New Mechanism Feasibility Study for Urban Transport Management in Vientiane, Lao PDR

By Katahira & Engineers International

1. Study Team and Counter Parts

Cooperation: Mitsubishi UFJ Morgan Stanley Securities (MUMSS: Assistance for the Survey)
Counter Parts: Ministry of Public Works and Transport, Department of Transport (MPWT, DOT)
Ministry of Natural Resource and Environment, Climate Change Office (MONRE, CCC)
Laos Transport Engineering Consultant (LTEC: Traffic Survey)
MEK Consultants (Assistance for the Survey)

2. Outline of the Project and Activity

(1) Contents of the Project and Activity

<table>
<thead>
<tr>
<th>Host Country:</th>
<th>Lao PDR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Area:</td>
<td>Center of Vientiane Capital</td>
</tr>
<tr>
<td>Contents of the Project and Activity:</td>
<td>The Master Plan on Comprehensive Urban Transport in Vientiane Capital in Lao PDR</td>
</tr>
<tr>
<td>Technologies introduced through the Project and Activity:</td>
<td>Public Transport Development and Traffic Management Plan included in the Master Plan</td>
</tr>
<tr>
<td>Possible Counter Parts on the Project:</td>
<td>Ministry of Public Works and Transport, Ministry of Natural Resource and Environment, Climate Change Office</td>
</tr>
<tr>
<td>Outline of the Project:</td>
<td>The Master Plan on Comprehensive Urban Traffic in Vientiane Capital in Lao PDR</td>
</tr>
</tbody>
</table>

Objective of the Master Plan

The study has formulated the “Master Plan on Comprehensive Urban Transport in Vientiane Capital in Lao PDR” with the assistance of JICA, aimed at following objectives:

- To deal with issues emerging from future traffic congestion;
- To formulate the EST tactics, and
- To deliver above two objectives

Contents of the Master Plan

The Master plan consists of three basic plans: 1) Road Network Development Plan, 2) Public Transport Development Plan, 3) Traffic Management Plan. Each plan includes subordinate projects as shown on below table.

<table>
<thead>
<tr>
<th>Table2-1 Plans and Sub Projects of the Master Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan</td>
</tr>
<tr>
<td>Sub-Project</td>
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<tr>
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<tr>
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</tr>
</tbody>
</table>
The study area
The study area covers total area of 38,190ha and almost 10% of Vientiane Capital, including districts of Chanthabuly, Hadxayfong, Sikhottabong, Sisattanak, Xaysetha, and Xaythany.

The GHG reduction by the Master Plan
Implementation of the Master Plan projects will reduce GHG emissions by future VKT reductions and ease the traffic congestion on existing roads.

Project Period of the Master Plan
The Master Plan is to be implemented in three terms: Short-term (2008～2013), Mid-term (2014～2018), Long-term (2019～2025). A part of paving, widening and repairing of road, and procurement of bus vehicles had been undertaken by the end of 2011.

(2) Current Condition of Host Country
Lao PDR is one of the least developed Countries (LDC), and is currently preparing and approaching National Adaptation Programs of Action (NAPA) with assistance of Least Developed Country Fund (LDCF) established under UNFCCC. And, NAMA has not yet submitted. However, according to the “Strategy on Climate Change of Lao PDR” formulated in 2010, Lao PDR states its approach on seven sectors which includes adaptation as well as mitigation measures. NSCCC plans to priorities this approach but also proposes to work on mitigation measures through continuous capacity development for CDM and a feasibility of NAMA.

Discussion was hold with CCO staff, and following opinions regarding their mitigation approach for the climate change were obtained.

- CCO continues to talk with Ministry of the Environment in Japan about a bilateral offset mechanism.
- Although there is no NAMA projects in Lao PDR at present, possibilities are examined including a bilateral offset mechanism and NAMA.
- Lao PDR is preparing GHG emission inventory. Currently “Land Use” and “Land-Use Change and Forestry” share a large part, however, a share of traffic sector is expected to increase in five years.
- This survey is the first approach undertaken in Lao PDR, and its importance has been recognized.

In the transport sector, Ministry of Public Works and Transport (MPWT) plans to improve urban environment continuously under the “Environmentally Sustainable Transport(EST)” Strategy. The subject of this Study, the “Master Plan on Comprehensive Urban Transport in Vientiane Capital in Lao PDR”, is positioned as the upper level plan of the urban transport/public transport sector in Lao PDR.

