New Mechanism Feasibility Study for Development of Mass Rapid Transit (MRT) Systems in Jakarta, Indonesia, and Hanoi and Ho Chi Minh, Viet Nam.

By Mitsubishi Research Institute, Inc.

FS Partner(s)	Marubeni Corporation, PT. Indokoei International, Transport Development and Strategy Institute（TDSI）, JICA
Location of Project Activity	Indonesia (Jakarta), and Viet Nam (Hanoi and Ho Chi Minh City)
Category of Project Activity	Transportation
Description of Project/Activity	The project will introduce mass rapid transit (MRT) systems in the three cities of Jakarta, Hanoi and Ho Chi Minh City, which have relied on motorbikes, automobiles, and buses for their urban transport. By promoting a modal shift, the project is expected to contribute to the reduction of GHG emissions from existing travel modes. This study aimed to estimate emissions reduction and establish MRV methods for the project.
Reference Scenario and Project/Activity Boundary	BAU is considered as reference scenario for the following reasons: a) Introduction of MRT requires huge amount of initial investment while profitability is generally low; b) as MRT is founded on advanced technology, it is difficult for the host country alone to introduce MRT. As for the boundary, the three options are considered, as follows: (1)MRT, (2) MRT + access/egress traffic, (3) MRT + access/egress traffic + traffic volume on nearby roads. The GHG emissions and reductions for each MRT line in this study are estimated under the conditions of Option (1).
Monitoring Methods and Plan	It is important to consider their feasibility within the host countries. On the other hand, accuracy and reliability must also be maintained. The key parameters to estimate emissions reduction are traffic volume (PKM) and modal share of reference scenario. As for traffic volume, three options have been proposed: (1) OD table between MRT stations, (2) Passenger survey, (3) Estimation from existing PT surveys. As for modal share, three options have been proposed: (1) Estimation from existing PT surveys, (2) Passenger survey, (3) Traffic volume surveys. The choice of options depends on a ticket system employed in the project and/or the availability of existing surveys. On the other hand, the accuracy of each option needs to be further evaluated.

<table>
<tr><td>GHG Emissions and Reductions</td><td>
<table>
<tr><td>（Unit: tCO2/yr）</td><td>Reference</td><td>Project</td><td>Reduction</td></tr>
<tr><td>Hanoi Line1</td><td>144,138</td><td>30,473</td><td>113,664</td></tr>
<tr><td>Hanoi Line2</td><td>135,016</td><td>30,147</td><td>104,869</td></tr>
<tr><td>HCMC Line1</td><td>135,925</td><td>21,440</td><td>114,485</td></tr>
<tr><td>Jakarta North-South Line</td><td>175,535</td><td>59,967</td><td>115,569</td></tr>
</table>
</td></tr>
<tr><td>MRV System for GHG Reductions</td><td>In principle, an MRV system should ideally minimize burden on the host country while simultaneously guaranteeing a required level of reliability.
Measurement: Since the estimation of traffic volume of reference scenario has a major impact on the amount of emissions reduction, the accuracy of estimation should be carefully reviewed whichever option -- (1) OD table between MRT stations, (2) Passenger survey, (3) Estimation from existing PT surveys -- is selected.
Reporting: Periodic reporting may be required by both governments of host country and Japan. Relevant procedures, including a reporting format, should be prepared.
Verification: Pre-project evaluation will, in accordance with the methodology adopted, check the project's eligibility under the BOCM and the validity of the monitoring methods. Post-project evaluation will confirm that monitoring and calculations conform to the approved methodology. Assuming local institution within the host country will conduct verification, Japan would need to provide assistance in terms of capacity building.</td></tr>
<tr><td>Analysis of Environmental, Socioeconomic and other Impacts (including Securement of Environmental Integrity)</td><td>Environment impact assessment (EIA) has been written into law in both host countries. The EIA for each MRT line has been completed and approved by the central and local governments. The project's environmental positive impacts would be reduction in air pollutants (NOx, CO, HC, PM). On the other hand, the project's environmental negative impacts are emissions of smoke and noise from the construction works, or vibration arising from MRT operation. Countermeasures have been implemented so that no major concerns exist in implementing the project in terms of environmental integrity.</td></tr>
<tr><td>Financial Planning</td><td>Each MRT line requires initial investment of approx. 140 – 250 billion Japanese yen. In each case, approx. 80% of the required costs will be procured through Japanese yen loans.</td></tr>
<tr><td>Introduction of Japanese Technology</td><td>When introducing an MRT system, tenders are commonly made for individual scopes, such as (1) civil engineering works, (2) rolling stock, and (3) E&M. Of these, Japan has the highest level of technology and safety in the world of (2) rolling stock as well as signal systems and ticket vending machines, which are included in (3) E&M. Because the Japanese yen loans are conditional upon fulfillment of the conditions, which require 30% or more of the loans are allotted for use of equipment, materials, and services originating in Japan, it is highly likely that Japanese technology would be introduced.</td></tr>
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"Co-benefits" (i.e. Improvement of Local Environmental Problems)	The Manual for Quantitative Evaluation of the Co-Benefits Approach recommends assessment of emission reductions of NOx among other air pollutants for this project. The emissions reduction of NOx from each MRT line was calculated by multiplying distance traveled by mode of transport [km] by NO_x emission factor by mode of transport [gNO_x/km].and estimated to be approx. 503 - 667 tNO2/year.
Contribution to Sustainable Development in Host Country	In both countries of this study, public transportation is underdeveloped, dependence on automotive transport is high, and urban population is rapidly growing. As a result, the existing transport systems will make sustainable development difficult. Therefore, building an efficient transportation system by introducing mass transit system is essential for realizing sustainable development. The benefits of introduction of MRT may include: ・Reduction in economic loss by reducing the time required for travel ・Reduction in traffic accidents ・Reduction in vehicle operating costs by reducing traffic congestion ・Countermeasures against the increasing traffic demand ・Reduction in air pollutants

1. FS Partners:

- Marubeni Corporation: Mainly responsible for investigating the project's feasibilityand conducting its economic analysisl as well as providing coordination among local stakeholders (related ministries, project entities, and local consulting firms).
- Transport Development and Strategy Institute (TDSI): TDSI is a scientific career organization with research functions supporting the Ministry of Transport's State management in the field of developing transport strategies, plans and policies. Iin charge of collection of related data, traffic volume sample surveys and questionnaire surveys in Vietnam.
- PT. Indokoei International （Indokoei）: In charge of collection of related data in Indonesia.
- Japan International Cooperation Agency (JICA): Provision of data and information for urban traffic surveys and developmental surveys for the project covered in this study.

2. Description of Project/Activity:

（1）Project/Activity

The project will introduce mass rapid transit (MRT) systems in the three cities of Jakarta, Hanoi and Ho Chi Minh City, which have relied on motorbikes, automobiles, and buses for their urban transport. By promoting a modal shift, the project is expected to contribute to the reduction of GHG emissions from existing travel modes.

The outline of the project is shown below. Since agreement has already been reached on providing yen loans for the project under the Japanese government's Special Terms for Economic Partnership (STEP) scheme, it is likely that Japanese technology will be implemented in carrying out the project.

