6. Transport / Railway Electrification

1. Typical Project

- Realization of fuel/energy shift in railway transportation through electrification.
- Including modal shift effects by enhancement of transportation capacity along with the electrification.

2. Applicability

(1) Electrification of existing non-electrified railway transportation.

(2) Modal shift effects on passenger and/or freight by enhancement of transportation capacity along with the electrification.

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. the non-electrified railway) and project scenario (the electrified railway). The emission reduction from the effects of passenger/freight modal shift is determined as the differences between the GHG emission of baseline scenario (e.g. existing modes of transportation, e.g. trucks and trailers for freight, buses and passenger cars for passenger) and project scenario (electrified railway transportation)[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

1) Electrification

Baseline GHG emission of the effect of electrification itself is calculated based on annual fossil fuel consumption of the existing railway and CO_2 emission factor of the fossil fuel.

$$BE_y = \sum_i (FC_{BL,i,y} \times NCV_i \times EF_{fuel,i} \div 10^6)$$

$FC_{BL,i,y}$: Consumption of fuel i associated with the operation of the existing 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)

2) Modal shift

Baseline GHG emission of the effect of modal shift is calculated based on the increased passenger/freight transportation activity/volume through the project in passenger-km and/or t-km, share of passenger/freight by baseline transport modes and CO_2 emission factor per passenger-km and/or t-km. Detailed method of the calculation is described in "3. Transport/Modal Shift (Passenger)" and "5. Transport/Modal Shift (freight)". Only the increased amount of passenger/freight transportation through the

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

project is considered.

(2) Calculation of Project Emission

It is estimated by multiplying annual electricity consumption of the project activity 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 project activity in year y (MWh/y)

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

4. Data and Parameters for the Estimation

<table>
<tr><th rowspan="2">Data</th><th rowspan="2">Description</th><th colspan="2">Data Sources</th></tr>
<tr><th>For baseline emission calculation</th><th>For project emission calculation</th></tr>
<tr><td>$FC_{BL,i,y}$</td><td>Consumption of fuel i associated with the operation of the existing railway in year y (t/y)</td><td>A measured value
(or estimated by, e.g., annual total trip distances and specific fuel consumption)</td><td rowspan="3">N/A</td></tr>
<tr><td>$EF_{fuel,i}$</td><td>CO_2 emission factor of fuel i (kg-CO_2/TJ)</td><td rowspan="2">A default value (Table 1 and Table 2, Appendix)
If there is no default value applied or if there is another appropriate value, that value may be used.</td></tr>
<tr><td>NCV_i</td><td>Net calorific value of fuel i (TJ/Gg=TJ/kt)</td></tr>
<tr><td>$EC_{PJ,y}$</td><td>Electricity consumption associated with the operation of the project activity in year y (MWh/y)</td><td rowspan="2">N/A</td><td>A planned value</td></tr>
<tr><td>EF_{elec}</td><td>CO_2 emission factor of the grid electricity (t-CO_2/MWh)</td><td>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.</td></tr>
</table>

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 participant and excludes mix of cargo. But this methodology does not set any limitation for the 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.

(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

The changes from the version 3.0 are as follows:

- In the version 3.0, the methodology for electrification is separated in "4. Transport / Railway (Passenger) / Electrification " and “6. Transport / Railway (Freight) / Electrification”, since electrification may cover both passenger and freight, these two methodologies are integrated as "6. Transport / Railway Electrification ".
- 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").