

CDM-MP80-A12

Draft Small-scale Methodology

SSC-III.XX: Ride-sharinghailing services

Version 03.0

Sectoral scope(s): 07

DRAFT



United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. A request for new methodology (SSC-NM102) “Greenhouse gas emission reduction methodology for online ride-hailing service”, (hereinafter referred as NM-102) was submitted on 3 August 2018 by Beijing Didi Infinity Technology and Development Co., Ltd.
2. The Executive Board of the clean development mechanism (CDM) (hereinafter referred to as the Board) at its 103rd meeting (EB103) reviewed the recommendation from the Methodologies Panel (MP) to approve the submission NM-102. The Board decided not to approve the proposed methodology and requested the MP to further work on the following issues (EB 103 meeting report para 33):

Clarify which concrete investments/costs the application of the methodology will trigger in addition to the existing investments/costs;

Ensure that the methodology establishes the attributability of the emission reductions to the project activity measures (e.g. through surveys, statistical approaches);

Develop criteria and requirements for the use of investment analysis for additionality demonstration, for example, credible means to verify the projections relating to unloaded ratio of taxis and private passenger cars that result in emission reductions, or identify other means for demonstrating additionality;

Include requirements/guidance to ensure the baseline is credible and remains credible throughout the crediting period, for example, by capturing potential fast-paced changes in the sector in the baseline through dynamic approaches.

2. Purpose

3. The revised draft of the new methodology aims to address the issues raised by the Board as above.

3. Key issues and proposed solutions

3.1. Issue 1: Clarify which concrete investments/costs the application of the methodology will trigger in addition to the existing investments/costs.

4. Ride-sharing services entail high technical needs due to reasons including but not limited to:
 - (a) Sophisticated algorithm to match the supply and demand of ride sharing requests (developing and upgrading), considering start points, destinations, feasibility of sharing travelling route, maximum number of passengers and the available seats, etc.;

- (b) Route planning is more complicated regarding ride-sharing because the sequences of passenger pick-up needs to be precisely computed. If a new project activity is developed, the capacity has to be further expanded;
 - (c) Ride-sharing services are not preferred by passengers exactly because 'they have to share seats', therefore the platform finds opportunities to promote ride sharing whenever appropriate. For example, during rush hours, PP calculates and presents information of shorter queuing time and cheaper prices to passenger to encourage them to choose ride sharing services.
5. Ride-sharing platform / app (app) has the technical capacity to satisfy these concerns and can provide not only a very personalized mobility experience but also ensure efficiency and sustainability via large-scale ride pooling.¹
 6. The stakeholder informed the MP that new data processing capacity and computing power needs are generated for the operation of the project activity and relevant expansion of the platform contributes to significant requirement of technical resources. Accordingly, extra investments such as specific staff for the new project of ride sharing department, R&D investment for platform expansion to include the service for new cities and performance upgrade, more server capacity and aided software needs for order processing of the new project are required.
 7. Further to the conventional investment (that includes investment to establish the new branch/company in the project city including cost of company registration, cost for office space, human resources such as drivers and office staff cost, purchase of local digital map, promotion cost and infrastructure set up cost), the stakeholder informed the MP that the application of the methodology triggers the following concrete investments/costs:

Subsidy for drivers and passengers that will be paid during promotional period to increase the use of ride-sharing among the passengers;

Cost for infrastructure set up such as:

Cost of research and development of new tools to provide efficient service to the commuters using ride-sharing;

Cost of server that will keep track of enormous data, for example, based on operational experience from the stakeholder it is estimated that project developer has to process 4,875 TB of the data including trajectory raw data, trip path/route planning data, trip request data, vehicle positioning data and national average monthly traffic reports. This data needs to be processed accurately to forecast the demand; and

Cost of software that is used to compile the data/records accumulated from the trips which is used for emission reduction calculation. The stakeholder informed that the software that will be used by project developer will process big-data and intelligent arbitration algorithm model and it will require only 10 milliseconds for online traffic liabilities judgment with accuracy of around 93%.

¹ Based on outcome of the study conducted by MIT on 'On-demand high-capacity ride-sharing via dynamic trip-vehicle assignment' available at <https://www.pnas.org/content/114/3/462>.

8. Further, the ride-sharing services have lower revenue and relatively higher cost compared with normal services for the following reasons: (i) The amount of the service orders counts small proportion; (ii) Extra technical investment is needed because the ride sharing service has higher technical requirements; (iii) The service price is relatively low; (iv) Subsidies are needed to encourage drivers to take ride sharing orders; and (v) Appropriate prices are required to encourage passengers to choose ride sharing options.
- 3.2. Issue 2: Ensure that the methodology establishes the attributability of the emission reductions to the project activity measures (e.g. through surveys, statistical approaches).**
9. The methodology established a rigorous QA/QC requirement for data monitoring to ensure quality of the data that is collected and used for emission reduction calculation. For example, methodology stipulates to use data from project system operator, municipal transit authorities to calculate 'Number of vehicle-kilometers', 'fraction of vehicles using a specific fuel type' and using 90/10 confidence/precision for data/parameters determined using survey method as per sampling standard and sampling guidelines. Further requirements on reliable data sources, system test, random sampling and related third-party audits are included in the monitoring methodology section. Further the methodology also added certain cross-checks to the survey results for example, if a respondent mentions that in absence of the project activity she/he would have completed the trip by driving car, then the survey needs to confirm that respondent has valid driving licence.
10. Appendix 1 of the methodology, includes enhanced requirements for conducting surveys. These include, requirements to conduct the survey during an entire week in each season to avoid bias. The selected weeks shall not correspond to a public holiday and shall be representative for the average demand for transport services in the considered year and shall avoid extreme weather such as heavy rain or snow. Average value of survey result is to be applied for emission reduction calculation. Also, survey results must be checked against information about survey respondents to ensure it is credible for example, respondents who say they would use a private car must show a valid driver licence.
11. In addition to these requirements, the original data recorded by the app and original information related to sample order will be made available to the DOE during verification exercise.
- 3.3. Issue 3: Develop criteria and requirements for the use of investment analysis for additionality demonstration, for example, credible means to verify the projections relating to unloaded ratio of taxis and private passenger cars that result in emission reductions or identify other means for demonstrating additionality.**
12. The stakeholder has removed measure related to booking on-line taxis and avoid empty driving of taxis. Therefore, this issue is no longer relevant.
- 3.4. Issue 4: Include requirements/guidance to ensure the baseline is credible and remains credible throughout the crediting period, for example, by capturing potential fast-paced changes in the sector in the baseline through dynamic approaches.**
13. The stakeholder has clarified that even if the app becomes popular, ride-sharing is unlikely to become common practice. The MP has cross-checked this claim against

information in public found literature² and found that similar opinion is expressed in the literature as well. However, to address concerns by the Board, the MP recommends to include parameter '*Fraction of comparable cities³ having in place ride-sharing services (F_y)*' that will confirm popularity of ride-sharing services within the host country, specifically, including ride-sharing services that are not registered as CDM project activity in year y . The MP believes this parameter will take care of concerns related to common practice and baseline emissions will be reduced as fraction increases. The MP also confirms that the practice of including such parameter is in-line with CDM methodologies where the methodology deals with the technology/measure that is growing at a fast-pace.

4. Impacts

14. The new methodology if approved is expected allow for the development of new CDM projects for ride-sharing in the transport sector.

5. Subsequent work and timelines

15. The methodology is recommended by the MP for consideration by the Board at its 105th meeting. No further work is envisaged.

6. Recommendations to the Board

16. The MP recommends that the Board adopt this new methodology, to be made effective at the time of the Board's approval.

² Article on 'Cracks in the ride-sharing market-and how to fill them', available at <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/cracks-in-the-ridesharing-market-and-how-to-fill-them>, discusses the challenges faced by ride-sharing business.

³ Cities having a population within +/- 50% range of the project city.