	Hanoi		Ho Chi Minh City	Jakarta
Project	Hanoi Urban Railway (Line 1)	Hanoi Urban Railway (Line 2)	Ho Chi Minh City Urban Railway (Line 1)	Jakarta Mass Rapid Transport (North-South Line)
Executing Entity	Viet Nam Railways (RPMU)	Hanoi People's Committee Hanoi Metropolitan Rail Transport Project Board (HRB)	Ho Chi Minh City People's Committee Ho Chi Minh City Management Authority for Urban Railways (MAUR)	Special Region of Yogyakarta (PT. MRT JAKARTA established as the executing entity)
Related Ministries	Ministry of Transport of Vietnam	Ministry of Transport of Vietnam	Ministry of Transport of Vietnam	Directorate General of Railways, Ministry of Transportation
Construction Phase	2013-2017 (the second phase completed in 2020)	2013-2017	2012-end of 2016	2013-end of 2016 (the second phase completed in 2018)
Summary	Length: 28 km Total 16 stations	Length: 27.7 km (of which 14.5 km underground) Total 16 stations	Length:19.7 km (of which 2.6 km underground) Total 14 stations (11 elevated and 3 underground stations)	Length: 23.2 km (of which 6 km underground) Total 21 stations(7 elevated, 1 aboveground and 13 underground stations)

（2）Situation in the Host Countries

Views on the BOCM

With the Japanese government concluding official agreements on the BOCM, Bilateral Offset Credit Mechanism, with the governments of Indonesia and Vietnam, which the

Japanese government regards as priority countries in promoting the BOCM, understanding of the mechanism's concepts is widespread in the government sector. The implementation of a large number of feasibility studies in the last year has also raised awareness among the counterparts. On the other hand, as specific details are still not clear within the bilateral agreements or in the UN, the counterparts' interest apparently remains limited to Japanese technology and the project itself.

Transportation sector and climate change policies

In major cities of developing countries, economic growth and concentration of population in urban areas have steadily pushed up road traffic volumes. In addition to the economic losses arising from traffic congestions, the trend has given rise to global environmental concerns, such as air pollution and increase in greenhouse gas (GHG) emissions. In particular, with bus services being the only urban public transport available in Jakarta, Hanoi and Ho Chi Minh City, the traffic issues require immediate attention. To address these issues, the MRT project is being promoted as part of the two countries' development plans.

The scope of NAMAs as envisaged by the host countries at present and their relation to the transportation sector are as shown below.

Table. NAMAs in the Transportation Sector

Country	NAMAs in the Transportation Sector
Vietnam[1]	Vietnam has not submitted its NAMA documents to the UN. According to an AWG-LCA presentation document dated June 2011, Vietnam has identified 28 mitigation options (15 in energy, 5 in agriculture, and 8 in LULUCF) with total potential GHG reduction of 3,270 MtCO2e.
Indonesia[2]	Indonesia has stated its goal of 26% reduction on its own by 2020 and up to 41% reduction with international support. It aims to achieve the 26% target by implementing NAMAs, including "shifting to low-emission transportation mode."

（3） Eligibility for the New Mechanism

Eligibility defines the project criteria under which a project can be awarded emissions reduction credits under the Bilateral Offset Credit Mechanism (BOCM). Considering that there should be eligibility that applies to all projects under the BOCM scheme as well as eligibility that applies to each sector, we make our proposals below for each type of eligibility.

Under the BOCM scheme, we believe that reduction in GHG emissions particularly though introduction of advanced low-carbon technologies (both hardware and software) should be actively embraced. One way of doing this may be to award credits to projects that, through international support in terms of funding and technology, achieve the emissions reduction beyond the reference level, which would be the Nationally Appropriate Mitigation Activities (NAMAs) of developing country Parties that could be implemented in a developing country using the country's own technology and measures.

In this regard, the project fulfills the eligibility criteria both in terms of funding and technology:

・Funding: The project will receive Japanese yen loans, provided that Japanese technology is

1 http://unfccc.int/files/meetings/ad_hoc_working_groups/lca/application/pdf/vietnam_presentation_to_workshop_on_nationally_appropriate_mitigation_actions_submitted_by_developing_country_parties.pdf

2 DNPI(2011), "DNPI Green Review on REDD+". The Japanese Ministry of the Environment/OECC (2011), "Shin Mecha EXPRESS," February 2011.

used. In other words, without foreign capital, the MRT will not be introduced.
- Technology: The project requires advanced technology and presupposes the use of both overseas funding and technology. It cannot be implemented by the host country alone.

Secondly, we discuss the project's eligibility in the transportation sector. One way of measuring eligibility in terms of funding may be to set a standard by which incomes from credits must make up a certain percentage of O&M costs. In terms of technology, it may be possible to set an efficiency benchmark or measure how much the technology has spread. Another way may be to make a positive list of vehicles and facilities with high levels of energy efficiency.

Relation with ODA

The Japan International Cooperation Agency (JICA) has already conducted studies for the project, and the Japanese government has agreed to provide Japanese yen loans to the project, provided it uses Japanese technology. Although we believe existing projects do not necessarily fall outside the scope of the BOCM, there is nonetheless a need to reappraise a project's eligibility in terms of GHG emissions reduction if such reduction had not been the primary objective in the development of the project's design.

(4) Measures to Spread the Project/Activity

Since introduction of the MRT requires substantial funding, development of a finance scheme comprising Japanese yen loans and financial support of international organizations and other developed countries is essential for the implementation of the project. We believe the low-interest Japanese yen loans, which will be provided based on the Special Terms for Economic Partnership (STEP) scheme for the project under this Study, will be effective both in improving the project's feasibility and promoting export of Japanese technology.

3. Description of the Study

(1) Challenges:

While ACM0016 is the existing CDM methodology applicable to MRT projects, only 4 projects have been registered under this methodology, and only 13 project proposals have been filed under it (of which 10 for introducing MRT). Even considering the fact that it is a relatively new methodology, which was adopted in October 2009, its use has been limited. Some of the factors discouraging implementation as CDM projects may include the requirements for annual passenger surveys and the cumbersome process for demonstrating additionality. In light of the existing CDM methodology, we considered a methodology that "reduces the burden on the operator," who will monitor regularly and continuously updated statistical data that are collectible. The main questions we considered were as follows:

- Should access/egress traffic be included in the boundary?
- How should changes in traffic volume on nearby roadss be treated?
- Proposition of a methodology considering the ease or difficulty of obtaining data for quantification, continuity of obtaining the data, and accuracy of the data. Our approach will be to maintain reliability of the methodology while adopting realistic methods for calculating emissions reduction.

(2) Contents:

From the perspective of maintaining reliability of the methodology, access/egress traffic will have to be included in the boundary, in which case it is highly likely that questionnaire surveys will have to be conducted and consideration made on what to include in the survey.

There is also a possibility that the traffic on nearby roads would not increase in the absence of the project. Therefore, a method for deducting an increase in traffic volume on nearby roads as a result of the introduction of the MRT from the actual number of passengers will have to be considered. This may be done, for example, by conducting traffic volume surveys on the roads in the vicinity of the MRT lines prior to and after the introduction of the MRT.