Furthermore, donor countries and agencies including Japan have promoted many development plans for Lao PDR. Among those, many of recent projects aim for building a low carbon society, and especially ADB takes up EST strategy such as CO2 reduction for issues in the Asian area, and undertook a preparatory study in Lao PDR in 2010. Based on the result of this study, ADB plans a fund of USD 15 million for a pilot project. Also WB considers targeting Vientiane Capital as a pilot city for the urban planning under the “Country Assistance Strategy”. This is a combined project of KfW and ADB, composed of land utilization, bus service and road development.

As the assistance of Japan, JICA currently implements the procurement of bus vehicles and the technical assistance for Vientiane Capital State Bus Enterprise (VCSBE).

(3) Eligibility for New Mechanism
The Subject of this study is eligible as New Mechanism, considering being one of policies of the host country, at the same time, it secures environmental integrity

1) Realization of the host country’s policy
The Master Plan is planned for a delivery of EST strategy which is currently prepared for prevention of future traffic issues. EST strategy aims to reduce environmental impacts of the traffic sector as well as Global Warming, and assists the realization of a low carbon society of Lao PDR.

2) Securement of environment integrity
The subject of the Study will be implemented under the Master Plan of the host country, however, delivery of the projects will be depended on the assistance of donor countries and agencies. Especially, the Public Transport Development is expected to be delivered through ODA of Japan. Promoting projects under New Mechanism will contribute on emission reduction of the traffic sector of the host country.

(4) Promoting Approach of the Projects and the Activities
The Master Plan for the center of Vientiane Capital is targeted as a pilot project of this survey. It aims to promote New Mechanism to allow an adequate MRV methodology and incentive system which promote projects with financial and technical assistance. And it is expected to contribute facilitation of GHG mitigation measures for urban traffic development projects such as this Master Plan.

Other cities such as Luang Prabang and Savannakhet have also concerns on future traffic as same to Vientiane Capital. Urban traffic policy is managed by MPWT and municipalities. Therefore, an establishment of the above implementation framework will allow deployment of New Mechanism to other cities in cooperation with municipalities.

Traffic problems have also became issues for many developing countries due to rapid economic development and urbanization. Urban transport master plans or urban transport strategies have been formulated at each country aiming to solve these issues. Although issues vary by country or city, objectives to cope with increasing traffic volume and environment conservation are common. As a response to this, many master plans or strategies have been proposed the plans such as road network development and/ or public transport development (bus, railway).

The reduction of GHG emission and MRV methodology for the “Master Plan on Comprehensive Urban Transport in Vientiane Capital in Lao PDR” has been examined and result is considered applicable to many similar projects and to be promoted to other countries with interest in mitigation of potential impact of traffic sector.
3. Contents of the Survey

(1) Issues of the Survey:
MUMSS Study Team conducted the survey in 2010. Objectives of the Study were to address issues arisen during the survey.

<table>
<thead>
<tr>
<th>Items</th>
<th>Issues</th>
<th>Policies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Setting Reference Scenario</td>
<td>Past traffic data indicating variations is scant.</td>
<td>A follow-up traffic survey of the 2007 survey is conducted and analyzed for the trend of traffic activities for last 5 years. / The past trend is reflected on Reference Scenario. / Projects implemented during 2007 and 2011 are surveyed to compare with the Do-nothing Scenario.</td>
</tr>
<tr>
<td>2) Quantification of GHG Emission and Reduction</td>
<td>Re-examination of the traffic demand forecast by Reference Scenario and Project Scenario / Re-calculation of the traffic demand forecast using emission factors by each velocity and vehicle type</td>
<td>The traffic volume of Reference Scenario and Project Scenario based on the latest traffic survey are forecasted and reflect to GHG reduction. / In Lao PDR, GHG emission factors have not been measured. Therefore considering many vehicles and fuels of Lao PDR being imported from Thailand, those of Thailand is employed.</td>
</tr>
<tr>
<td>3) Monitoring Methodology</td>
<td>Adequacy of using the revised basis data for review / Possibility of implementing traffic survey / Frequency of monitoring and implementation body(organization)</td>
<td>Adequacy of Reference Scenario offset is examined by comparing results of the 2007’s traffic volume forecast and the 2011’s traffic survey. / Potential to implement the traffic survey is discussed among counter parts / Potentials to measure emission factors and conduct monitoring are examined on a basis of Thailand case. / Fuel consumption and a potential to monitor fuel consumption data in Laos PDR are surveyed.</td>
</tr>
<tr>
<td>4) MRV Methodology</td>
<td>Adequacy of pre-determination of Reference Scenario / Validation of uncertainty for the traffic forecast model / Feasibility of reporting by implementation body / Feasibility of validation of applying the traffic demand model</td>
<td>Adequacy of the ex-ante decision of Reference Scenario and application of the forecast model are evaluated through comparing the results of 2007’s and 2011’s survey. / Transparent reporting process on the basis data, estimation, and results of the monitoring is explored. / Implementation body for monitoring and its feasibility in Laos PDR are examined</td>
</tr>
</tbody>
</table>
(2) Contents of the Survey:
Results of the survey are shown on Table.3-2.

