus the average number of operation days of a bus (based on bus operator information).<br>The total distance driven for all buses is the multiplication of average annual distance driven per bus and the number of registered buses operating in the city (see parameter table 2) |
| Any comment: | This data is required if various sub-categories of buses operate |



**Data / Parameter table 7.**

| **Data / Parameter:** | $EC_R$ |
|---|---|
| Data unit: | kWh |
| Description: | Quantity of electricity consumed by ~~the~~ electricity based baseline ~~rail based~~ transit system *i* |
| Source of data: | ~~Rail~~ system operator; last available year |
| Measurement procedures (if any): | If various electricity based ~~rail~~ systems exist (e.g. trolley buses, metro, tram) data has to be collected for each system.<br>Only include electricity used to move trains (not e.g. for lighting, traffic signals). |
| Any comment: | Required if the city has ~~rail~~ electricity based transit systems |

**Data / Parameter table 8.**

| **Data / Parameter:** | $EF_{Grid}$ |
|---|---|
| Data unit: | $kgCO_2/kWh$ |
| Description: | Emission factor for the grid |

| | |
|---|---|
| Source of data: | ~~Official data for same year as parameter table 7; follow procedures~~ ~~a~~As per in "Tool to calculate the emission factor for an electricity system" |
| Measurement procedures (if any): | ~~Follow procedures in~~ As per "Tool to calculate the emission factor for an electricity system" |
| Any comment: | - |

**Data / Parameter table 9.**

| **Data / Parameter:** | $P_{R,i}$ |
|---|---|
| Data unit: | Passengers |
| Description: | Total passengers transported by electricity based baseline ~~rail based~~ transit system *i* per year |
| Source of data: | Rail operator data for same year as parameter table 7 |
| Measurement procedures (if any): | Based on turnpike or electronic ticketing system; Cross check with ticket sales where possible |
| Any comment: | Required if the city has rail based transit systems as pkm for rail based systems is calculated in general based on total passengers and average trip distance instead of average occupancy~~tion~~ rate |

**Data / Parameter table 10.**

| **Data / Parameter:** | $TD_{PR}$ |
|---|---|
| Data unit: | ~~Kilometres~~ km |
| Description: | Average trip distance of urban electricity ~~rail~~ based transit passengers |
| Source of data: | Rail operator data for same year as parameter table 7 preferable |
| Measurement procedures (if any): | Based in general on electronic ticketing system or on surveys |
| Any comment: | Only ~~rail~~ trip distance covered by electricity based transit system not total trip distance;<br>Required if the city has electricity ~~rail~~ based transit systems as pkm for electricity ~~rail~~ based systems is calculated in general based on total passengers and average trip distance instead of average occupancy~~tion~~ rate |



## 6.2. Data and Parameters monitored

**Data / Parameter table 11.**

| **Data / Parameter:** | ***P*** |
|---|---|
| Data unit: | Passengers |
| Description: | Total passengers transported by the project |
| Source of data: | Cable car operator |
| Measurement procedures (if any): | Based on electronic (e.g. electronic smart cards) or mechanical control means (e.g. turnpikes at stations) |
| Monitoring frequency: | Continuously, aggregated at least per quarter |
| QA/QC procedures: | Control with ticket sales |

| | |
|---|---|
| Any comment: | For passenger numbers controls must be based on counting physically passengers, e.g. through electronic smart cards or mechanical entry control units. Systems operating only with tickets valid for 1 ride can also use ticket sales. Systems operating however without multiple ticket entry (e.g. monthly card allowing the user indiscriminate usage of the system) must have entry control units to count the number of passengers. In case of such systems ticket sales only offer an approximation of passengers using the system, appropriate for QA/QC. |

**Data / Parameter table 12.**

| **Data / Parameter:** | $SP_{BL,i,s}$ |
|---|---|
| Data unit: | % |
| Description: | Share of passengers in the quarter *s* of the respective year who would have used the baseline mode *i* |
| Source of data: | Cable car operator |
| Measurement procedures (if any): | Based on survey principles as mentioned in appendix to this methodology ~~(see details below)~~ |
| Monitoring frequency: | Continuously, aggregated at least per quarter |
| QA/QC procedures: | The survey is realized at a 95% confidence interval with a maximum 5% error margin |
| Any comment: | Refer to appendix for details regarding ~~See below~~ survey principles |