As for access/egress traffic and traffic on nearby roads, however, if such traffic turns out to have little impact on the emission reductions, it would be desirable, from the point of view of feasibility (in terms of reducing the monitoring costs), to either exclude it from the calculation or take such steps as to subtract a certain fraction from the overall emission reductions.

As for the method for obtaining traffic volume under the Reference Scenario, which will have the greatest impact on emission reductions, we made a study of methodologies that would be based on the use of existing materials (including person trip surveys) but that would also allow us to gain data that are highly "reliable" while providing due consideration on "continuity." As a result, we have found three options, as follows:

- Option 1: Use of OD table between MRT stations
- Option 2: Conducting simple questionnaires for MRT passengers
- Option 3: Correcting existing person trip surveys

4. Results of the Feasibility Study of New Mechanism Project/Activity

(1) Emission Reductions from Implementation of the Project/Activity:

With some users of the existing transportation modes (private automobiles, motorbikes, buses, etc.) shifting to the use of MRT, which will efficiently transport a large number of people simultaneously when introduced by the project, the project will reduce the energy consumption and CO2 emissions in each travel mode.

The traffic that should be calculated in the methodology can be divided into traffic (A) on the MRT, (B) of access to and egress from the MRT, and (C) on nearby roads, as shown in the figure below. There can be three boundary options as to how they are included in the calculation in the methodology, as follows:

- Boundary Option (1): (A) to be included in the calculation
- Boundary Option (2): (A) + (B) to be included in the calculation
- Boundary Option (3): (A) + (B) + (C) to be included in the calculation

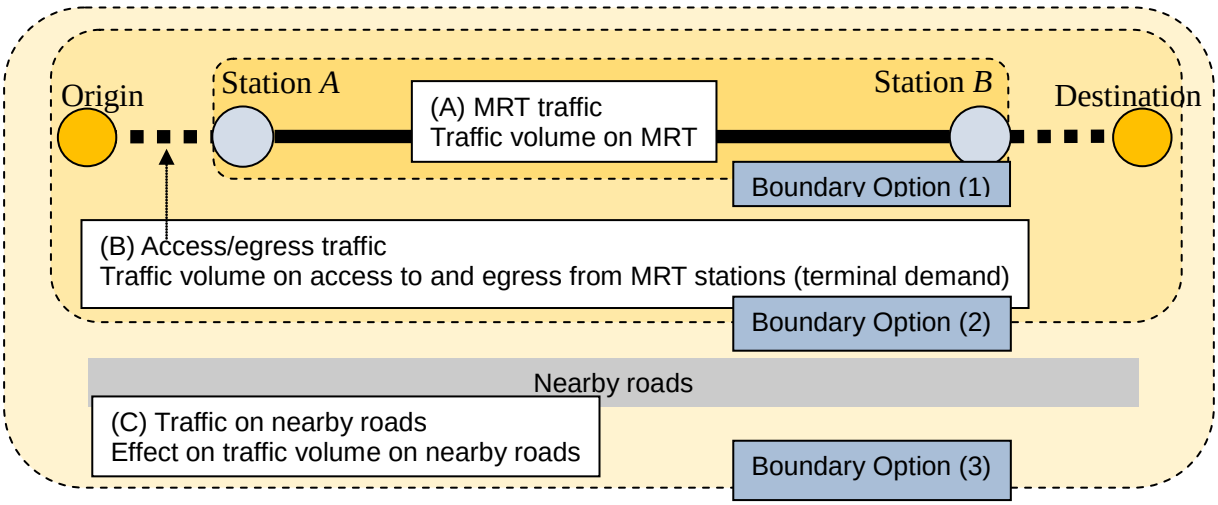
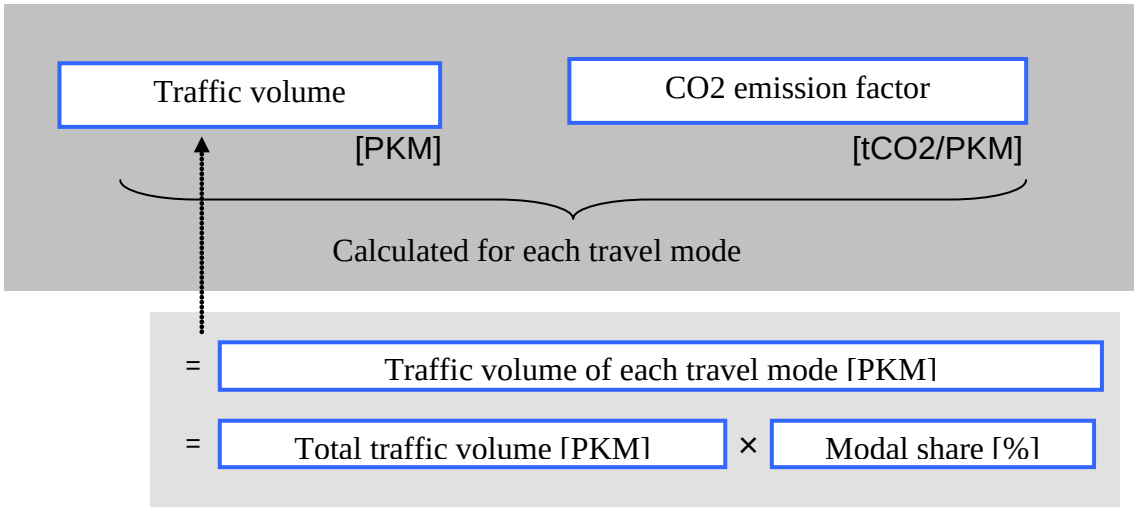


Figure. Conceptual Diagram of Boundary Options

The calculation of emissions from the travel modes that MRT passengers would have used over the trip segment covered by the MRT had the MRT not existed (the reference emissions for (A) in the figure above) is the most essential and the most difficult. The basic approach is to multiply the traffic volume of the travel modes under the Reference Scenario [PKM] by its standard unit [tCO2/PKM]. As for the traffic volume, the total traffic volume may be multiplied by the modal share, depending on how we view such a volume, as an option.



In the above calculation of the reference emissions, the traffic volume weighs most heavily. In calculating the traffic volume, we propose three options as shown in the table below in consideration of the availability of data in the host countries.

Table. Options for Calculating the Traffic volume

Options	Description	Remarks
(1) Use of an OD table between MRT stations	Calculate the traffic volume by obtaining the number of passengers between MRT stations from an OD table[3]. Total traffic volume [PKM] = Σ (number of person traveling between stations [person] × distance between stations [km])	An OD table can easily be created if Suica or other IC cards have been introduced.
(2) Passenger survey	Calculate the traffic volume for each travel mode from a questionnaire survey on MRT passengers' travel modes, their origins and destinations, etc., had MRT not exist.	The use of a passenger survey, as in the CDM methodology, is costly. However, if the access/egress traffic is to be included in the calculation, it is highly likely that questionnaire surveys would be required, in which case the two surveys can be conducted simultaneously.

[3] OD table: Origin-destination table expresses the volume of traffic movement within a zone (from a certain origin to a certain destination) in the form of a table (matrix).