<table>
<thead>
<tr>
<th>Contents and Results of the Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Setting a Reference Scenario</td>
</tr>
<tr>
<td>Results of the traffic survey are showed as follows.</td>
</tr>
<tr>
<td>/ Traffic volume grew 1.96 times at the cordon line survey, 1.34 times at the screen line survey. Average growth is 1.42 times between 2007 and 2011. Regards to a composition ratio of vehicles and motor cycles, vehicle was a dominant with almost 50 percent at the cordon line survey and 60 percent at the screen line survey.</td>
</tr>
<tr>
<td>/ Master plans and projects implemented during 2007 and 2010 were examined, and confirmed with counter parts for implemented projects in Vientiane Capital.</td>
</tr>
<tr>
<td>2) Quantification of GHG Emission and Reduction</td>
</tr>
<tr>
<td>Results of the traffic survey was analyzed and the future traffic activity was forecasted.</td>
</tr>
<tr>
<td>/ The 2003’s emission factors measured by each velocity and vehicle type were obtained.</td>
</tr>
<tr>
<td>/ A consultation with measurement agencies of Thailand and Japan was hold to discuss measuring of emission factors.</td>
</tr>
<tr>
<td>3) Monitoring Methodology</td>
</tr>
<tr>
<td>The traffic survey was implemented to examine the adequacy of employing monitoring for a review.</td>
</tr>
<tr>
<td>/ Input data was gathered in order to revise the traffic demand forecast model.</td>
</tr>
<tr>
<td>/ Fuel consumption data in Laos was studied for the purpose of comparing “Top Down Approach” and “Bottom Up Approach”.</td>
</tr>
<tr>
<td>4) MRV Methodology</td>
</tr>
<tr>
<td>Based on the result of the traffic survey, uncertainty of the forecast model was examined by comparing the actual and estimated measurement. The traffic demand forecast model was proposed as the one of adequate MRV methodology.</td>
</tr>
<tr>
<td>/ Fuel consumption data in Laos was examined for the purpose of comparing “Top Down Approach” and “Bottom Up Approach”.</td>
</tr>
<tr>
<td>5) Other surveys</td>
</tr>
<tr>
<td>Information and data on EIA and the atmospheric environment of Vientiane were collected.</td>
</tr>
<tr>
<td>/ On the Master Plan, questionnaire survey was conducted for the stakeholders.</td>
</tr>
</tbody>
</table>

Table 3-2  Results of the Survey
4. Results of the Feasibility Survey on New Mechanism Project

(1) GHG Reduction by the Project Implementation

1) Basis of the Reduction by the Project Implementation

In Vientiane city, the number of vehicles has been increasing dramatically correspond to the growth of income. As a result, traffic has congested during the morning and evening peak time, and causes increase in GHG emission and air pollution.