**Data / Parameter table 13.**

| **Data / Parameter:** | $SP_{PJ,i,s}$ |
|---|---|
| Data unit: | % |
| Description: | Share of passengers using the project mode *i* in the quarter *s* of the respective year from trip origin to the project entry station and from project exit station to their final destination |
| Source of data: | Cable car operator |
| Measurement procedures (if any): | Based on survey principles as mentioned in appendix to this methodology ~~(see details below)~~ |
| Monitoring frequency: | Continuously, aggregated at least per quarter. |
| QA/QC procedures: | The survey is realized at a 95% confidence interval with a maximum 5% error margin |
| Any comment: | Refer to appendix for details regarding ~~See below~~ survey principles |

**Data / Parameter table 14.**

| **Data / Parameter:** | $TD_{BL,i,s}$ |
|---|---|
| Data unit: | ~~Kilometres~~ km |
| Description: | Trip distance of passengers using in the baseline mode *i* in the quarter *s* of the respective year |
| Source of data: | Cable car operator |
| Measurement procedures (if any): | Based on survey principles as mentioned in appendix to this methodology ~~(see details below)~~ |

| | |
|---|---|
| Monitoring frequency: | Continuously, aggregated at least per quarter |
| QA/QC procedures: | The survey is realized at a 95% confidence interval with a maximum 5% error margin.<br>To ensure a conservative trip distance and thus conservative baseline emissions the lower boundary of the 95% confidence interval for the trip distance is taken, i.e. this ensures that with 95% probability the actual trip distance baseline is equal to or higher than the trip distance taken for project baseline emission calculations. |
| Any comment: | Refer to appendix for details regarding ~~See below~~ survey principles |

**Data / Parameter table 15.**

| **Data / Parameter:** | $TD_{PJ,i,s}$ |
|---|---|
| Data unit: | ~~Kilometres~~ km |
| Description: | Trip distance of passengers using in the project mode *i* in the quarter *s* of the respective year from their trip origin to the project entry station and from the project exit station to their final destination |
| Source of data: | Cable car operator |
| Measurement procedures (if any): | Based on survey principles as mentioned in appendix to this methodology ~~(see details below)~~ |
| Monitoring frequency: | Continuously, aggregated at least per quarter |
| QA/QC procedures: | The survey is realized at a 95% confidence interval with a maximum 5% error margin.<br>To ensure a conservative trip distance and thus conservative project emissions the upper boundary of the 95% confidence interval for the trip distance is taken, i.e. this ensures that with 95% probability the actual trip distance project to/from the project is equal to or lower than the trip distance taken for indirect project emission calculations. |
| Any comment: | Refer to appendix for details regarding ~~See below~~ survey principles |



**Data / Parameter table 16.**

| **Data / Parameter:** | $EC_{PJ}$ |
|---|---|
| Data unit: | kWh |
| Description: | Quantity of electricity consumed by the cable car for traction |
| Source of data: | Cable car operator |
| Measurement procedures (if any): | Calibrated meters |
| Monitoring frequency: | Continuously, aggregated at least annually |
| QA/QC procedures: | Cross check measurement results with invoices for purchased electricity |
| Any comment: | - |

**Data / Parameter table 17.**

| **Data / Parameter:** | **Occupancy rate of vehicle category i** |
|---|---|
| Data unit: | Passengers |