(3) Estimation from existing PT surveys	An OD table between MRT stations is prepared by correcting existing data from PT surveys[4] by population, number of MRT passengers, etc. to calculate the volume of transportation. (The trip generation rates and trip concentration rates may be used for the correction.)	Because PT surveys are not conducted each year, correction is essential. It requires availability of statistical data on residential population, daytime population, etc., for correction.

The calculating method is determined by which of an boundary option showed in the figure on page 7 is adopted. The calculating method options are shown in the figure below. (Future issues are shown in red)

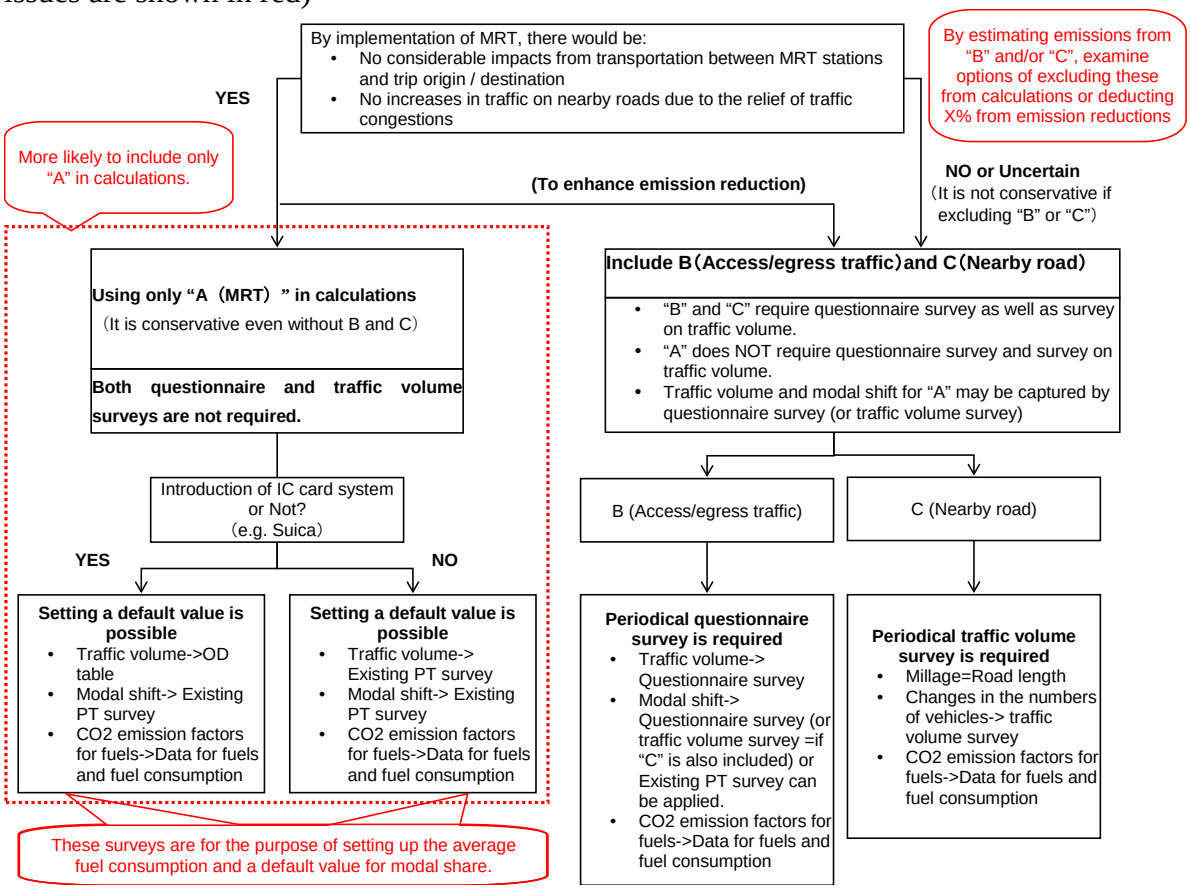


Figure. Options for calculating method

(2) Reference Scenario and Project/Activity Boundary:

The Reference Scenario has been considered from the perspectives of funds, policy, practice, and technology, as shown in the table below.

Concerning the boundary, as previously mentioned the three options outlined in the figure on page 7 are considered, as follows:

- Boundary Option (1): MRT
- Boundary Option (2): MRT + access/egress traffic

[4] PT survey: Person trip survey studies "movement of a person" (person trip) within an area of the survey. "Trip" is both a concept representing one-directional movement when a person travels from an origin to a destination for a certain purpose (for example, commuting or shopping) and the unit used to express such a movement quantitatively.

・ Boundary Option (3): MRT + access/egress traffic + traffic on nearby roads

Table. Conceptual Framework for the Reference Scenario of the MRT Project

Perspective	Approach	Application to the Project
Funds	Profitability: As profitability is generally low for this project type, newly introduced MRT meeting certain conditions is recognized as eligible. The Reference Scenario will be one where the MRT will not be introduced.	Provided that certain conditions are met, the project's Reference Scenario is "one where the MRT will not be introduced."
	Funding: Where MRT cannot be realized without foreign capital, the Reference Scenario will be one where the MRT will not be introduced. (Further consideration is needed, however, on applying certain conditionality to projects utilizing foreign capital.)	As there is an agreement to provide Japanese yen loans for the project, the Reference Scenario is "one where the MRT will not be introduced" (subject, however, to the conditionality mentioned in the left column).
Policy	Master plan: The MRT lines in question are covered in the master plan, but introduction of MRT is not necessarily the Reference Scenario. Whether or not the MRT lines are included in the master plan has no implications on the identification of the Reference Scenario.	Have no implications on the Reference Scenario.
	NAMA: It is unclear whether the MRT project will be considered as NAMA in the countries where this feasibility study (FS) is conducted. Whether or not NAMA activities will be made subject to the BOCM is dependent on policy decisions.	Implications on the Reference Scenario are dependent on policy decisions.
Practice	If, for example, "there is no MRT in the same city" is set as an eligibility requirement and a project meets the requirement, the Reference Scenario will be one where the MRT will not be introduced.	The three cities in the project have no existing MRT system, fulfilling the requirement that "there is no MRT in the same city." Therefore, the Reference Scenario is "one where the MRT will not be introduced."
Technology	As MRT is founded on advanced technology, it is difficult for the host country alone to introduce MRT. For this reason, an MRT project is considered to achieve additional emissions reduction, and the Reference Scenario will be one where the MRT will not be introduced. (Further consideration is needed, however, on the identification of advanced technology.)	The MRT is founded on advanced technology, and it is difficult for the host country alone to introduce the MRT. Therefore, the Reference Scenario is "one where the MRT will not be introduced."

(3) Monitoring Methods and Plan:

In developing the monitoring methods, it is important to consider their feasibility within the host countries. On the other hand, accuracy and reliability at levels above certain standards must also be maintained.

The monitoring methods and frequency for each parameter used in the calculation of the reference emissions are shown in the table below. As for the project emissions, monitoring of electricity consumption arising from MRT operation is necessary.