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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)	Project activities that involve the introduction of on-line ride-hailing sharing services, including booking of taxis, ride-hailing sharing cars sharing (ride-sharing with another passenger(s)) or hitch-riding cars (ride-sharing with the driver) using a ride-hailing sharing application/platform.
Type of GHG emissions mitigation action	Energy efficiency. Displacement of more-GHG-intensive transportation mode by less-GHG-intensive ones

2. Scope, applicability, and entry into force

2.1. Scope and Applicability

2. This methodology is applicable under the following conditions:

The project activity involves the introduction of a new⁴ ride-hailing sharing application/platform (app) to the project city, for on-line ride-sharing services, including booking of ride-sharing cars or hitch-riding cars to the project city.

The project activity enables local passengers to use the app to book taxis, book ride-hailing sharing cars (hereinafter referred as ride-sharing with another passenger(s)) and/or book hitch-riding cars (hereinafter referred as ride-sharing with the driver);

The extension of an existing app through the increase in the number of participating vehicles is not eligible;

The cars covered by under this methodology shall be are taxis or private passenger cars.

The Taxis passenger cars shall only be allowed eligible to claim emission reductions from measure for ride-sharing with another passenger(s) via 'booking ride-sharing cars', while passenger cars shall only be allowed eligible to claim emission reductions from measures 'booking ride-sharing cars' and 'booking hitch-riding cars' and/or sharing ride with the driver;

All cars under the methodology should shall be in compliance comply with applicable local or national regulations on the passenger transport service. The private passenger cars without relevant licence which are prevented by law from transporting passengers (e.g. without relevant licence) should shall not be included in the project activity under the methodology;

No ride hailing sharing app providing on-line same ride-hailing sharing services⁵ as described under para 0 and 0 below the proposed project activity are used prior to the project activity in the project city;

⁴ Introduction of new ride-sharing app means a new app that was not available for application in the project city while it may be existing elsewhere. Ride-sharing service that is added in an app as a brand-new service in the project city is also considered as new app (e.g. the app may have provided services to book taxis but was not providing any ride-sharing services). Modification to an existing app is not considered as a new app.

The number of taxis in the pre-project and project scenario remains same. This is demonstrated by showing that there are fixed number of taxi licences issued in the project city;

Only the ride-hailing app provider can apply for emission reductions from project activities under this methodology. To avoid double counting of emission reductions the company that owns the ride-sharing app shall apply for emission reductions from the project activities under this methodology. The other app stakeholders including taxi providers, drivers of taxis and private passenger cars and passengers are not eligible to submit claim for emission reductions using this app;

The methodology is only applicable to the project activity with the annual emission reductions less than or equal to 60,000 tCO₂.

3. The methodology is not applicable for the travelling activity between different cities.

2.2. Entry into force

4. The date of entry into force is the date of the publication of the EB ### meeting report on DD month YYYY.

2.3. Applicability of sectoral scope

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

3. Normative references

6. This methodology is based on the proposed small-scale methodology “SSC-NM102: DiDi online ride-hailing service emission reduction project in Baoding City” submitted by Beijing Didi Infinity Technology and Development Co., Ltd.
7. Project participants shall apply the “General guidelines for SSC CDM methodologies” and the “TOOL21: Demonstration of additionality of small-scale project activities” (previously known as attachment A to appendix B) provided at:
<<http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html>> mutatis mutandis.
8. This methodology also refers to the latest approved versions of the following methodologies and tools:

“Sampling and surveys for CDM project activities and programme of activities”;

“Guidelines for sampling and surveys for CDM project activities and programme of activities”;

“TOOL03: Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”;

“TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”;

⁵ For example, in a project city, if an existing ride-sharing app provides services to book taxis and services to book ride-sharing cars, and the new ride-sharing app introduced provides services to book hitch-riding cars. Then the new ride-sharing app applying this methodology should claim emission reductions only for those services which were not provided by the existing app, i.e. to book hitch-riding cars.

“TOOL07: Tool to calculate the emission factor for an electricity system;

“TOOL18: Baseline emissions for modal shift measures in urban passenger transport”;

“TOOL19: Demonstration of additionality of microscale project activities”;

“TOOL21: Demonstration of additionality of small-scale project activities”.

4. Definitions

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

10. The following definitions apply:

Car booking model - a type of project intervention, i.e. ~~booking of taxis,~~ booking ride-sharing cars or booking of hitch-riding cars using ride-~~hailing sharing~~ app.

~~**Cruising Taxi (hereinafter referred to as Taxi)** - vehicle cruises to find passengers providing travelling service wherein the driver holds a taxi licence. Taxi travels according to the needs of passengers and charges based on mileage and time;~~

Private Passenger car - vehicles designed and constructed for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat, and having maximum permissible laden mass not exceeding 3.5 tons;

Ride-~~hailing sharing~~ car - vehicle ~~which providing~~ travelling service to ~~multiple~~ passengers through the ride-~~hailing sharing~~ app ~~without cruising~~;

Hitch-riding car - when travelling by cars, drivers ~~post~~ their own travelling route through the ride-~~hailing sharing~~ apps. Passengers who have the same or similar travelling route ~~can may~~ share the car for travelling;

~~**Empty Mileage** - the travelling mileage of the taxis without carrying any passenger;~~

~~**Unloaded Ratio** - the proportion of the empty mileage in the total travelling mileage of the taxis;~~

Ride-~~hailing sharing~~ app - the software or application/platform for ride-~~hailing sharing~~ services;

Ride-sharing with another passenger(s) - process through which a number of passengers travelling separately with the same or similar travelling route, book and share the same ~~hailing taxi or~~ car through the ride-~~hailing sharing~~ app;

Ride-sharing with the driver - process through which a number of passengers and driver of a car travelling separately with the same or similar travelling route, book and share the same ~~hailing~~ car through the ride-~~hailing sharing~~ app;

Travelling mileage - the distance ~~actually~~ travelled by cars. The travelling mileage ~~should shall~~ include the mileage from the location of the ~~taxi or~~ car where the booking is accepted to the starting point of the ~~first~~ passenger. The travelling mileage included in different travelling sharing orders ~~should shall~~ not be double counted;

Booking order - one booking order is regarded as a passenger (with or without companion(s) traveling together) makes the booking order through ride-~~hailing sharing~~ app for ~~a taxi,~~ ride-sharing with another passenger(s) or driver to fulfil the travelling;

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

5. Baseline methodology

5.1. Project boundary

11. The spatial extent of the project boundary covers the city in which the project takes place. As the project cannot control the trip origins or destinations of passengers, the spatial area of the project is the entire urban zone of the city in which the project operates.
12. In case the cars use electricity from an interconnected grid or captive power plant, the project boundary also includes the power plants connected physically to the electricity system that supply power to the project, and/or the captive power plant.
13. The greenhouse gases included in or excluded from the project boundary are shown in Table 2.

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

Source		Gas	Included	Justification/Explanation
Baseline	Mobile source emissions from different modes of transport that would have taken in absence of project activity	CO ₂	Yes	Major emission source
		CH ₄	No	CH ₄ emissions are a minor emission source of the total CO ₂ e emissions in diesel/gasoline vehicles. Neglecting these emissions in baseline as well as project emissions is conservative as fuel consumption and thus also CH ₄ emissions are reduced through the project
		N ₂ O	No	N ₂ O emissions are a minor source of the total CO ₂ e emissions. Neglecting these emissions in baseline as well as project emissions is conservative as fuel consumption and thus also N ₂ O emissions are reduced through the project
Project activity	Mobile source emissions from project vehicles	CO ₂	Yes	Major emission source
		CH ₄	No	See argument above
		N ₂ O	No	See argument above

5.2. Baseline scenario

14. The project activity involves implementing the service for booking taxi, booking a ride-sharing cars with another passenger(s) and/or booking a ride-sharing with the driver for travelling hitch-riding cars using a ride-hailing sharing application (app). The project activity promotes improvement in taxi loading/utilization factor of taxis and private passenger cars. The baseline scenario for each car booking model is determined as follows:

Booking of taxis, the baseline scenario is that the taxis find the passengers through the existing ways, including cruising, waiting at the taxi stand or taxi service centre or web-based

booking system or phone booking on non-sharing basis etc. Also, when a taxi is not available, the passengers would take various transportation modes for travelling;

For booking a ride-sharing cars with another passenger(s), the baseline scenario is that the passengers would take transportation modes other than ride-sharing cars with another passenger(s) in the absence of the project activity. In case of trips up to 2.5 km⁶ the default baseline scenario will be travelling by one of the non-motorised transport modes;

For booking a hitch-riding cars ride-sharing with the driver, the baseline scenario is that the drivers would travel alone without sharing the cars with the passengers or travel by other transportation modes, and the passengers would take different transportation modes other than hitch-riding cars ride-sharing with the driver in the absence of the project activity. In case of trips up to 2.5 km the default baseline scenario will be travelling by one of the non-motorised transport modes.