| | |
|---|---|
| Description: | Any significant (10% or higher) change in the average occupancy rate of each of the vehicle category is considered as leakage of the project |
| Source of data: | Specific studies done by the project proponent or a third party |
| Measurement procedures (if any): | Before project start plus specified intervals thereafter |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | The occupancy rate of different vehicle categories is monitored through representative samples. If results show reduced occupancy rates (> 10 % in the load factor), this change is included in the leakage calculation for all years since the last monitoring of the load factor. Recommended interval: year 3, 6 and 10 for 10-year crediting period; year 3 and 7 for 7-year crediting period.<br><br>**Details of Load Factor Study**<br><br>The frequency of the load study is:<br>(a) If 100% of the project is implemented at the start: Year 2 to monitor short-term response of vehicle categories to the MRTS and years 5 and 10 to monitor medium-term response. Data of year 2 is used for years 3-5 and data of year 5 for rest of crediting period. To monitor the occupancy rate of the vehicle categories every year is not considered as necessary, as changes are expected either in the first years (short-term response) or then in the medium-term. In between only incremental annual changes are expected which would not justify the considerable expenses for realizing such surveys.<br>(b) With gradual project implementation monitoring years may vary. It is proposed to monitor at a minimum every 3 years, e.g. year 3, 6 and 10. If the load factor reduces less than 10 percentage points no leakage is included. If the load factor reduces by more than 10 percentage points relative to the measurement before project start (benchmark) then leakage is calculated and included. In this case the amount of leakage is the cumulative sum of all years since the last load factor survey was realized assuming that the reduction of the load factor occurred immediately since the last survey. |

## 6.3. Project activity under a programme of activities

45. ~~Further guidance on leakage is required[11] to adapt this methodology for use in a programme of activities.~~ The methodology is applicable to a programme of activities. No additional leakage estimations are necessary other than that indicated under the leakage section above.

~~[11] A request for revision may be proposed in accordance with the procedures~~

# Appendix. Survey principles and default survey

1. The following survey principles shall be followed:

   (a) The sampling size is determined by the 95% confidence interval and the 5% maximum error margin;

   (b) Sampling must be statistically robust and relevant, i.e. the survey has a random distribution and is representative of the persons using the project transport system;

   (c) For each cable car line a separate survey needs to be realized;

   (d) The method to select persons for interviews is random;

   (e) Only persons over age 12 are interviewed;

   (f) The survey is realized on all week days including weekends with the sample size per day being proportional to the number of passengers transported by the project per corresponding week day;

   (g) The sample size for upward journey and downward journey in the cable car must be proportional to the number of passengers transported upwards/downwards on the cable car;

   (h) The PDD must contain the design details of the survey;

   (i) A representative sample survey of passengers using the project transport system shall be conducted four times a year (once every quarter) to capture potential seasonal effects of passenger transport and the average value of the four (4) surveys is taken. The surveys should commence no later than six months from the commissioning of the project. The surveys are conducted only for one year and are not repeated.

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

**Default Survey**

Interviewer:……

Date:…….

Time:……..

Point (station) where the interview was performed:…….

Identification of cable car line:……

**Question 1**

"Describe the trip you are currently realizing"

1.1. Your trip origin (starting point, e.g. my home):……

1.2. Your entry (boarding) station cable car (name of station):……

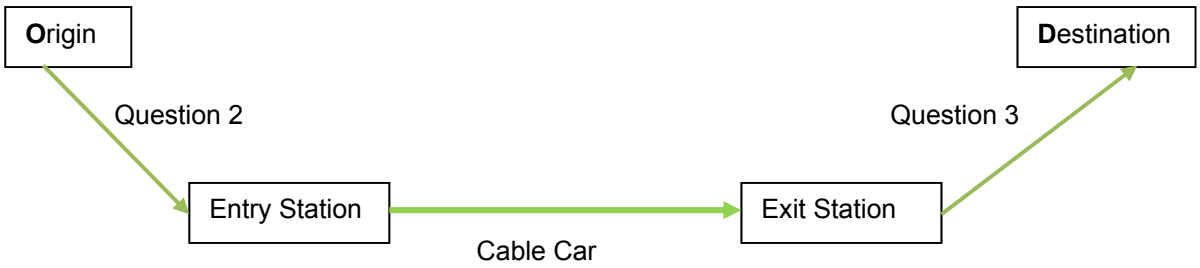
1.3. Your exit (de-boarding) station cable car (name of station):……