As a response to this situation, reducing motorcycles and private cars is considered to contribute GHG reduction. In other words, implementation of the Urban Traffic Master Plan will replace the existing low efficient private transportation into the high efficient public transportation. The plan will ease the current traffic congestion and ultimately contribute to the reduction of GHG emission by the vehicles.

\[
\text{Appropriate Urban Transport Management}
\]
\[
\begin{align*}
\text{Activities} & \quad \text{Effects} \\
\text{Road Network Development} & \quad \text{Effect on GHG Reduction} \\
\text{Road Traffic Management} & \quad \text{\begin{itemize}
\item Appropriate Mode Choice
\item Reduction of Traffic Congestion
\item Improvement of travel speed
\item Reduction of travel cost
\item Improvement of accessibility
\end{itemize}}
\end{align*}
\]

\[
\text{Public Transport Management}
\]

\[
\text{Traffic Demand Management}
\]

\[
\text{Figure 4-1 GHG Reduction by the Project Implementation}
\]

2) Verification Methodology

There are two methods for calculating GHG emissions in the traffic sector. One is “Top down Approach” based on fuel consumption. The other is “Bottom up Approach” which based on the traffic volume. “Bottom up Approach” is more adequate to evaluate a trend of traffic activities, therefore adopted for the study.

The GHG reduction is calculated based on the difference between GHG emission “without” and “with” the Master Plan. Each GHG emission is calculated by multiplying VKT (Vehicle Kilometer Travelled) with GHG emission factors of each transport mode. Emission factors by velocity and vehicle are also applied.

Projects such as “The National Strategy and Action Plan on Environment Sustainable Transport (EST)” and “Vientiane Sustainable Urban Transport Project” were reviewed. Then VKT was calculated based on the demand forecast, which was revised by the result of this traffic survey and the future urban traffic policies.

Adopting vehicle emission factors of Thailand has already explained. Emission factors of vehicles is to be inherent values on each country or city, therefore, potential to develop “factor of Lao PDR” was also studied with interview to the laboratory which measures emission factors.

3) Development of Methodology

Work required for developing methodology is shown as follows.

Step 1: Estimate traffic volume of base year 2011

The traffic demand forecast was surveyed based on the latest basis data of 2007’s model. Survey results were compared between the latest surveyed traffic of 2011 and the estimated traffic by the demand forecast. Then traffic volume of base year was estimated by the revised 2011’s and 2025’s
OD table.

Step 2: Estimating future traffic volume of Reference Scenario and Project Scenario

OD table was distributed into the future road network of 2025, and the traffic volume and vehicle velocity of each link were calculated.

Step 3: Estimating reduction of GHG emission of Reference Scenario and Project Scenario

GHG emission and reduction volume were calculated by multiplying GHG emission factors with traffic volume of each link and vehicle velocity according to Reference Scenario and Project Scenario. Emission factors of Thailand was adopted as explained already.
(2) Setting the Reference Scenario and the Project Scenario

1) Reference Scenario, and its Adequacy
In this Study, emission trend is set to reflect the past traffic trend. And that is, difference of Reference Scenario and Project Scenario becomes objective of offset credit.

According to the survey of policies implemented between 2007 and 2011, among those projects under the Master Plan, a part of the Road Network Development has been implemented. Overseas assistance is essential for implementation, however, state fund also contributed to the implementation. Therefore, the Road Network Development of the Master Plan has been included in Reference Scenario, and this is regarded as an approach sufficiently conservative. The other plans of the Master Plan, such as the Public Transport Development and the Traffic Management are set as Project Scenario. The reduction volume achieved by the implementation of these projects is regarded as objects of offset credit.

2) Boundary Setting
Geographic Boundary
Same to the Master Plan survey, the study area was set to all the area of Chanthabuly and Sisattanak districts, and a part of Sikhottabong, Xaysetha, Hadxayfong and Xaythany districts. Although residential area in Vientiane city has been expanding to the outside of city, this Study adopted original areas as the Master Plan survey due to the 2007 data adopted. However, trips which have origin and destination in the survey area were included as objects of this survey.

As stated in above, the result of this traffic survey indicate that the Vientiane urban area expands to outside of city. Therefore, consideration is required in the future for reviewing the Master Plan to include a new urban plan and extending the boundary.

Subject GHG Matter
GHG emitted from vehicle with internal combustion are CO2, CH4 and N2O. Because the volume of CH4 and N2O is significantly small (total of both matters is equal to 2% of CO2), only CO2 is considered as the object of this Study.