Table. List of Monitoring Methods (Reference Emissions)

Parameter		Monitoring Method	Frequency	Remarks
Traffic volume for each travel mode [PKM]				
1) Number of trips for each travel mode [person times] × distance traveled [km]				
Number of trips for each travel mode [person times]	1) Results of questionnaire	② Questionnaire Ask MRT passengers the entry and exit stations and the travel modes.	Once a year	Sample survey
	2) Results of existing surveys (corrected)	③ Existing PT Correct the number of trips in each segment by number of MRT passengers, etc.	Once at the start	Use of existing surveys
Distance traveled [km]	1) Distance between stations	② Questionnaire Obtain the distance between MRT stations from route charts, etc.	Once at the start	Fixed value
	2) Distance between sites	② Questionnaire (when access/egress traffic is included) Obtain O-D distance from maps, etc.	At each round of questionnaire survey	Sample survey
	3) Distance between meshes	③ Existing PT Calculate the distance between centers of each segment (mesh)	Once at the start	Use of existing surveys
2) Total number of trips [person times] × distance traveled [km] × Modal share[%]				
Total number of trips [person times]	1) Number of entries and exits at each MRT station	① OD table Record all passengers' entry and exit stations, using Suica or other IC cards.	As needed (tabulation once a year)	Actual measure-ment
Distance traveled [km]	1) Distance between stations	① OD table Obtain the distance between MRT stations from route charts, etc.	Once at the start	Fixed value
Modal share [%]	1) Results of existing PT surveys	Modal share of the segment (mesh) covering MRT lines	Once at the start	Use of existing surveys
	2) Results of questionnaire	Modal Share used had MRT not existed, as indicated in the questionnaire	Once a year	Sample survey

	3) Results of traffic volume surveys	Share of the number of vehicles in transit obtained from traffic volume surveys	Once a year	Sample survey
CO2 emission coefficient [tCO2/PKM]				
CO2 emission factors by fuel type		Obtained from IPCC, etc.	Once at the start	Default
Average fuel consump-tion	1) Average fuel consumption	Obtained from existing surveys, etc.	Once at the start	Default
	2) Fuel consumption	Bus company data	Once a year	Actual measure-ment
	2) Distance traveled	Bus company data	Once a year	Actual measure-ment
Average number of passengers	1) Average number of passengers	Obtained from existing surveys, etc.	Once at the start	Default
	2) Total number of passengers	Bus company data	Once a year	Actual measure-ment

（4） GHG Emissions and Reductions：

The GHG emissions and reductions for each MRT line in this study are estimated under the conditions of Boundary Option (1) (only MRT segment included in the calculation) mentioned above.

As for the reference emissions (the emissions arising from the travel modes that MRT passengers would have used over the distance traveled by MRT had the MRT not existed), the total traffic volume (PKM), obtained from OD tables between MRT stations for each line, is multiplied by the modal share (for buses, motorbikes and automobiles) that would be expected if the MRT was not introduced. For this study, OD tables between MRT stations, based on a demand forecast by the local executing entity of the MRT project, and estimates on the number of passenger entries and exits at stations were used.

On the other hand, as for the project emissions, Hanoi Line 1's annual electricity consumption per kilometer of laid track was used as a reference to estimate the project emissions for each line in Vietnam in accordance with the distance of each line's laid track. As for Jakarta North-South Line, their specific data was used.

The results of the estimation and assumptions are as shown in the table below.

Table. Estimated Emission Reductions and Assumptions for Each MRT Line

Hanoi, Line 1 (2030)	Reference emissions	144,138 tCO2/year	Project emissions	30,473 tCO2/year	Emission reductions	113,664 tCO2/year
	Assumptions, etc. on which estimation is based: ● Estimated operational route distance of 28.0 km (a total of 16 stations) and total number of users at 543,772 passengers/day as of 2030 ● The estimated modal share replaced by MRT (PKM): buses 21.9%, motorbikes 50.9%, and automobiles 27.2% ● The annual electricity consumption per unit operational route distance is estimated at 2,339 MWh/km/year (source: Viet Nam Railways (VNR)).					

Hanoi, Line 2 (2020)	Reference emissions	135,016 tCO2/year	Project emissions	30,147 tCO2/year	Emission reductions	104,869 tCO2/year
	Assumptions, etc. on which estimation is based: ● Estimated operational route distance of 27.7 km (a total of 16 stations) and total number of users at 535,000 passengers/day as of 2020 ● The estimated modal share replaced by MRT (PKM): buses 21.9%, motorbikes 50.9%, and automobiles 27.2% ● The annual electricity consumption per unit operational route distance is estimated to be the same as with Hanoi Line 1.					
Ho Chi Minh City, Line 1 (2020)	Reference emissions	135,925 tCO2/year	Project emissions	21,440 tCO2/year	Emission reductions	114,485 tCO2/year
	Assumptions, etc. on which estimation is based: ● Estimated operational route distance of 19.7 km (a total of 14 stations) and total number of users at 620,000 passengers/day as of 2020 ● The estimated modal share replaced by MRT (PKM): buses 7.3%, motorbikes 89.9%, and automobiles 2.8% The annual electricity consumption per unit operational route distance is estimated to be the same as with Hanoi Line 1.					
Jakarta, North-South Line (2037)	Reference emissions	175,535 tCO2/year	Project emissions	59,967 tCO2/year	Emission reductions	115,569 tCO2/year
	Assumptions, etc. on which estimation is based: ● Estimated operational route distance of 23.3 km (a total of 21 stations) and total number of users at 629,900 passengers/day as of 2037 ● The estimated modal share replaced by MRT (PKM): buses 24.2%, motorbikes 52.5%, and automobiles 23.3% ● The annual electricity consumption per unit operational route distance is estimated at 3,016 MWh/km/year.					

(5) MRV System for GHG Reductions:

In principle, an MRV system should ideally minimize burden on the host country while simultaneously guaranteeing a required level of reliability. In keeping with this condition, our approach to M (measurement), R (reporting) and V (validation) is outlined below.

① Measurement (M)

As discussed under (3) Monitoring Methods and Plan, above, the methods for monitoring various parameters used in the calculation of emission reductions can be divided into five categories, namely, actual measurement, sample surveys, correction of existing surveys, fixed values, and default values.

・Actual measurement: Parameters actually measured include OD tables between MRT stations and amounts of purchases of electricity and fuel.

In particular, OD tables between MRT stations should be considered. Accuracy of the OD tables will depend on the accuracy of the ticketing system that would be introduced. As details of the ticketing system used for the MRT lines in this study are unknown at present, accuracy will have to be considered after the details become clear. As acquisition of the OD tables would be significantly facilitated by introducing an IC card system, such as Suica, the MRT operator should be able to take the measurements.

・Sample survey: There are two types of sample surveys: MRT passenger questionnaire surveys and traffic volume surveys on roads in the vicinity of the MRT lines. While the accuracy of the data will depend on the detailed design of the surveys, it is important to strike a balance between accuracy and cost, as too much burden placed on the entity executing the project will reduce the feasibility of the surveys.

