5. Transport / Modal Shift (Freight)

1. Typical Project

- Freight modal shift from existing transportation modes (e.g. trucks) to railway.

2. Applicability

(1) Development of transport system(s) that can realize an efficient freight transport such as railway and water transportation.

(2) The baseline transport modes should be such as road transportations (e.g. trucks) and aircrafts 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 (e.g, existing mode of transportation, e.g. truck) and project scenario (railway etc.)[1].

Details of sources of each data in the following formulae are provided in "4. Data and Parameters for the Estimation".

$$ER_y = BE_y - PE_y$$

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)

(1) Calculation of Baseline Emission

Baseline GHG emission is calculated based on the freight transportation activity/volume in ton-km after the project starts, share of freight by baseline transport modes and CO_2 emission factor per ton-km.

$$BE_y = \sum_i \left(BTKM_{by} \times MS_{i,y} \times EF_{TKM,i} \right)$$

$BTKM_{by}$: Freight transportation activity/volume by the project in year y (t-km/y).

$MS_{i,y}$: Share of freight by transport mode i in the baseline scenario in year y.

$EF_{TKM,i}$: CO_2 emission factor per ton kilometer for transport mode i (t-CO_2/t-km)

(2) Calculation of Project Emission

- In the case of the project activity using electricity

It is estimated by multiplying annual electricity consumption of the railway with the 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 railway 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 fuel

[1] The target year shall be a representative year under average operation or an annual average of multiple years.

It is estimated by multiplying annual fossil fuel consumption of the railway with the CO_2 emission factor of the fuel.

$$PE_y = FC_{PJ,i,y} \times NCV_i \times EF_{fuel,i} \div 10^6$$

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

NCV_i : Net calorific value of fuel i (TJ/Gg=TJ/kt)

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

- In case if consumption of electricity and fuel is not available

Multiply "Freight transportation volume/activity by the project in year y (t-km/y)" by CO_2 emission factor per ton-km of railways etc.

$$PE_y = BTKM_y \times EF_{PKM,rail}$$

$EF_{PKM,rail}$: CO_2 emission factor per ton-km of railway etc (t-CO_2/t-km)

4. Data and Parameters for the Estimation

Data	Description	Data Sources	
		For baseline emission calculation	For project emission calculation
$BTKM_y$	Freight transportation activity/volume by the project in year y (t-km/y).	A planned value	N/A
$MS_{i,y}$	Share of freight by transport mode i in the baseline scenario in year y (%)		
$EF_{TKM,i}$	CO_2 emission factor per ton kilometer for transport mode i (t-CO_2/t-km)	From the following sources in the order of priority i) A project specific value: use values of the country/city. ii) Literature value which can be applied to the project iii) Default value (Appendix 7)	
$EC_{PJ,y}$	Electricity consumption associated with the operation of the railway in year y (MWh/y)	N/A	A planned value
$FC_{PJ,i,y}$	Consumption of fuel i associated with the operation of the railway in year y (t/y)		A planned value
EF_{elec}	CO_2 emission factor of the grid electricity (t-CO_2/MWh)		A default value (Table 3, "Electricity Consumption", Appendix) 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/Gg=kt)		A default value (Table 1 and Table 2, Appendix) If there is no default value applied or if there
$EF_{fuel,i}$	CO_2 emission factor		

	of fuel i (kg-CO_2/TJ)		is another appropriate value, that value may be used.
$EF_{TKM,rail}$	CO_2 emission factor per ton kilometer for railway etc. (t-CO_2/t-km)		From the following sources in the order of priority i) A project specific value: use values of the country/city. ii) Literature value which can be applied to the project iii) Default value (Table 7, Appendix)

5. Others

(1) Project Boundary

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

(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 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 CDM methodology, AM0090 (Modal shift in transportation of cargo from road transportation to water or rail transportation). The CDM methodology allows both in the baseline and project activity, only one type of cargo owned by the project participants and excludes mix of cargo. But this methodology does not set any limitation for cargo type. The CDM methodology also has some strict applicability conditions regarding investments to the project and conditions for project participants; however, this methodology has no limitation for these conditions also.

(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.

(5) Revision history

Version	Year/Month	Revisions
2.0	March 2014	• Integrated and recategorized the calculation methodologies as follows based on objects (passengers/ freights) and measures (modal shift/ electrification) - Railway /passenger (Modal Shift) - Railway /passenger (Electrification) - Railway /Freight (Modal Shift) - Railway /Freight (Electrification) • Amended the calculation method for baseline emissions to calculate emissions per passenger-kilometer

3.0	September 2019	• Added instructions to calculate annual emission reductions by using an average for the calculation period • Added a method for road congestion • Prioritized the use of default values • Added instructions not to consider CH_4 and N_2O emissions
4.0	March 2023	• In the methodology "5. Traffic Congestion Mitigation / Modal Shift (Freight), version 3.0)", both modal shift and congestion mitigation were involved in the same methodology. However, since the emission reduction logic differs between the two components, the methodology was separated into "5. Transport / Modal Shift (Freight)" and "4. Transport / Measures on road congestion". • An alternative method is presented when electricity consumption cannot be obtained for the project emissions (a method calculated based on emission factors per ton-kilometer). • In the description of the calculation method and necessary data of baseline emissions, the words "before project implementation" was revised to use "the baseline scenario". The baseline scenario is the scenario that would have occurred in the absence of the project, such as continuation of the pre-project conditions. • Deleted the column "Ex-post" in "4. Data and Parameters Estimated and Need Monitoring": current version of Climate-FIT aims to quantify GHG emission reductions in the "planning phase").
5.0	March 2024	• No revision.