(3) Monitoring Methodology and Plan
1) Monitoring Methodology
“Bottom up Approach” which is GHG emission estimated based on the traffic demand forecast, enables to evaluate a trend of transport activities, facility development and policy of urban transport. However, at the same time, it requires various data on traffic activities.
Table 4-2 Data required for Traffic Demand Forecast

<table>
<thead>
<tr>
<th>Socio-Economic Index</th>
<th>Traffic Activities/Transport Facility Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population in the Area</td>
<td>Traffic Volume (Screen Line, Cordon Line)</td>
</tr>
<tr>
<td>GRP</td>
<td>Results of SP Survey</td>
</tr>
<tr>
<td>Number of Vehicles in the Area</td>
<td>Travel Speed</td>
</tr>
<tr>
<td></td>
<td>Data of Person Trip survey</td>
</tr>
<tr>
<td></td>
<td>Road Network</td>
</tr>
<tr>
<td></td>
<td>Public Transport</td>
</tr>
<tr>
<td></td>
<td>Traffic Policy</td>
</tr>
</tbody>
</table>

The proposed MRV methodology requires traffic monitoring of such as traffic volume and vehicle speed of each mode within the project boundary, in order to utilize the traffic demand forecast model for the implementation. Therefore, for this survey, the 2011’s OD table developed based on the 2007’s traffic demand forecast model was distributed to the 2011’s road network. Then the estimated traffic volume was compared with the surveyed traffic volume, and adequacy of the proposed methodology is examined.

During this survey, following input data were gathered; socio-economic data including population and the number of possessed vehicles, traffic network condition data including road network and public transport network. Gathered data were applied to traffic demand forecast and the result was compared with the 2007’s estimation. Then adequacy of the proposed monitoring method was further examined including monitoring items, scale, and frequency.

This study was implemented in cooperation with the Study Team, MPWT, and LTEC of a local consultant and so on. Through a discussion on a feasibility of monitoring among the Study Team and those above listed counter parts, it was agreed that the counter parts could implement traffic survey and data collection, but not traffic demand forecast due to lack of experience and shortage of engineers in the field. For this point, a need of capacity development is to be address as a technical transfer project in the future.

2) Monitoring Plan
Monitoring of urban traffic master plan varies in its size and scale. Large scale master plans such as Manila, Jakarta, Bangkok, Hanoi, are revised every 10 to 15 years and generally implemented as cooperation with donor countries like Japan and host countries. In Japan, road traffic census survey is conducted every two to five years. Some include OD survey and traffic survey, and some are conducted as general traffic survey. Person Trip survey is conducted every 10 years in Tokyo metropolitan district and Kei-Hanshin district, however, in Lao PDR, Person Trip survey and relating survey were conducted in 2007, and not been conducted since.

Small scale survey such as implemented in this survey is easier and more reasonable to conduct, which is also feasible for the host country to be conducted every three to five years.

4) GHG Emission and Reduction
GHG emission of Reference Scenario is calculated as follows.

\[
GHG_{r,y} = \sum_{m=1}^{M} VKT_{r,m,y} \cdot EF_{r,m,y} \]

\(GHG_{r,y}^{tCO_2}\): CO2 Emission on the Reference Scenario (tCO2)

\(VKT_{r,m,y}\): VKT of Traffic mode(m), Reference Scenario(r), years(y)

\(EF_{r,m,y}\): Emission Factor of Traffic mode(m), years(y), Reference Scenario(r)

GHG emission of Project Scenario is calculated as follows.

\[
GHG_{p,y} = \sum_{m=1}^{M} VKT_{p,m,y} \cdot EF_{p,m,y} \]

\(GHG_{p,y}^{tCO_2}\): CO2 Emission on the Project Scenario (tCO2)

\(VKT_{p,m,y}\): VKT of Traffic mode(m), Project Scenario(p), years(y)

\(EF_{p,m,y}\): Emission Factor of Traffic mode(m), years(y), Project Scenario(p)

Reduction of GHG emission on each year is calculated as follows.
The GHG reduction of Reference Scenario and Project Scenario were calculated with traffic activities obtained from the traffic demand forecast and emission factors. According to Table 4-3 GHG reduction volume of each scenario, implementation of the Public Transport Development Scenario will reduce by 130 thousand ton per year (21.9%). Furthermore, additional implementation of Traffic Management (influx regulation) Scenario will reduce by 210 thousand ton per year (36.0%).