5.3. Additionality demonstration

15. The additionality shall be demonstrated applying the latest approved version of the “TOOL19: Demonstration of additionality of microscale project activities” (TOOL19) or “TOOL21: Demonstration of additionality of small-scale project activities” (TOOL21).

16. In case of application of TOOL21: “Demonstration of additionality of small-scale project activities”, the project participant shall demonstrate additionality using investment barrier. The investment barrier shall provide investment analysis considering the investment cost related to the development of the project activity. The investment cost mainly covers specific administration costs and technical costs relevant to the operation of the ride-sharing app services, such as Human Resources cost for the specific technical staff, R&D cost for the ride-sharing functionality, extra server cost, software cost for the capacity expansion, apps localization cost⁷, etc.

17. The project participant shall substantiate the price charged to the user (including surge or peak pricing) of the ride-sharing service as well as the assumptions underlying the forecast of the level of the demand.

18. In case the investment barrier is selected, only the investment cost for the introduction of the app to the project city can be considered. The initial investment cost may mainly involve the establishment of a company in the project city, apps localization⁸, digital map development, etc. The operation cost mainly covers administration cost such as human resources cost, technical cost such as R&D cost, server cost, software cost, etc. while the cost for the investment of the whole encoding and algorithm development should not be considered.

⁶ According to the study “A Global High Shift Cycling Scenario”, prepared by the Institute for Transportation and Development Policy (ITDP) and by the Institute of Transportation Services (ITS) from UC Davis, a typical cycling trip distance is of 3 – 5 km.

⁷ The cost involving the development of local service on app on the algorithm basis to realize the following travelling booking function: detailed local map, location, route planning and service fee settlement.

⁸ The cost involving the development of local service on app on the algorithm basis to realize the following travelling booking function: detailed local map, location, route planning and service fee settlement.

18. Data sources used for additionality demonstration may include but not limited to statistics published by the government authorities, studies published in scientific journals, reports published by international organisations working in transport sector.

5.4. Baseline emissions

19. The project activity may lead to modal shift of passengers as well as drivers of hitch-riding cars. The baseline emissions are the mobile emissions of vehicles which would be taken in absence of the project activity. The baseline emissions are calculated by for each car booking model respectively, as follows:

$$BE_y = \sum_i BE_{i,y} = BE_{t,y} + (BE_{o,y} + BE_{h,y}) \times (1 - Fy) \quad \text{Equation (1)}$$

$$= BE_{t,y} + (BE_{o,y} + (BE_{h,d,y} + BE_{h,p,y})) \times (1 - Fy)$$

Where:

- BE_y = Baseline emissions in year y (tCO₂e)
- $BE_{i,y}$ = Baseline emissions of car-booking model i in year y (tCO₂e)
- $BE_{t,y}$ = Baseline emissions of the passengers travelling by booking taxis in year y (tCO₂e)
- $BE_{o,y}$ = Baseline emissions of the passengers travelling by ride-sharing cars in year y (tCO₂e)
- $BE_{h,y}$ = Baseline emissions of the passengers and drivers travelling by hitch-riding cars in year y (tCO₂e)
- $BE_{h,d,y}$ = Baseline emissions of the drivers travelling by hitch-riding cars in year y (tCO₂e)
- $BE_{h,p,y}$ = Baseline emissions of the passengers travelling by booking a ride-sharing hitch-riding cars with the driver in year y (tCO₂e)
- y = Crediting year when emissions reductions are estimated
- i = Car booking model under project activity, representing t, o, h
- t = Traveling by booking taxis under project activity
- o = Traveling by booking ride-hailing sharing cars sharing under project activity
- h = Traveling by booking hitch-riding cars under project activity
- Fy = Fraction of comparable cities⁹ having in place ride-sharing services, including booking of ride-sharing cars or hitch-riding cars not registered as CDM project activity in year y

20. The emission reductions under the methodology are generated from the shift of transport mode. Thus, the baseline transport mode should shall be identified for each car booking model, i.e. booking of taxi, booking ride-sharing cars with another passenger(s) or booking hitch-riding cars ride-sharing with the driver.

⁹ Cities having population within +/- 50% range of the project city.

21. The share of the baseline transport mode ~~should~~ shall be determined through sampling survey as per requirements mentioned in Appendix 1 for the calculation of baseline emissions. All the feasible transport modes in project city ~~should~~ shall be listed for the survey. The baseline transport modes may include but are not limited to the following vehicle categories:

Bus;

Private passenger car;

Taxis;

~~Hailing cars without sharing;~~

Private motorcycles;

Urban rail transit (metro, light rail transit, trams);

E-biking;

E-Scooters;

Non-motorised transport modes

Walking;

Bicycling;

Passenger tricycle;

Cycle rickshaws;

Skates;

Skateboards;

Push scooters;

Hand carts;

Other vehicle categories such as para-transit;

No travelling;

Others.

22. If certain vehicles cannot be identified or listed, it ~~should~~ shall be categorized as “others”, and the baseline emissions ~~should~~ shall be determined as zero.

~~23. The project proponent may undertake promotion campaign which leads to the increase of the travelling trips. The survey should eliminate the impact from the promotion campaign. Only the trips from the passenger those who still choose to use the project app for travelling without promotion campaign can be included in project activity.~~

23. Baseline emissions of car booking model *i* are estimated as following equation

$$BE_{i,y} = PEF_{b,i,y} \times PD_{b,i,y} \times 10^{-6} \quad \text{Equation (2)}$$

Where:

- $PEF_{b,i,y}$ = Baseline emissions factor per passenger-kilometer of car booking model i in year y (gCO₂/pkm)
- $PD_{b,i,y}$ = Baseline passenger-mileage of car-booking model i in year y (pkm)
- 10^{-6} = Conversion from gCO₂e to tCO₂e

5.4.1. Determination of the baseline emission factor:

24. The baseline emission factor **should shall** be determined for each car booking model based on the share of passengers shifted from baseline vehicle categories j .

$$PEF_{b,i,y} = \sum_j (EF_{pkm,j,y} \times SD_{i,j}) \quad \text{Equation (3)}$$

Where:

- $PEF_{b,i,y}$ = Baseline emissions factor per passenger-kilometer of car booking model i in year y (gCO₂/pkm)
- $EF_{pkm,j,y}$ = Emission factor per passenger-kilometer of vehicle category j in year y (gCO₂/pkm)
- $SD_{i,j}$ = Share of vehicle category j as mentioned in **paragraph 21**, in baseline scenario (%) by passengers **or drivers** using car booking model i in the project scenario

25. The share of passengers **booking the taxis ($SD_{t,j}$), share of passengers** booking a ride sharing with another passenger(s) ($SD_{o,j}$), share of passengers booking a ride sharing with the driver ($SD_{h,p,j}$) and share of hitch-riding cars' drivers sharing their ride ($SD_{h,d,j}$) who would take baseline vehicle category j as mentioned in **paragraph 21** in baseline scenario **should shall** be determined by a sampling survey.