1.4. Your final trip destination (final point, e.g. office):…….

*Explanations for the interviewer:*

- *The question refers to the current trip the passenger is making.*
- *If the passenger has walked less than 10 minutes between trip origin and boarding the cable car the two points are considered as identical and 1.1. can be filled in with "identical to the project entry station".*
- *If the passenger will walk less than 10 minutes between leaving the cable car until reaching his final destination the two points are considered as identical and 1.4. can be filled in with "identical to the project exit station".*
- *The trip origin and the trip destination must be identified with a clear address. Use a map if it is unclear. If the person does not know or does not want to disclose this information then stop at this point. The questionnaire is deemed thereafter as non-valid.*
- *The cable car stations identified in 1.2 and 1.3 must be listed with their official names.*
- *Only urban trips are considered. If the passenger has as trip origin or trip destination a point outside the city boundaries then discontinue the interview. The questionnaire is deemed thereafter as non-valid.*

**Figure 3. Passenger Trip Actually Made**




**Calculation** of result by interviewer or 3rd party:

1. Distance in meters origin to project entry station (if not identical):…….
2. Distance calculation based on:…….
3. Distance in meters from project exit station to destination (if not identical):……
4. Distance calculation based on:…….

**If 1.1. and 1.2. are different, then go to question 2; otherwise continue with question 3.**

**Question 2**



"What mode of transport did you use from your trip start to the cable car? Please refer to the mode on which you performed the longest stretch if you used various modes"

☐ Bus ☐ Rail/Metro/Tram ☐ Taxi ☐ Passenger car ☐ Motorcycle ☐ Taxi tri-cycle ☐ Bike or per foot

*Explanations for the interviewer:*

- *See graph 1 for explanation*
- *Rail refers to metro, urban rail, tram etc.*
- *Only tick 1 answer (the mode used for the longest stretch of this trip segment)*

**If 1.1. and 1.4. are different, then go to question 3; otherwise continue with question 4.**

**Question 3**

"What mode of transport will you use from the point where you leave the cable car until your final destination? Please refer to the mode on which you will perform the longest stretch if you intend to use various modes"

☐ Bus ☐ Rail/Metro/Tram ☐ Taxi ☐ Passenger car ☐ Motorcycle ☐ Taxi tri-cycle ☐ Bike or per foot

*Explanations for the interviewer:*

- *See graph for explanation*
- *Rail refers to metro, urban rail, tram etc.*

- *Only tick 1 answer (the mode used for the longest stretch of this trip segment)*

**Question 4**

"Assuming that the cable car you are currently using would not exist: Would you have made the trip you are currently doing anyway or would you have stayed at home/office/origin"

☐ *i* would have made the trip ☐ *i* would have stayed at home/office/origin

*For the interviewer:*

- *The purpose of this question is to know if the passenger made this trip only because the cable car exists. In absence of the cableway the passenger would not have made any trip and would have stayed at his point of origin.*

**If you would have made the trip continue with question 5; otherwise the questionnaire is terminated.**

**Question 5**

"Assuming that the cable car you are currently using would not exist: Would you have used 1 or various modes of transport for your entire trip from origin to destination?"

☐ *i* would have used 1 mode ➔ go to question 6

☐ *i* would have used more than 1 mode (e.g. taxi plus bus)

If you would have used various modes of transport identify the intermediate points where you changed the mode of transport except if between these points you walked less than 10 minutes. Example: From home *i* would have taken the bus to point XXY and from there *i* would have taken the taxi to my office.



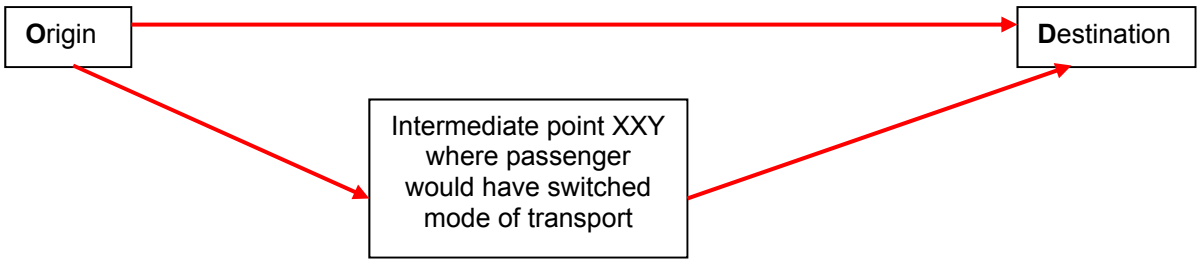
a. Origin of trip (identical to 1.1.):……
b. Intermediate point 1:
c. Intermediate point 2:
d. Destination of trip (identical to 1.4.):……

