3. Traffic Congestion Mitigation / Modal Shift (Passenger)

1. Typical Project

- Passenger modal shift from existing transportation modes (e.g. buses, private car, taxi, motorbike) to MRT (Mass Rapid Transit), railway, monorail, LRT (Light Rail Transit), BRT (Bus Rapid Transit) and trunk bus.
- A project to reduce greenhouse gas (GHG) emissions by promoting congestion mitigation of existing transportation facilities through road maintenance, bridge construction, double track, etc.

2. Applicability

(1) Development of transport system(s) that can realize an efficient inner-city passenger transport such as MRT (Mass Rapid Transit), railway, monorail, LRT (Light Rail Transit), BRT (Bus Rapid Transit) and trunk bus. Or promoting congestion mitigation of existing transportation facilities through road maintenance, bridge construction, double track, etc.

(2) The baseline transport modes should be buses, private cars, taxis and existing railways etc.

3. Methodology of Emission Reduction Calculation

The emission reduction from the project activity is determined as the differences between the GHG emission of baseline scenario (existing mode of transportation, e.g. buses, private car, taxi, motorbike) and project scenario (e.g. MRT, road maintenance, bridge construction, double track, etc.).

$$ER_y = BE_y - PE_y$$

ER_y : GHG emission reduction through the project in year y (t-CO_2e/y)

BE_y : GHG emission from the baseline scenario in year y (t-CO_2e/y)

PE_y : GHG emission from the project scenario in year y (t-CO_2e/y)

The representative value of annual emission reductions should indicate the average value for the calculation period.

(1) Calculation of Baseline Emission

Baseline GHG emission is calculated based on the transportation number (or multiplying number of passenger and share of passengers and divided by average occupancy rate) completed by the project, average trip distance by baseline transport modes and CO_2 emission factor per km.

$$BE_y = \sum_i \left(\frac{P_y \times MS_{bi,y}}{OR_{bi}} \times BTDP_{by} \times SFC_i \times NCV_i \times EF_{fuel,i} \right)$$

$$= \sum_i \left(\frac{P_y \times MS_{bi,y}}{OR_{bi}} \times BTDP_{by} \times EF_{KM,i} \right)$$

$BPKM_y$: Passenger transportation volume/activity by the project in year y (passenger-km/y)

P_y : Number of passengers transported by the project in year y (passenger/y)

$BTDP_y$: Average trip distance of the passenger of the project activity in year y (km)

$MS_{i,y}$: Share of passengers by transport mode i in the baseline scenario in year y (%)

OR_{bi} : Average occupation rate of transport mode i (passenger/vehicle)

SFC_i : Fuel consumption rate of transportation i (t/km)

$EF_{KM,i}$: CO_2 emission factor of transport mode i (t-CO_2/km)

(2) Calculation of Project Emission

2-1) Modal shift

- In the case of the project activity using electricity

It is estimated by multiplying annual electricity consumption of the project activity and CO_2 emission factor of the grid electricity.

$$PE_y = EC_{PJ,y} \times EF_{elec}$$

$EC_{PJ,y}$: Electricity consumption associated with the operation of the project activity in year y (MWh/y)

EF_{elec} : CO_2 emission factor of the grid electricity (t-CO_2/MWh)

- In the case of the project activity using fossil fuels

It is estimated by multiplying annual fossil fuel consumption of the project activity and CO_2 emission factor of the fossil fuel.

$$PE_y = \sum_i \left(FC_{PJ,y} \times NCV_i \times EF_{fuel,i} \right)$$

$FC_{PJ,i,y}$: Consumption of fuel i associated with the operation of the project activity in year y (t/y)

NCV_i : Net calorific value of fuel i (TJ/t)

$EF_{fuel,i}$: CO_2 emission factor of fuel i (t-CO_2/TJ)

2-2) Promoting congestion mitigation through road maintenance, bridge construction, double track, etc.