5.4.1.1. Determination of baseline emission factor per passenger-kilometer:

5.4.1.1.1. Electricity based transport system.

26. The emission factor per passenger-kilometer for electricity-based transport systems (e.g. urban rail-based systems) is determined using the **following equation provided under step 3 of the "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"** .:

$$EF_{pkm,j,y} = \frac{TE_{EL,j,y}}{PE_{EL,j,y} \times D_{EL,j,y}} \times 10^6 \quad \text{Equation (4)}$$

Where:

- $EF_{pkm,j,y}$ = **Emission factor per passenger-kilometer for electricity-based vehicle category j in year y (g CO₂/PKM)**
- $TE_{EL,j,y}$ = **Total emissions from electricity-based vehicle category j in year y (t CO₂), calculated using the "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"**

- $PF_{EL,j,y}$ = Total number of passengers transported by electricity-based vehicle category j in year y (passengers)
- $D_{EL,j,y}$ = Average trip distance travelled by passengers using electricity-based vehicle category j in year y (km)

5.4.1.1.2. Fuel based transport system.

27. Emission factors per PKM for fuel-based transport systems (e.g. road-based vehicles) ~~should~~ shall be calculated as follows using equation provided under step 3 of the "TOOL18: Baseline emissions for modal shift measures in urban passenger transport".:

$$EF_{pkm,j,y} = \frac{EF_{km,j,y}}{OC_{j,y}} \quad \text{Equation (5)}$$

Where:

- $EF_{pkm,j,y}$ = Emission factor per passenger-kilometer for vehicle category j in year y (g CO₂/pkm)
- $EF_{km,j,y}$ = Emission factor per kilometer of vehicle category j in year y (g CO₂/km)
- $OC_{j,y}$ = Average occupancy rate of vehicle category j in year y (passengers)

28. Emission factor per kilometer ~~should~~ shall be calculated based on the fraction of vehicles using a specific fuel type, the consumption of each fuel type and CO₂e emissions per unit of fuel consumed using equation provided under step 2 of the "TOOL18: Baseline emissions for modal shift measures in urban passenger transport".:

$$EF_{km,j,y} = \sum_n \frac{N_{j,n,y}}{N_{j,y}} \times (SFC_{j,n,y} \times NCV_{j,n} \times EF_{CO_2,n}) + \frac{N_{j,e,y}}{N_{j,y}} \times [SEC_{j,e,y} \times EF_{CO_2,e} \times (1 + TDL_{j,y})]$$

Equation (6)

Where:

- $EF_{km,j,y}$ = Emission factor per kilometer of vehicle category j in year y (gCO₂/km)
- $N_{j,n,y}$ = Number of vehicle-kilometers of vehicle category j using fuel type n driven in year y (VKM) or number of vehicles in vehicle category j using fuel type n in year y (units)
- $N_{j,e,y}$ = Number of vehicle-kilometers of vehicle category j using electricity driven in year y (VKM) or number of vehicles in vehicle category j using electricity in year y (units)
- $N_{j,y}$ = Number of vehicle-kilometers of category j driven in year y (VKM) or number of vehicles of category j in year y (units)
- $SFC_{j,n,y}$ = Specific fuel consumption of vehicle category j using fuel type n in year y (mass or volume units of fuel/km)
- $SEC_{j,e,y}$ = Specific electricity consumption of vehicle category j using electricity in year y (kWh/km)

$NCV_{j,n}$	=	Net calorific value of fuel n used in vehicle category j (MJ/mass or volume units of fuel)
$EF_{CO_2,n}$	=	Emission factor for fuel type n (g CO ₂ /MJ)
$EF_{CO_2,y}$	=	Emission factor for electricity in year y (g CO ₂ /kWh)
$TDL_{j,y}$	=	Average technical transmission and distribution losses for providing electricity to vehicle category j using electricity
n	=	Fuel types used by vehicle category j in year y
y	=	Crediting year when emissions reductions are estimated
j	=	Vehicle categories

29. Instead of the parameters $N_{j,n,y}$, $N_{j,e,y}$ and $N_{j,y}$, it is possible to use one parameter $N_{j,n,y}/N_{j,y}$ or $N_{j,e,y}/N_{j,y}$ which can be defined using the following options, described in the order of preference (refer to “Data and parameters” section for further guidance on data requirements):

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

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

5.4.2. Determination of baseline passenger-mileage

29. The baseline passenger-mileage ~~should~~ shall be determined using project passenger number and mileage of each booking order.

~~For the travelling by booking taxis, taxi drivers take booking orders from the passengers nearby through ride-hailing app, so long distance cruising to find the passengers could be shortened and the unloaded ratio of taxis is reduced. Thus, the taxis transport more passengers compared with the baseline scenario. The baseline mileages of the passengers travelling by booking taxis are the unloaded mileages reduced under project activity. The baseline passenger-mileages is calculated as:~~

$$PD_{b,t,y} = PD_{t,y} \times \left(\frac{k_B}{(1-k_B)} - \frac{k_{p,y}}{(1-k_{p,y})} \right) \quad \text{Equation (7)}$$

Where:

$PD_{b,t,y}$	=	Passenger-mileage of travelling by booking taxis in year y (pkm)
$PD_{t,y}$	=	Total travelling passenger-mileage of taxis under the project activity (km)
k_B	=	The average unloaded ratio of the taxis under baseline scenario (%)
$k_{p,y}$	=	The average unloaded ratio of the taxis under project scenario in year y (%)

For booking a ride-sharing car, the passengers with the same or similar route share the cars for travelling, which avoids the same trip taking place for each passenger under the baseline transportation mode. The baseline passenger-mileages $PD_{b,o,y}$ is calculated by the baseline

mileage and passenger number of each **ride-hailing sharing cars sharing** booking order k as follows:

$$PD_{b,o,y} = \sum_k (BD_{o,k,y} \times NP_{o,k,y}) \quad \text{Equation (8)}$$

Where:

$PD_{b,o,y}$	=	Baseline passenger-mileage of ride-hailing sharing cars sharing (pkm)
$BD_{o,k,y}$	=	Baseline travelling mileage under booking order k of ride-sharing cars (km)
$NP_{o,k,y}$	=	Number of passengers under booking order k of ride-sharing cars (passenger)
k	=	Travelling booking order

For booking a hitch-riding car, the baseline mileages of drivers $PD_{b,d,y}$ and the baseline mileage of passengers $PD_{b,p,y}$ **should shall** be determined respectively. The baseline passenger-mileages of drivers to be considered are the mileage of drivers which would **not** have used their personal car in the baseline scenario. The baseline passenger-mileage of passengers $PD_{b,p,y}$ **should shall** be calculated by the baseline mileage and passenger number of each hitch-riding cars booking order. The baseline passenger-mileages $PD_{b,d,y}$ and $PD_{b,p,y}$ are calculated as:

$$PD_{b,d,y} = \sum_k (BD_{h,d,k,y} \times ND_{h,k,y}) = \sum_k BD_{h,d,y} \quad \text{Equation (9)}$$

Where:

$PD_{b,d,y}$	=	Baseline passenger-mileage of hitch-riding cars' drivers (pkm)
$BD_{h,d,k,y}$	=	Baseline passenger-mileage of hitch-riding cars' drivers under booking order k (pkm)
$ND_{h,k,y}$	=	Number of hitch-riding cars' driver under booking order k , which equals to 1 (person)
$BD_{h,d,y}$	=	Total baseline passenger-mileage of hitch-riding cars' drivers (pkm)
k	=	Travelling booking order

$$PD_{b,p,y} = \sum_k (BD_{h,p,k,y} \times NP_{h,k,y}) \quad \text{Equation (10)}$$

Where:

$PD_{b,p,y}$	=	Baseline passenger-mileage of passengers travelling by hitch-riding cars (pkm)
$BD_{h,p,k,y}$	=	Baseline travelling mileage under booking order k of hitch-riding cars (km)
$NP_{h,k,y}$	=	Number of passenger under booking order k of hitch-riding cars (passenger)
k	=	Travelling booking order

30. To obtain the parameters of baseline mileage $BD_{o,k,y}$, $BD_{h,d,k,y}$ and $BD_{h,p,k,y}$, the planned shortest mileage between starting point and destination of each booking order **should shall** be used to avoid the inclusion of the detour mileage.