・Correction of existing surveys: Results of PT (person trip) surveys are used to measure traffic volume, distance of travel, modal share, etc. The accuracy of the data will likely depend on PT survey's zone granularity, time, and correction methods, among others. These require further consideration.
・Fixed value: Such parameters as the distance between MRT stations have fixed values. The values indicated in design drawings may be used, which can be double-checked against online maps to maintain accuracy. Fixed values can also reduce the monitoring costs.
・Default value: Such parameters as electricity grid CO2 emission factor, CO2 emission factor by fuel type, and average fuel consumption have default values. As default values are set once a methodology is approved, the issue of accuracy does not arise in individual projects. As default values are provided by recognized institutions, it increases the receptiveness of host countries.

② Reporting (R)

The results of the monitoring discussed above will be used to calculate and report on the emission reductions.

As for the frequency of reporting, reporting at regular intervals is desirable. Therefore, options likely to emerge are reporting at an interval, for example, of once a year or reporting when requesting issuance of credits as is the case in CDM.

It is expected that the entity implementing the project in the host country or the Japanese party to the implementation will report to both the host country government and the Japanese government. From the point of view of reducing reporting costs, it may be necessary to prepare separate reporting formats, one, for example, for aspects common to all methodologies and another dealing with specific items in individual methodologies.

③ Validation (V)

It may be necessary to conduct validation both before and after the implementation of the project. Pre-project validation will, in accordance with the methodology adopted, check the project's eligibility under the BOCM and the validity of the monitoring methods expected to be implemented, among others. Post-project validation will confirm that monitoring and calculations conform to the approved methodology.

While the validation should preferably be conducted by an institution within the host country from the perspective of reducing costs, it may be that few institutions have the specific expertise and the skills needed for GHG validation, particularly in the field of transportation. Therefore, Japan would need to provide assistance in terms of capacity building.

Because the above MRV methods have been developed to ensure that existing data (from statistical surveys, etc.) will be used as much as possible and that the methods can be implemented as part of (or in association with) regular MRT operation and management, the host countries will be likely to be receptive to them. We believe that this notion of reducing burden on the entities carrying out the project in the host countries while securing a sufficient level of reliability is also important.

(6) Environmental, Socioeconomic Impacts:

Environment impact assessment has been written into law in both host countries. In Vietnam, the Law on Environmental Protection requires environment impact assessment (EIA) for certain projects that are expected to have a large environmental impact. Consequently, the project's EIA report was approved by the Ministry of Natural Resources

and Environment in December 2007 for Hanoi Line 1 and by the Hanoi municipal government's Department of Natural Resources and Environment in February 2008 for Hanoi Line 2. The Ministry of Natural Resources and Environment had also approved the EIA report for Ho Chi Minh City Line 1 in November 2006.

Indonesia also has a legal framework for environment impact assessment. In August 2005, the EIA report for the first phase of the project was approved by the Environmental Management Agency (BPLHD) of the provincial government of the Special Capital City District of Jakarta.

Apart from the project's impact on global warming, the results of the project's EIAs suggest that the project's environmental impacts would be as follows (excluding social aspects):

<Positive impacts>
・Reduction in air pollutants (NOx, CO, HC, PM)

<Negative impacts>
・Emission of smoke and soot, noise and vibration, and traffic congestion arising from the construction works
・Noise and vibration arising from MRT operation

As for the above negative impacts, countermeasures have been implemented (including installment of sound insulating walls and controls on construction works hours) so that no major concerns exist in implementing the project in terms of environmental integrity.

(7) Other Impacts:

The implementation of the project will give rise to the issue of eminent domain and relocation of citizens. This has the potential to bring negative consequences on the citizens living in areas where the tracks will be laid. On the other hand, the delay in addressing the issue of eminent domain is putting back the construction schedule and bringing up the cost. We interviewed related organizations in the host countries on expropriation of land and on compensation for relocation of the affected citizens. Both in Vietnam and Indonesia, the local government draws up a plan for executing eminent domain, and after obtaining approval from related ministries, the local government begins the process of expropriation. Basically, an eminent domain plan is based on the preliminary design and is prepared after the preliminary design has been completed.

At present, the process of eminent domain for the project is progressing in accordance with due process and relevant legal systems.

(8) Comments by the Stakeholders:

The purpose of this study is to consider methods for quantitatively estimating GHG emission reductions effected as a result of introducing MRT, and not to investigate the feasibility of the MRT project per se. Therefore, the stakeholders in the matters dealt by the study are expected to be the related ministries and agencies of the host countries, the entities executing the project, and JICA, which is providing financial support.

The overview of BOCM and the result of the study have been explained to local stakeholders. As Vietnam and Indonesia have faster progress on bilateral negotiations with Japan, the related ministries of Indonesia and Vietnam have possessed a deep understanding of the BOCM. Also, they have showed positive responses to the BOCM. The MRT operating

entities are also interested in the BOCM, and they requested to hold a seminar to inform the BOCM to their local stakeholders. They had a high expectation of continuing this study.

(9) Framework for Implementation of the Project/Activity:

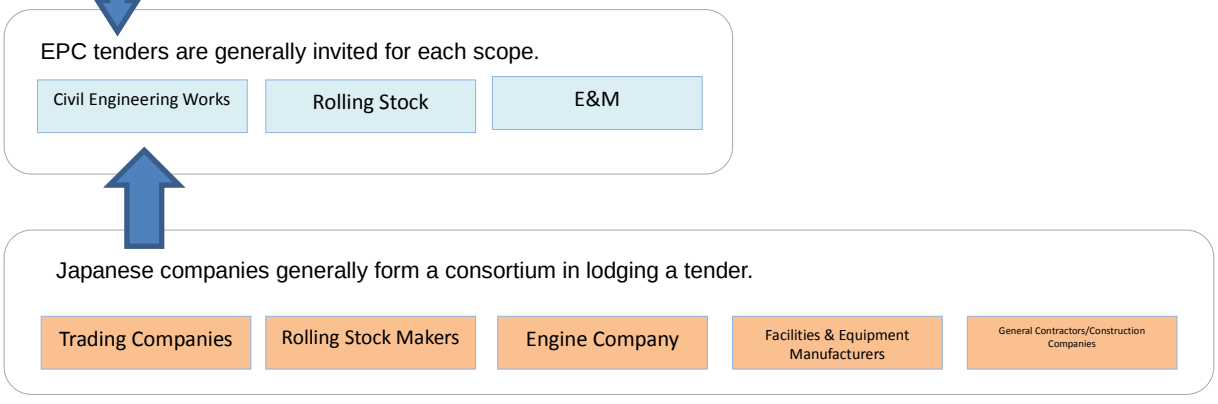
The framework for the project implementation is shown in the figure below.

It is generally the case for the municipal government or a project entity established by the municipal government to take on the role of the executing entity for a MRT project.

As a project to introduce MRT will require substantial funding, beginning with the funding for urban traffic surveys that will feed into the project planning, formation of a financial scheme comprising of Japanese yen loans and other financial assistance from international organizations and other developed countries will be essential in the expansion of MRT.

EPC tenders are usually separated into scopes and invited for each scope. Local construction companies often bid in the civil engineering scope due to their cost advantage. In many instances, Japanese and other foreign companies participate in scopes such as rolling stock and E&M where they can capitalize on the technological advantage that developed countries have.