*For the interviewer*

- *The trip origin and the trip destination are identical to question 1 i.e. they are the actual trip starting point and the actual destination of the passenger you are questioning*
- *We want to know how the passenger would have reached his destination if the cable car would not exist, i.e. the passenger should relate how he did this or a comparable trip before existence of the cable car using all other existing modes of transport he normally used.*
- *The trip route between origin and destination can and is usually different. We must reach however the same final destination.*
- *The passenger may have used one or various modes between starting and final point, e.g. car plus bus or bus plus metro etc. Each time he would have changed modes we must identify the geographical point where he would have changed modes (23. and 24.)*

- *It is not previewed that more than 2 intermediate points exist (this would mean 3 modes of transport for 1 trip, i.e. origin to point 1, point 1 to point 2, point 2 to destination). If the passenger used more modes and thus had more intermediate points these shall be added.*
- *Walking trips of less than 10 minutes are not counted, e.g. walking from origin to bus station of less than 10 minutes is not counted as a separate trip.*
- *The points must be identified with a clear address. Use a map if it is unclear. If the person does not know or does not want to disclose this information then stop at this point. The questionnaire is deemed thereafter as non-valid*

**Graph 2: Passenger Trip Made Without Existence of Cable Car (examples)**




**Calculation** of result by interviewer or 3rd party:

1. Distance in meters origin to intermediate point:……..
   Distance calculation based on:……
2. Distance in meters from intermediate point to destination (if not identical):……
   Distance calculation based on:…….



Idem if various intermediate points exist.

**Question 6**

"What mode of transport would you have used between each identified point?" Please answer this question for each distance realized separately, e.g. origin to XXY and XXY to destination.

Trip segment (based on question 5, e.g. origin to point XXY):…….

Mode *i* would have used in absence of the cable car for this trip segment:

☐ Bus ☐ Rail/Metro/Tram ☐ Taxi ➔ go to 6A ☐ Passenger car ➔ got to 6B ☐ Motorcycle ➔ go to 6C ☐ Taxi tri-cycle ➔ go to 6D ☐ Bike or per foot

*Explanations for the interviewer:*

- *See graph 2 for explanation*
- *Rail refers to metro, urban rail, tram etc*
- *Only tick 1 answer (the mode used for the longest stretch of this trip segment)*
- *For each segment of the trip note a separate answer*

**Question 6A**

**"**Have you used a taxi in the last 6 months?"

☐ Yes ☐ No

*If the passenger responds with No this specific questionnaire is deemed as non-consistent and removed from the final counting*

**Question 6B**

**"**Do you or your family own a car or do you have access to a car (e.g. car-sharing) or have you used a passenger car in the last 6 months?"

☐ Yes ☐ No

*If the passenger responds with No this specific questionnaire is deemed as non-consistent and removed from the final counting*

**Question 6C**

**"**Do you or your family own a motorcycle or do you have access to a motorcycle or have you used a motorcycle in the last 6 months?"

☐ Yes ☐ No

*If the passenger responds with No this specific questionnaire is deemed as non-consistent and removed from the final counting*



**Question 6D**

**"**Have you used a taxi tri-cycle in the last 6 months?"

☐ Yes ☐ No

*If the passenger responds with No this specific questionnaire is deemed as non-consistent and removed from the final counting*

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

- - - - -

## Document information

| *Version* | *Date* | *Description* |
|---|---|---|
| 02.0 | 3 July 2015 | SSCWG 48, Annex 08<br>To be considered by the Board at EB85.<br>Revised to provide guidance for application of the methodology under programme of activities. |
| 01.0 | 26 September 2008 | EB 42, Annex 13<br>Initial adoption. |

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