31. In the case that negative overall emission reductions arise in a year, CERs are not issued to project participants for the year concerned and in subsequent years, until emission reductions from subsequent years have compensated the quantity of negative emission reductions from the year concerned. For example, if negative emission reductions of 30 tCO₂e occur in the year t and positive emission reductions of 100 tCO₂e occur in the year t+1, only 70 CERs are issued for the year t+1.

~~32. The baseline emissions are the summation of the baseline emissions from each car booking model covered by the project activity.~~

5.5. Leakage

32. No other leakage emissions are considered.

5.6. Project emissions

33. The project emissions are to be calculated as follows:

$$PE_y = PE_{t,y} + PE_{o,y} + PE_{h,y} \quad \text{Equation (11)}$$

Where:

PE_y	=	Project emissions in year y (tCO ₂ e)
$PE_{t,y}$	=	Project emissions of the travelling by booking taxis in year y (tCO ₂ e)
$PE_{o,y}$	=	Project emissions of the travelling by booking hailing cars sharing ride-sharing cars in year y (tCO ₂ e)
$PE_{h,y}$	=	Project emissions of the travelling by booking hitch-riding cars in year y (tCO ₂ e)

~~34. Project emissions of travelling by booking taxis $PE_{t,y}$ is deemed as zero since the total travelling mileages of taxis remains the same under project activity scenario.~~

34. The project emissions of the travelling by booking a ride-sharing with another passenger(s) cars are calculated as follows:

$$PE_{o,y} = D_{o,y} \times EF_{km,o,y} \times 10^{-6} \quad \text{Equation (12)}$$

Where:

$PE_{o,y}$	=	Project emissions of the travelling by booking hailing cars ride-sharing cars in year y (tCO ₂ e)
$D_{o,y}$	=	The total travelling mileage of the hailing cars ride-sharing cars under car-sharing booking orders (km)
$EF_{km,o,y}$	=	The emission factor per kilometer of hailing cars ride-sharing cars in year y (gCO ₂ /km), to be calculated according to equation (6) para 28 above, in which the vehicle category j refers to hailing ride-sharing cars

35. The project emissions of the booking a ride-sharing with the drivers hitch-riding cars are calculated as follows:

$$PE_{h,y} = D_{h,y} \times EF_{km,h,y} \times 10^{-6} \quad \text{Equation (13)}$$

Where:

- $PE_{h,y}$ = Project emissions of the travelling by booking hitch-riding cars sharing in year y (tCO₂e)
- $D_{h,y}$ = The total travelling mileage of the hitch-riding cars (km)
- $EF_{km,h,y}$ = The emission factor per kilometer of hitch-riding cars in year y (gCO₂/km), to be calculated according to equation (6) para 28 above, in which the vehicle category j refers to hitch-riding cars

36. The emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{Equation (14)}$$

Where:

- ER_y = Emission reductions in year y (tCO₂e)
- BE_y = Baseline emissions in year y (tCO₂e)
- PE_y = Project emissions in year y (tCO₂e)

37. Only the data of the booking orders which have been fulfilled can be included in the emission reductions.

6. Monitoring methodology

37. In addition to the parameters listed in the tables below, the procedures contained in the tools referred to in this methodology also apply.

6.1. Data and parameters monitored

Data / Parameter table 1.

Data / Parameter:	F_y
Data unit:	-
Description:	Fraction of comparable cities having in place ride-sharing services, including booking of ride-sharing cars or hitch-riding cars not registered as CDM project activity in year y
Source of data:	Published Literature
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	Parameter shall be evaluated at validation and then after updated every year
Any comment:	-

Data / Parameter table 2.

Data / Parameter:	SD_{i,j}
Data unit:	%

Description:	Share of vehicle category j which would be taken in baseline scenario by passengers using car booking model i in the project scenario
Source of data:	Survey
Measurement procedures (if any):	The sampling survey on the travelling modes could be conducted by the project system operator or by third-party entity. The sampling could be questionnaire survey. The target could be the passengers who take the taxis or cars using the ride-hailing app.
Monitoring frequency:	For fixed crediting period or first seven years of a renewable crediting period: The year 1 and 4. 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 period of the project activity. Second and third crediting periods of a renewable crediting period: Year 1: Annually See appendix for survey guidance.
QA/QC procedures:	Samples shall be based on 90/10 confidence/precision
Any comment:	-

Data / Parameter table 3.

Data / Parameter:	$SD_{t,j}$
Data unit:	%
Description:	Share of passengers booking the taxis who would take vehicle category j in baseline scenario
Source of data:	Survey
Measurement procedures (if any):	The sampling survey on the travelling modes could be conducted by the project system operator or by third-party entity. The sampling could be questionnaire survey. The target could be the passengers who take the taxis using the ride-hailing app.
Monitoring frequency:	For fixed crediting period or first seven years of a renewable crediting period: The year 1 and 4. 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 period of the project activity. Second and third crediting periods of a renewable crediting period: Year 1: Annually See appendix for survey guidance.
QA/QC procedures:	Samples shall be based on 90/10 confidence/precision
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	$SD_{o,j}$
Data unit:	%
Description:	Share of passengers booking a ride-sharing cars with another passenger(s) who take vehicle category j in baseline scenario

Source of data:	Survey
Measurement procedures (if any):	The sampling survey on the travelling modes could shall be conducted by the project system operator or by third-party entity. The sampling shall could be questionnaire survey. The target could shall be the passengers who use the hailing ride-sharing cars sharing
Monitoring frequency:	For fixed crediting period or first seven years of a renewable crediting period: The year 1 and 4. 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 period of the project activity. Second and third crediting periods of a renewable crediting period: Year 1. Annually. See appendix for survey guidance
QA/QC procedures:	Samples shall be based on 90/10 confidence/precision. As cross-check, if the respondent states that its baseline mode of travel is travelling by car then, the ride-sharing app shall have a copy of respondent's driving licence or driving permit
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	$SD_{h,p,j}$
Data unit:	%
Description:	Share of passengers booking a ride with the driver hitch-riding car, where passenger take vehicle category j in baseline scenario
Source of data:	Survey
Measurement procedures (if any):	The sampling survey on the travelling modes could shall be conducted by the project system operator or by third-party entity. The sampling could shall be questionnaire survey. The target could shall be the passengers who use the hitch-riding cars
Monitoring frequency:	For fixed crediting period or first seven years of a renewable crediting period: The year 1 and 4. 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 period of the project activity. Second and third crediting periods of a renewable crediting period: Year 1. Annually. See appendix for survey guidance
QA/QC procedures:	Samples shall be based on 90/10 confidence/precision. As cross-check, if the respondent states that its baseline mode of travel is travelling by car then, the ride-sharing app shall have a copy of respondent's driving licence or driving permit
Any comment:	

Data / Parameter table 6.

Data / Parameter:	$SD_{h,d,j}$
Data unit:	%
Description:	Share of hitch-riding cars' drivers who take vehicle category j in baseline scenario

Source of data:	Survey
Measurement procedures (if any):	The sampling survey on the travelling modes could shall be conducted by the project system operator or by third-party entity. The sampling shall be questionnaire survey. The target could shall be the hitch-riding cars' drivers who drive the hitch-riding cars
Monitoring frequency:	For fixed crediting period or first seven years of a renewable crediting period: The year 1 and 4. 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 period of the project activity. Second and third crediting periods of a renewable crediting period: Year 1. Annually. See appendix for survey guidance
QA/QC procedures:	Samples shall be based on 90/10 confidence/precision
Any comment:	-

Data / Parameter table 7.

Data / Parameter:	$PE_{EL,j,y}$
Data unit:	passengers
Description:	Total number of passengers transported per annum by electricity-based vehicle category j in year y
Source of data:	As per "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 8.

Data / Parameter:	$DEL_{j,y}$
Data unit:	km
Description:	Average trip distance travelled by passengers using electricity-based vehicle category j in year y
Source of data:	As per "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 9.