General Scheme of Project Implementation		Hanoi		Ho Chi Minh City	Jakarta
MRT Project	Project	Hanoi Urban Railway (Line 1)	Hanoi Urban Railway (Line 2)	Ho Chi Minh City Urban Railway (Line 1)	Jakarta Mass Rapid Transport (North-South Line)
Ministry of Transport, etc.	Related Ministries	Ministry of Transport of Vietnam	Ministry of Transport of Vietnam	Ministry of Transport of Vietnam	Directorate General of Railways, Ministry of Transportation
Municipal Government/MRT Project Entity	Executing Entity	Viet Nam Railways (RPMU)	Hanoi People's Committee (HRB)	Ho Chi Minh City Management Authority for Urban Railways (MAUR)	Special Region of Yogyakarta (PT. MRT JAKARTA established as the executing entity)
ODA/Gov. Funding	Funding	Phase I: Yen loan 80%, government funds 20% Phase II: Yen loan planned	Phase I: Yen loan 84.3%, government funds 15.7% Phase II: Yen loan planned	Yen loan 83%, government funds 17%	Phase I:Yen loan 83%, government funds 17% Phase II: Yen loan planned
EPC	Project Formation	EPC (BOQ) O&M: Executing Entity	EPC (Design&Build) O&M: Executing Entity	EPC (Design&Build) O&M： Contractor (5 years)	EPC (Design&Build) O&M: Executing Entity



(10) Financial Planning:

The total investment required for the project's implementation is as shown in the table below. In each case, slightly less than 80% of the required funds will be procured through Japanese yen loans.

	Hanoi		Ho Chi Minh City	Jakarta
Project	Hanoi Urban Railway (Line 1)	Hanoi Urban Railway (Line 2)	Ho Chi Minh City Urban Railway (Line 1)	Jakarta Mass Rapid Transport (North-South Line)
Total Investment	Approx. ¥160 billion (Phase I)	Approx. ¥150 billion (Phase I)	Approx. ¥240 billion	Approx. ¥142.1 billion (Phase I)
Funding	Phase I: Yen loan 80%, government funds 20% Phase II: Yen loan planned	Phase I: Yen loan 84.3%, government funds 15.7% Phase II: Yen loan planned	Yen loan 83%, government funds 17%	Phase I:Yen loan 83%, government funds 17% Phase II: Yen loan planned
L/A (Loan-Agreement)	Engineering-Service: 2008/3 (¥4,683 million) RTS works: Loan expected to be provided	Engineering-Service & RTS works: 2009/3 (¥14,688 million) RTS works: Continuation of loan	Engineering-Service & RTS works: 2007/3 (¥20,887 million) RTS works: Continuation of loan	Engineering-Service: 2006/11 (¥1,869 million) RTS works:2009/3 (¥48,150 million) Continuation of loan
EIRR	10.64%	(TBA)	Approx. 20%	7.38%
FIRR	0.28%	(TBA)	Approx. 4%	1.99%
EIRR/FIRR Sources	The Study on Urban Transport Master Plan and Feasibility Study in Ho Chi Minh Metropolitan Area (HOUTRANS)		Report of feasibility study Hanoi elevated railway project	JICA preliminary assessment table

(11) Introduction of Japanese Technology:

When introducing an MRT system, tenders are commonly made for individual scopes, such as (1) civil engineering works, (2) rolling stock, and (3) E&M (Electrical & Mechanical: signals, communications, electrification, etc.). Of these, Japan has the highest level of technology and safety in the world with respect to the technology and operational knowhow of (2) rolling stock as well as signal systems and ticket vending machines, which are included in (3) E&M. Moreover, because the Japanese yen loans, which have already been decided to be provided for the project, are conditional upon fulfillment of the Japanese government's Special Terms for Economic Partnership (STEP), which require 30% or more of the loans are allotted for use of equipment, materials, and services originating in Japan, it is highly likely that Japanese technology would be introduced for the scopes (2) and (3) above.

As for automated fare collection systems, there are considerable expectations from host countries as such systems would allow use of the collected data for preparation of OD tables as well as for potential development of side businesses.

(12) Future Prospects and Issues:

The four MRT lines covered in this FS study are expected to start operations as shown in the table below.

	Hanoi		Ho Chi Minh City	Jakarta
1 Project	Hanoi Urban Railway (Line 1)	Hanoi Urban Railway (Line 2)	Ho Chi Minh City Urban Railway (Line 1)	Jakarta Mass Rapid Transport (North-South Line)
2 Start of MRT Operations (expected)	2018	2018	2017	2017
3 Issues	①Eminent domain ②Securing budget (increase in budget) ③Design risks	①Eminent domain ②Securing budget (increase in budget) ③Design risks	①Securing budget (increase in budget) ②Design risks	①Eminent domain ②Securing budget (increase in budget) ③Design risks
4 Measures	Eminent domain: Although this is basically an issue for the host countries to address, constructors will need to keep a close eye on the developments lest they affect bidding or construction schedules. Securing budget (increase in budget): Delay in bidding or construction schedules may lead to an increase in the budget (for construction materials). Need to monitor the situation closely. Design risks: Constructors may have difficulty responding to changes in the basic design/detailed design, making up for deficiencies, etc. Negotiations with the host countries and formation of a strong consortium on the constructor's part would be required.			

[Prospects of the Project and Challenges]

The issues of eminent domain, securing budget, and design risks are common issues faced by this type of project; however, the project has no major problem at this time. The outlook for each MRT line is as follows:

- Hanoi Urban Railway (Line 1): A series of PQ notices, beginning with the ground leveling package, is expected in early 2012, which will be followed by PQ notices on E&M systems and rolling stock. Factors affecting the schedule may include eminent domain and increase in budget.
- Hanoi Urban Railway (Line 2): The basic design is currently being drawn up. PQ and bidding are expected to occur along the same schedule as Hanoi Line 1.
- Ho Chi Minh City Urban Railway (Line 1): A construction contract is believed to be signed by the client and contractor around May 2012.
- Jakarta Mass Rapid Transport (North-South Line): Following the announcement of bidding for the construction works package in January 2012, PQ notice for the E&M package is expected in early 2012.

[Issues Related to Feasibility of the BOCM Project/Activity]

Essentially, MRT is introduced for the purpose of utilizing MRT's ability to realize mass, rapid, and punctual transportation to enhance convenience of urban transport and to facilitate sustainable development of urban economy. In cities like Hanoi and Ho Chi Minh City in Vietnam and Jakarta, Indonesia, which are covered by this study and where there is heavy congestion of automobile traffic, the aim will be to promote modal shift from automobile traffic, ease traffic congestion, and thereby reduce air pollution from exhaust gas emissions. In a global economy, however, sustainable development on a global scale is essential for any city to achieve sustainable development. Therefore, GHG reduction, which requires implementation of measures globally, must be integral to the sustainable development of these cities.