Project GHG emission is calculated by multiplying number of vehicle of each transport mode (multiplying number of passenger and share of passengers and divided by average occupancy rate), average trip distance and CO_2 emission factor per km.

$$PE_y = \sum_i \left(\frac{P_y \times MS_{pi,y}}{OR_{pi}} \times BTDP_{py} \times SFC_i \times NCV_i \times EF_{fuel,i} \right)$$

$$= \sum_i \left(\frac{P_y \times MS_{pi,y}}{OR_{pi}} \times BTDP_{py} \times EF_{KM,i} \right)$$

P_y : Number of passengers transported by the project in year y (passenger/y)

$BTDP_{py}$: Average trip distance of the passenger of the project activity in year y (km)

$MS_{pi,y}$: Share of passengers by transport mode i in the baseline scenario in year y (%)

OR_{pi} : Average occupation rate of transport mode i (passenger/vehicle)

SFC_i : Fuel consumption rate of transportation i (t/km)

$EF_{KM,i}$: CO_2 emission factor of transport mode i (t-CO_2/km)

4. Data and Parameters Estimated and Need Monitoring

Data	Description	Data Sources			
		For baseline emission calculation		For project emission calculation	
		Ex-ante	Ex-post	Ex-ante	Ex-post
P_y	Number of passenger of the project activity in year y (passenger/y)	A planned value	A monitored value		
$BTDP_{by}$	Average trip distance of the passenger in the baseline scenario in year y (km). In the case of modal shift, it is the distance traveled by the project transportation				
$BTDP_{py}$	Average trip distance of the passenger of the project activity in year y (km)				
$MS_{bi,y}$	Share of passengers by transport mode i in the baseline scenario in year y (%)	From the following sources in the order of priority i) A planned value ii) Modal share of the city done by an previous study	From the following sources in the order of priority i) A monitored value (e.g. interview survey) ii) A planned value	N/A	
$MS_{pi,y}$	Share of passengers by transport mode i in the project activity in year y (%)				
$EF_{KM,i}$	CO_2 emission factor of transport mode i (t-CO_2/km)	A default value: Table 7, Appendix However, if there is no default value applied or if there is another appropriate value, that value may be used.			
OR_{bi}	Average occupation rate of transport mode i in the baseline scenario (passenger/vehicle)	A project specific value: Published value of the city or the country.			
OR_{pi}	Average occupation rate of transport mode i in the project activity (passenger/vehicle)				
$EC_{PJ,y}$	Annual electricity consumption associated with the operation of the	N/A		A planned value	A monitored value (Electric meter or estimated by, e.g., annual total trip

	project activity in year y (MWh/y)			distances and specific electricity consumption)
$FC_{PJ,i,y}$	Annual consumption of fuel i associated with the operation of the project activity in year y (t/year)		A planned value	A monitored value (Purchase receipt of the fuel or estimated by, e.g., annual total trip distances and specific fuel consumption)
EF_{elec}	CO_2 emission factor of the grid electricity ($t\text{-}CO_2/MWh$)		A default value (Table 3, Appendix) However, if there is no default value applied or if there is another appropriate value, that value may be used.	
$EF_{fuel,i}$	CO_2 emission factor of fuel i ($t\text{-}CO_2/TJ$)		A default value (Table 1 and 2, Appendix) However, if there is no default value applied or if there is another appropriate value, that value may be used.	
NCV_i	Net calorific value of fuel i (TJ/t)			

5. Others

(1) Project Boundary

The physical boundary for estimating GHG emissions includes the operation of MRT etc.

(2) Leakage

There are indirect emissions that potentially lead to leakage due to activities such as productions and transportations of raw materials for MRT facilities and rolling stocks, and their constructions and productions. However, these emissions are temporary and negligible compare to the project scale. Therefore, it can be ignored. These indirect emissions are also not counted in the CDM methodologies for MRT such as ACM0016 (Mass Rapid Transit Projects) and AM0031 (Bus rapid transit projects).

(3) Comparison with existing methodologies

The methodology is developed mainly based on the JBIC J-MRV methodology number 5 (The methodology for transport projects in urban area). The logic of emission reduction calculation in the methodology is in line with the J-MRV methodology. The methodology provides default values for some key parameters and simplifies the emission reduction calculations, so that the methodology will be more practical for users. Existing CDM methodologies similar to the methodology are AM0031 (Bus rapid transit projects) and ACM0016 (Mass Rapid Transit Projects). The major difference from these methodologies in terms of the logic of emission reduction calculation is the definition of project boundary. For simplicity, the methodology limits the project boundary from the entry station to the exit station of MRT. On the other hand, these CDM methodologies include origins and destinations of passengers.

(4) CH_4 and N_2O

Since methane (CH_4) and nitrous oxide (N_2O) do not have a significant impact on emission reductions by the project, they were not considered for simplification.