Data / Parameter:	$OC_{j,y}$
Data unit:	passengers
Description:	Average occupancy rate of vehicle category j in year y

Source of data:	As per "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
Measurement procedures (if any):	As per "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 10.

Data / Parameter:	$N_{j,n,y}$
Data unit:	vkm or units
Description:	Number of vehicle-kilometers vehicle category j using fuel type n driven in year y (VKM) or number of vehicles in vehicle category j using fuel type n in year y (units)
Source of data:	The data from the project system operator, 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 national data from the statistical data or other publicly available information, such as industry research data, literature data can shall be used
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	In case the data of vehicle category j is obtained from the system operator, the registration information of the cars in the project system shall should be used. 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
Any comment:	This parameter is used to calculate emission factor per kilometer of ride-sharing cars and / or hitch-riding cars as per equation provided in "TOOL18: Baseline emissions for modal shift measures in urban passenger transport". Used for all relevant vehicle categories. Or use the parameter $N_{j,n,y}/N_{j,y}$

Data / Parameter table 11.

Data / Parameter:	$N_{j,e,y}$
Data unit:	vkm or units
Description:	Number of vehicle-kilometers vehicle category j using electricity driven in year y (VKM) or number of vehicles in vehicle category j using electricity in year y (units).

Source of data:	The data from the project system operator, 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 national data from the statistical data or other publicly available information, such as industry research data, literature data can shall be used
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	In case the data of vehicle category <i>j</i> is obtained from the system operator, the registration information of the cars in the project system shall should be used. 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
Any comment:	This parameter is used to calculate emission factor per kilometer of ride-sharing cars and / or hitch-riding cars as per equation provided in "TOOL18: Baseline emissions for modal shift measures in urban passenger transport". Used for all relevant vehicle categories. Or use the parameter $N_{j,e,y}/N_{j,y}$

Data / Parameter table 12.

Data / Parameter:	$N_{j,y}$
Data unit:	vkm or units
Description:	Number of vehicle-kilometers of category <i>j</i> driven in year <i>y</i> (VKM) or number of vehicles of category <i>j</i> in year <i>y</i> (units)
Source of data:	The data from the project system operator, 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 national data from the statistical data or other publicly available information, such as industry research data, literature data can shall be used
Measurement procedures (if any):	-
Monitoring frequency:	Annually

QA/QC procedures:	<p>In case the data of vehicle category j is obtained from the system operator, the registration information of the cars in the project system shall should be used.</p> <p>Used for all vehicle categories identified as relevant.</p> <p>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</p>
Any comment:	<p>This parameter is used to calculate emission factor per kilometer of ride-sharing cars and / or hitch-riding cars as per equation provided in "TOOL 18: Baseline emissions for modal shift measures in urban passenger transport".</p> <p>Used for all relevant vehicle categories.</p> <p>Or use the parameter $N_{j,n,y}/N_{j,y}$, $N_{j,e,y}/N_{j,y}$</p>

Data / Parameter table 13.

Data / Parameter:	$N_{j,n,y}/ N_{j,y}$
Data unit:	%
Description:	The fraction of vehicles using fuel type n in vehicle category j
Source of data:	National transport statistics based on vehicle registration statistics, company data (for buses), surveys or other publicly available information, such as industry research data, literature data.
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	<p>In case the data of vehicle category j is obtained from the system operator, the registration information of the cars in the project system shall should be used.</p> <p>Used for all vehicle categories identified as relevant.</p> <p>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</p>
Any comment:	<p>This parameter is used to calculate emission factor per kilometer of ride-sharing cars and / or hitch-riding cars as per equation provided in "TOOL 18: Baseline emissions for modal shift measures in urban passenger transport".</p> <p>Used for all relevant vehicle categories</p>

Data / Parameter table 14.

Data / Parameter:	$N_{j,e,y}/ N_{j,y}$
Data unit:	%

Description:	The fraction of vehicles using electricity <i>in</i> vehicle category <i>j</i>
Source of data:	National transport statistics based on vehicle registration statistics, company data (for buses), surveys or other publicly available information, such as industry research data, literature data, etc.
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	In case the data of vehicle category <i>j</i> is obtained from the system operator, the registration information of the cars in the project system shall should be used. 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
Any comment:	This parameter is used to calculate emission factor per kilometer of ride-sharing cars and / or hitch-riding cars as per equation provided in "TOOL18: Baseline emissions for modal shift measures in urban passenger transport". Used for all relevant vehicle categories

Data / Parameter table 15.

Data / Parameter:	$SFC_{j,n,y}$
Data unit:	mass or volume units of fuel/km
Description:	Specific fuel consumption of vehicle category <i>j</i> using fuel type <i>n</i> in year <i>y</i>
Source of data:	As per "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
Measurement procedures (if any):	As per "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 16.

Data / Parameter:	$SEC_{j,e,y}$
Data unit:	kWh/km
Description:	Specific electricity consumption of vehicle category <i>j</i> using electricity in year <i>y</i>
Source of data:	As per "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
Measurement procedures (if any):	As per "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"

Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 17.

Data / Parameter:	$NCV_{j,n}$
Data unit:	MJ/mass or volume units of fuel
Description:	Net calorific value of fuel n used in vehicle category j
Source of data:	As per "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
Measurement procedures (if any):	-
Monitoring frequency:	As per "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
QA/QC procedures:	As per "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
Any comment:	As per "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"

Data / Parameter table 18.

Data / Parameter:	$EF_{CO_2,n}$
Data unit:	g CO ₂ /MJ
Description:	Emission factor for fuel type n
Source of data:	As per "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
Measurement procedures (if any):	-
Monitoring frequency:	As per "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 19.

Data / Parameter:	$EF_{CO_2,y}$
Data unit:	gCO ₂ /kWh
Description:	Emission factor for electricity in year y
Source of data:	As per "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"
Measurement procedures (if any):	As per "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 20.

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

Data / Parameter table 21.

Data / Parameter:	$PD_{t,y}$
Data unit:	km
Description:	Travelling passenger mileage of the taxis under the project activity
Source of data:	Project system operator
Measurement procedures (if any):	Accumulated by the carrying mileage multiplying passenger number of each taxi booking order. Default value of taxi passenger number from "TOOL18: Baseline emissions for modal shift measures in urban passenger transport" may be used.
Monitoring frequency:	Monitored by each booking order, recorded at least annually
QA/QC procedures:	The maintenance and management of GPS-based positioning system or taxi odometer shall meet the requirements of relevant international/national standards. The carrying mileage should be checked with the billing data.
Any comment:	-

Data / Parameter table 22.

Data / Parameter:	k_B
Data unit:	%
Description:	Average unloaded ratio of the taxis under baseline scenario
Source of data:	Calculated by monitoring the taxis' unloaded mileage and total travelling mileage in the project city;
Measurement procedures (if any):	If the data source by monitoring the mileage of the taxis is chosen, the data can be monitored with the assistant of local taxi company or administrative department or by sampling survey. The vintage of the data could be as follows in decreasing order of preference: 1. The data of the taxis without ride-hailing app in year y ; 2. The lowest value of the data in the most recent 3 years before the starting date of the project.
Monitoring frequency:	Once, before the project start date

QA/QC procedures:	<p>In case sampling survey is conducted, samples shall be based on 90/10 confidence/precision.</p> <p>The mileage data should be monitored and recorded by GPS, odometer or other electronic method. The maintenance and management of GPS-based positioning system or odometer shall meet the requirements of relevant international/national standards.</p> <p>Compare the data for cross-check purpose with one of the following:</p> <ul style="list-style-type: none"> — The statistical data in the city, region or the country where the project activity takes place; — The data from other publicly available information, such as industry research data, literature data, etc.
Any comment:	All the existing practices for booking taxi should be considered for the determination of k_B . The existing practices may include taxi cruising, taxi waiting at the taxi stand or passenger calling taxi service centre, etc.

Data / Parameter table 23.