As a result of our consideration this year, we believe there are three issues to be addressed, as already mentioned, as we consider the methodology for bilateral credits and as we move towards the Bilateral Offset Credit Mechanism, as follows:

- Development of continued collaboration with entities executing the MRT project (towards Bilateral Offset Credit Mechanism)

- Consideration on the details of the methodology (consideration on the methodology)
- Approach to credit distribution (consideration on the methodology)

Development of continued collaboration with entities executing the MRT project (towards Bilateral Offset Credit Mechanism)

The entities executing the MRT project have shown interest in the Bilateral Offset Credit Mechanism and are hopeful for further continuation of the study.

There is a need to sustain efforts in further providing them details of the BOCM system and information on the advantages of participating in it. As there is a particular interest in how decisions will be made on the purchasing entities and prices of the credits, it is hoped that the Japanese expeditiously work on the system design and reach policy decisions. As for the methodology considered and prepared in this FS study, discussion must continue with local project entities and others concerned to enhance its feasibility.

Consideration on the details of the methodology (consideration on the methodology)

Efforts will be made in the next year and beyond to acquire data we were not able to collect adequately this year. Apart from using the data in the Reference Scenario after the implementation of the MRT, we believe it is important to share the methods of data acquisition with the host countries.

Table. Data of Necessary Data and Their Descriptions

Item	Proposed Method for Data Acquisition	Remarks
Average fuel consumption by modes	(Proposed method): Recruit monitors who will measure fuel consumption on weekdays and holidays using the full-tank method. At the same time, the monitors will have a GPS to record data on distance traveled, duration of travel, travel speed by region, etc.	・MRI Inc. has vast experience in Japan with respect to behavioral analysis using GPS. We also have patents on the technology for automatically mapping data obtained from GPS on a map. ・We have worked with the University of Tokyo's Associate Professor Hato, an expert on traffic behavioral analysis using GPS, and with Tokyo University of Marine Science and Technology's Professor Hyodo, who has extensive experience in traffic analyses in Vietnam and Indonesia, in numerous projects. It is possible to seek their advice for this project.
Modal share of expected MRT passengers	(Proposed method 1): Household survey like the one conducted this year and other questionnaire survey (Proposed method 2): Use GPS, etc. on cell phones to collect data on tracks of travel (origin, destination) and travel modes used. At the same time, obtain data on distance of travel, etc.	・This year, household survey was conducted in Vietnam. The Vietnamese side (Ministry of Transport (MOT), MOT's TDSI, etc.) recognizes the need for expanding the survey (additional questions, greater sample size). A similar survey will also need to be conducted in Indonesia. ・As mentioned above, MRI Inc. has vast experience in the acquisition of GPS track data.

We presented three options for calculation ((1) MRT, (2) MRT + access/egress traffic, and (3) MRT + access/egress traffic + traffic on nearby roads). While adopting Boundary Option (1) from the point of view of feasibility, for the calculation, in principle, we will nonetheless need to take estimates of GHG emission reductions under the other two options and consider whether we can leave out the other two if they turn out to have little impact on the emission reductions or take such steps as to subtract a certain fraction from the overall emission reductions.

Furthermore, there is a need to work out the detailed design of the MRV system, including details on the entities performing the measurement and validation. Together with the sharing of information on the methods of data collection mentioned above, capacity building for measurement, validation, etc. will be required in the host countries.

Approach to credit distribution (consideration on the methodology)

Tenders for a project to introduce MRT are usually divided into several categories, such as (1) civil engineering works, (2) rolling stock, and (3) E&M (signals, communications, electrification, etc.), and Japanese technology may not necessarily be awarded all tenders. For example, if Japanese technology is adopted only for the signal system, there would be a need to consider how to distribute emission reductions arising from the project as a whole. Possible options are shown below. These options require bilateral agreement and will need to be considered further.

- Provided there is a bilateral agreement, all credits generated from the project as a whole may be passed on to Japan regardless of the share of Japanese technology adopted in the project.
- Credits may be distributed in accordance with the cost of each technology comprising the project as a whole.

5. "Co-benefits" (i.e. Improvement of Local Environmental Problems)

As for a co-benefit approach to global warming in the transportation sector, the *Manual for Quantitative Evaluation of the Co-Benefits Approach* recommends assessment of emission reductions of NOx among other air pollutants. Therefore, we selected NOx emissions for assessment of co-benefits in this study.

As results of this evaluation serve only as a reference material to the general assessment of the project's effectiveness and do not directly affect investment decisions or lead immediately to monetary transactions of credits, the method adopted for the calculation of the co-benefit should be able to be performed jointly with the calculation of GHG emission reductions to lessen additional burden as much as possible.

Specifically, we adopted a simple assessment method as shown below.

<Reference emissions>

NOx emissions = Distance traveled by travel mode [vehicle km] × NOx emission factor by travel mode [gNOx/km]

Distance traveled by travel mode [vehicle km] = Traffic volume by travel mode [PKM]/average rate of vehicle occupancy (person/vehicle)

<Project emissions>

The project emissions are regarded as 0. (This is because railroad is powered by electricity and emissions from a suburban power station do not lead directly to urban air pollution.)

As a result, total emission reductions of 2,404 tNO2/year can be expected from the four MRT lines as shown below.

Table. Estimated NO2 Emission Reductions **(Unit: tNO2/year)**

Project		Hanoi Line 1	Hanoi Line 2	Ho Chi Minh City Line 1	Jakarta North-South Line
Year of Assessment		2030	2020	2020	2037
Reference Emissions		637	597	667	503
	358	335	158	171	282
	215	201	500	248	71
	65	61	9	84	88
Project Emissions		0	0	0	0
Emission Reductions		637	597	667	503

6. Contribution to Sustainable Development in Host Country

In both countries of this study, public transportation is underdeveloped, dependence on automotive transport (motorbikes, private-owned cars) is high, and urban population is rapidly growing. As a result, the existing transport systems will make sustainable development difficult. Therefore, building an efficient transportation system by introducing public transportation and in particular, mass transportation system is essential for realizing sustainable development in the two cities that drive growth in the two countries.

In Indonesia, traffic congestion is already causing substantial economic loss in terms of loss of time and traffic accidents (in a study conducted in 2005, Pelangi Foundation estimated an annual loss of 12.8 trillion rupiah in time, fuel and health). The passenger transportation capabilities need to be strengthened to realize improvements in the environment in which people live as well as in the investment climate.

In Vietnam, traffic congestion continues to grow, and improvements in traffic safety are lagging. Hanoi is drawing up the city's master plan to promote sustainable development, and expansion of public transportation system is indicated as a top priority item in its urban transportation master plan (a share of public transportation to increase from 5% today to between 40 and 50% in 2025).

The project dealt with in this study is being promoted against such a background. The project's prospectus clearly indicates its objectives to ease traffic congestion, counter air pollution, create jobs, and contribute to urban development. Therefore, the project is expected to contribute to sustainable development of the two countries through alleviation of the transportation-related problems, promotion of people's activities, movement of materials, and services, and stimulation of the economy.

As for quantitative assessment of benefits generated by the mass transportation system of this study in term of sustainable development, it may be possible to convert the following effects into currency for the assessment:

- Reduction in the time required for travel
- Reduction in vehicle operating costs
- Reduction in the incidence of traffic accidents