Data / Parameter:	Unloaded mileage of taxis under baseline scenario
Data unit:	km
Description:	Unloaded travelling mileage of the taxis under baseline scenario
Source of data:	If the data source of k_B by monitoring is chosen, the data can be monitored with the assistance of local taxi company or administrative department or by sampling survey.
Measurement procedures (if any):	<p>Using GPS and odometer to record the total travelling mileage and the mileage carrying passenger. The difference should be the unloaded mileage.</p> <p>All the existing practices for booking taxi should be considered. The existing practices may include taxi cruising, taxi waiting at the taxi stand or passenger calling taxi service centre, etc.</p> <p>For total travelling mileage, only the mileage under business mode of taxis should be considered. The mileage during the period when the taxi is not available for carrying passengers, such as shifting duty or the driver travelling home, should not be included as total travelling mileage.</p>
Monitoring frequency:	Once, before the project start date
QA/QC procedures:	<p>In case sampling survey is conducted, samples shall be based on 90/10 confidence/precision.</p> <p>The mileage data should be monitored and recorded by GPS, odometer or other electronic method. The maintenance and management of GPS-based positioning system or odometer shall meet the requirements of relevant international/national standards. The carrying mileage should be checked with the billing data.</p>
Any comment:	Used for calculating k_B when option (a) is selected.

Data / Parameter table 24.

Data / Parameter:	$k_{P,y}$
Data unit:	%
Description:	Average unloaded ratio of the taxis under project scenario in year y
Source of data:	The data obtained from local taxi company by monitoring the taxis' unloaded mileage and total travelling mileage in the city.
Measurement procedures (if any):	The data could be obtained by monitoring 100% of the taxis under the project activity, or by sampling survey
Monitoring frequency:	Annually
QA/QC procedures:	In case sampling survey is conducted, samples shall be based on 90/10 confidence/precision. The mileage data should be monitored and recorded by GPS, odometer or other electronic method. The maintenance and management of GPS-based positioning system or odometer shall meet the requirements of relevant international/national standards. Mileage and time calculation system of the app should meet relevant national/industrial standard and should be tested by authorized entity.
Any comment:	The traveling mileage during the period when driver turn-off their availability in the system should be included. If it is not able to know whether the taxi is taking any passenger during the period, the mileage during the period should be deemed as unloaded mileage to be conservative.

Data / Parameter table 25.

Data / Parameter:	Unloaded mileage of taxis under project scenario
Data unit:	km
Description:	Unloaded travelling mileage of the taxis under project scenario
Source of data:	Project system operator
Measurement procedures (if any):	The data could be obtained by monitoring 100% of the taxis under the project activity, or by sampling survey. Using GPS and odometer to record the total travelling mileage and the mileage carrying passenger. The difference should be the unloaded mileage. The traveling mileage during the period when driver turn-off their availability in the system should be included in the total travelling mileage. If it is not able to know whether the taxi is taking any passenger during the period, the mileage during the period should be deemed as unloaded mileage to be conservative.
Monitoring frequency:	Annually
QA/QC procedures:	In case sampling survey is conducted, samples shall be based on 90/10 confidence/precision. The mileage data should be monitored and recorded by GPS, odometer or other electronic method. The maintenance and management of GPS-based positioning system or odometer shall meet the requirements of relevant international/national standards. Mileage and time calculation system of the app should meet relevant national/industrial standard and should be tested by authorized entity.
Any comment:	Used for calculating $k_{P,y}$ when option (a) is selected.

Data / Parameter table 26.

Data / Parameter:	$BD_{o,k,y}$
Data unit:	km
Description:	Baseline travelling mileage under booking order k of hailing ridecars-sharing cars
Source of data:	Project system operator
Measurement procedures (if any):	<p>The baseline mileage shall should be recorded as the shortest planned mileage between the starting point and the destination of each hailing ride-sharing cars' sharing booking order.</p> <p>The method how the planned mileage is determined shall should be justified to ensure the reasonableness and conservativeness of baseline travelling mileage data.</p> <p>Mileage and time calculation system of the app shall should meet relevant national/industrial standard and shall should be tested by authorized entity</p>
Monitoring frequency:	Monitored by each booking order, recorded at least annually
QA/QC procedures:	<p>The maintenance and management of GPS-based positioning system or odometer shall meet the requirements of relevant international/national standards.</p> <p>The mileage data shall should be checked with the billing data</p>
Any comment:	-

Data / Parameter table 27.

Data / Parameter:	$NP_{o,k,y}$
Data unit:	passenger
Description:	Number of passenger under booking order k of hailing cars ride-sharing cars
Source of data:	Project system operator
Measurement procedures (if any):	When booking hailing ride-sharing cars, passenger usually need to submit the number of passenger under the booking order to meet the carrying capacity of hailing ride-sharing cars. The project system shall should record the data correspondingly to $BD_{o,k,y}$
Monitoring frequency:	Monitored by each booking order, recorded at least annually
QA/QC procedures:	The passenger data shall be recorded by a data logger and be protected such that it cannot be modified artificially
Any comment:	-

Data / Parameter table 28.

Data / Parameter:	$BD_{h,d,y}$
Data unit:	km
Description:	Total b Baseline passenger-mileage of hitch-riding cars' drivers
Source of data:	Project system operator

Measurement procedures (if any):	Accumulated and recorded as the shortest planned mileage between the starting point and the destination of the hitch-riding cars' drivers. The baseline mileage shall be recorded as the shortest planned mileage between the starting point and the destination of each hitch-riding cars' drivers. The method how the planned mileage is determined shall should be justified to ensure the reasonableness and conservativeness of baseline travelling mileage data
Monitoring frequency:	Monitored by each booking order, recorded at least annually
QA/QC procedures:	The maintenance and management of GPS-based positioning system or taxi odometer shall meet the requirements of relevant international/national standards. Mileage and time calculation system of the app shall should meet relevant national/industrial standard and shall should be tested by authorized entity
Any comment:	-

Data / Parameter table 29.

Data / Parameter:	$BD_{h,p,k,y}$
Data unit:	km
Description:	Baseline travelling mileage under order k of hitch-riding cars
Source of data:	Project system operator
Measurement procedures (if any):	The baseline mileage shall should be recorded as the shortest planned mileage between the starting point and the destination of each hitch-riding cars booking order booking order. The method how the planned mileage is determined shall should be justified to ensure the reasonableness and conservativeness of baseline travelling mileage data
Monitoring frequency:	Monitored by each booking order, recorded at least annually
QA/QC procedures:	The maintenance and management of GPS-based positioning system or odometer shall meet the requirements of relevant international/national standards. The mileage data shall should be checked with the billing data. Mileage and time calculation system of the app shall should meet relevant national/industrial standard and shall should be tested by authorized entity
Any comment:	-

Data / Parameter table 30.

Data / Parameter:	$NP_{h,k,y}$
Data unit:	passenger
Description:	Number of passenger under order k of hitch-riding cars
Source of data:	Project system operator
Measurement procedures (if any):	When booking hitch-riding cars, passenger usually need to submit the number of passenger under the booking order to meet the carrying capacity of hitch-riding cars. The project system shall should record the data correspondingly to $BD_{h,p,k,y}$
Monitoring frequency:	Monitored by each booking order, recorded at least annually

QA/QC procedures:	The passenger data shall be recorded by a data logger and be protected such that it cannot be modified artificially. The original data recorded by the app shall should be provided to DOE for verification
Any comment:	-

Data / Parameter table 31.

Data / Parameter:	$D_{o,y}$
Data unit:	km
Description:	The total travelling mileage of the hailing cars ride-sharing cars under car-sharing booking orders
Source of data:	Project system operator
Measurement procedures (if any):	The data shall should be monitored and recorded by GPS, odometer or other electronic method
Monitoring frequency:	Continuously, recorded at least annually
QA/QC procedures:	The maintenance and management of GPS-based positioning system or taxi odometer shall meet the requirements of relevant international/national standards. Mileage and time calculation system of the app shall should meet relevant national/industrial standard and shall should be tested by authorized entity
Any comment:	-

Data / Parameter table 32.

Data / Parameter:	$D_{h,y}$
Data unit:	km
Description:	The total travelling mileage of the hitch-riding cars
Source of data:	Project system operator
Measurement procedures (if any):	The data shall should be monitored and recorded by GPS, odometer or other electronic method
Monitoring frequency:	Continuously, recorded at least annually
QA/QC procedures:	The maintenance and management of GPS-based positioning system or taxi odometer shall meet the requirements of relevant international/national standards
Any comment:	-

Appendix 1. Methodological design of survey

1. Survey objective

1. The survey objective is to determine the baseline travelling modes in absence of the project activity and the ratio of each baseline travelling mode.

2. Target population

2. The target population are all passengers who use taxis, ~~hailing cars~~ ride-sharing cars, or hitch-riding cars, as well as the drivers of hitch-riding cars under the project activity, respectively.

3. Sample frame

3. Data for the passenger/driver frame is obtained from the project system.

4. Sample design

4. Since the travelling activity take place across the city, the simple random sampling ~~could~~ **shall** be applied.

5. Sample frequency

5. ~~The survey is realized minimum once during the year 1 and 4 of the crediting period. The survey shall take place during an entire week. The selected week shall not correspond to a public holiday and shall be representative for the average demand for transport services in the considered year.~~ The survey is realized annually. To avoid bias, the survey shall take place during an entire week in each season. The selected weeks shall not correspond to a public holiday and shall be representative for the average demand for transport services in the considered year and shall avoid unusual weather such as heavy rain or snow. Average value of survey result is to be applied for emission reduction calculation.

6. Sample size

6. The latest version of “Standard: Sampling and surveys for CDM project activities and programme of activities” and “Guidelines for sampling and surveys for CDM project activities and programme of activities” ~~shall~~ **should** be applied.

7. Selection method of the sample

7. It is necessary to ensure that the sample selection process is completely random and not affected by any variables such as age, gender **or usage of the app**. The selection of the sample will be performed according to the systematic sampling design and considering the following steps:

- a) A random starting point is generated according to the statistics tables of uniform distribution between 1 and the average flow of passengers in the evaluation hour;

- b) Systematic selection of passengers: every nth passenger using the taxi, **hailing cars ride-sharing cars** or hitch-riding cars service, starting with the random number. In this way, if the random number is 10, the first passenger selected is the 10th that uses the booking service for taxis, **hailing cars ride-sharing cars** or hitch-riding cars, the 2nd n+10 and thus successively every nth passenger. The number n, called selection interval, will be determined based on the passenger flow per hour and the sample distribution of the specific measurement day. For the driver of hitch-riding cars, the similar approach **could shall** be applied.

8. Survey realization

8. The following principles are to be followed in the survey realization:

- a) Non-responses **shall should** be recorded;
- b) Record and store all original surveys;
- c) Surveys **can shall** be conducted through the ride-**hailing sharing** app. The respondents **shall should** be numbered based on the survey date and time. It **shall should** be avoided to realize the survey with people de-boarding the cars as latter will not want to invest time in a survey thus potentially giving wrong answers.

9. The questionnaire can be sent to the target to be surveyed through the ride-**hailing sharing** app. The following phase **shall should** be followed:

- a) Preparation phase

This phase is characterized by the development of all the activities previous to the execution of the survey realization and it is divided in:

Determine the survey questionnaire and draft the manual on information collection and basic concepts. The manual on information collection and basic concepts covers the questionnaire structure, the instructions and specifications for filling in the questionnaire, the definitions and basic concepts of the study and the instructions and formats used;

Relevant materials **shall should** be prepared including the explanation on the basic concepts, relevant instructions, and so on. The materials **shall should** be sent to the passengers through the project system platform before the investigation begins, so that the participants **can shall** understand the background, significance and requirements of the survey when they receive the questionnaire. Preliminary tests **can shall** be conducted prior to the actual survey to understand passenger acceptance of the questionnaire and to ensure that all the concepts are clearly defined and the questions are not ambiguously phrased and avoid interviewer errors. Interviewers may misread the question or twist the answers in their own words and thereby introduce bias. The pre-test has to detect and minimize this potential error;

The results of the pre-test will be documented and will be taken into consideration for the modification of the final instrument and for the preparation of the model of information collection;

- b) Validation process of the information:

A supervisor **shall should** be used to carry out the survey verifications, guaranteeing the validity of the gathered information as well as the attained coverage. At least the questions on the default questionnaire included below is to be used. This questionnaire **shall should** be used by

all projects except if valid arguments exist to change the questionnaire and to adapt it to local circumstances. The questionnaire shall be realized in the local language. The questionnaire needs to be adapted to national or local circumstances, the wording needs to be checked locally and local test-runs shall should be performed to ensure that the questions are simple, easily understood, cannot be misinterpreted and lead to reliable results.

c) Collection of the survey result:

The result of the survey shall should be archived in time to avoid missing data.

9. Verification of the survey

10. Original information of the sampled order shall should be recorded and provided to DOE, including the ID of the passenger, the travelling route (including the starting point and destination point of the order) and the responses from the passenger. DOE shall verify whether the samples are selected according to the survey design.

Appendix 2. Default questionnaire

Date:.....

Time:

Location:

General Data of Interviewed Person

Age of interviewed person:

- 12-17 years
- 18-25 years
- 26-35 years
- 36-45 years
- 46-55 years
- 56-65 years
- over 65 years

Gender of the interviewed person

- Female Male

Details about the current trip

1. Starting point of the travelling:
2. Destination of the travelling:
3. Car booking model used to travel

Booking taxi;

- Booking a ride with another passenger(s);
- Booking a ride driver (passenger);
- Hitch-riding cars' driver.

4. The frequency of your use (or plan to use) of taxi/hailing cars sharing/hitch-riding cars is:

Car booking model	Frequency of usage		
	Almost every day	Occasionally	Rarely
Booking taxi			
Booking a ride with another passenger(s);			

Car booking model	Frequency of usage		
Booking a ride driver (passenger)			
Hitch-riding cars' driver			

~~5. Which kind of promotion campaign do you receive for this trip?~~

~~No campaign; Discount of travelling fee; Rebate on travelling fee; Other campaign;~~

~~6. (For those who have received promotion campaign for the trip) If there is no promotion campaign, would you choose the app to book travelling?~~

~~Yes; No;~~

~~7. 4. If there is no taxi/hailing cars ride-sharing/hitch-riding cars booking service, which way do you choose to arrive at your destination? (please choose one item)~~

~~Note: Please choose your answer considering there is **NO** promotion campaign for this trip.~~

- Bus;
- Private passenger car
- If you choose a private passenger car: does your private passenger car use renewable fuels? Yes ; No ;
- Taxi⁴⁰;
- ~~Hailing cars without sharing;~~ Private motorcycles
- If you choose a motorcycle: does your motorcycle use renewable fuels? Yes ; No ;
- Urban rail transit;
- E-Biking;
- E-Scooters;
- Walking;
- Bicycles;
- Passenger tricycle;
- Cycle rickshaws;
- Skates;
- Skateboards;
- Push scooters
- No travelling;
- Others

Note: The information on date, time, location and travel information can may also be automatically recorded by the project system platform to reduce the content to be filled by the respondents and to improve the response ratio and the accuracy of information.

⁴⁰ ~~Should not be an option for passengers booking a taxi using ride-hailing app~~

Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
03.0	9 October 2019	MP 80, Annex 12 To be considered by the Board at EB 105. This version incorporates the input and guidance provided by the Board at EB 103.
02.0	20 May 2019	MP 79, Annex 3 To be considered by the Board at EB 103. This version incorporates the input and guidance provided by the Board at EB 102.
01.0	11 March 2019	MP 78, Annex 8 To be considered by the Board at EB 102.

Decision Class: Regulatory
Document Type: Standard
Business Function: Methodology
Keywords: simplified methodologies, transport, type (iii) projects