Table 4-3 Estimation of GHG Reduction in 2025 (ton)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Emission/day</th>
<th>Reduction/day</th>
<th>Reduction/year</th>
<th>Reduction Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference Scenario</td>
<td>1,616.6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Public Transport Development Scenario</td>
<td>1,262.9</td>
<td>353.7</td>
<td>129,101</td>
<td>21.9%</td>
</tr>
<tr>
<td>Public Transport Development &amp; Traffic Management (Influx Regulation) Scenario</td>
<td>1,033.9</td>
<td>582.7</td>
<td>212,686</td>
<td>36.0%</td>
</tr>
</tbody>
</table>

Figure 4-4 GHG Emission Reduction of each Scenario

(5) MRV Methodology on GHG Reduction Effect
1) Measurement
Measurement procedure is described as follows.

Step1. Setting out Boundary
Geographic boundary includes project affected areas and road network. In this Study, due to the result of 2007’s survey adopted, only six districts in Vientiane city are included in the geographic boundary, however, utilization of administrative boundary is considered practical approach in the future.

Step2. Estimation of Reference Emission
Step2.1 Setting out Reference Scenario
Future Scenario is assumed from the condition of host country or targeted areas. In this Study, Road Network Scenario was employed as Reference Scenario.

Step2.2 Calculation of Traffic Volume of Base Year
Traffic volume of the base year is calculated with a standard and practical method of traffic planning. The applied traffic model is calibrated to measured values of the base year. For the early stage trial, it is recommended to implement with a set of traffic planning procedure including data collection and modeling. VKT on the base year is calculated with the calibrated traffic model.

Step2.3 Traffic forecast of Reference Scenario
VKT is calculated based on Reference Scenario on Step2.1. Future traffic volume is calculated reflecting input data such as condition of socio-economic, road network, and so on.

In this Master Plan projects, VKT was calculated by traffic volume after the implementation of the Road Network Development. In addition, based on the calculated volume, an average vehicle speed of each link was forecasted.

Step2.4 Calculation of CO2 Emission of Reference Scenario
CO2 emission is calculated with VKT by vehicle emission factors according to the type of vehicle, engine, driving mode and so on. Therefore, the utilization of an inherent value of each area is ideal. However, in this project, emission factors of Thailand were applied for following reasons:
In Lao PDR, many vehicle and fuels have been imported from Thailand.
Condition of climate and geography in Thailand is similar to those of Lao PDR.

Step 3. Calculation of Project Emission

Step 3.1 Traffic Forecast of Project Scenario
Along with Project Scenario, future traffic volume is forecasted with same approach as Step 2.

Step 3.2 CO2 Emission of Project Scenario
The emission of Project Scenario is calculated by multiplying with vehicle emission factors. Same procedure is applied as Reference Scenario. The Project emission is calculated using the emission factors of the base year.

2) Report
Report is to be prepared twice: before and during the implementation of the Project. Work Plan is submitted before the implementation of the Project, and Monitoring Report with a result of monitoring and emission volume is submitted during the construction of the Project.

Table 4-4 Recommendation of Documents for Report

<table>
<thead>
<tr>
<th>Contents</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Plan Project Outline</td>
<td></td>
</tr>
<tr>
<td>Reference Scenario</td>
<td></td>
</tr>
<tr>
<td>Calculation Method of GHG Emission</td>
<td></td>
</tr>
<tr>
<td>Monitoring Plan</td>
<td></td>
</tr>
<tr>
<td>Eligibility</td>
<td></td>
</tr>
<tr>
<td>Monitoring Report</td>
<td>Results of Monitoring</td>
</tr>
<tr>
<td></td>
<td>Results of Calculation of GHG Emission</td>
</tr>
</tbody>
</table>

3) Validation and Verification
“Validation” and “Verification” are implemented in two phases: before and during the project implementation. Validation is implemented before the project implementation and to be simplified process. Verification is implemented during the project implementation and verifies the result of monitoring by the project owner. For projects requiring technical knowledge such as this Study, it is suggested that review is to be carried out by experts in the field.

4) Environmental Integrity
In Lao PDR, Environmental Impact Assessment (EIA) is implemented based on “Environmental Protection Law” and “Regulations on Environment Assessment in the Lao PDR”. Furthermore, “Decree on Environmental Impact Assessment” was enforced in 2010. This decree stipulates a detail implementing procedure of EIA including responsibility of stakeholders (central and local administration, and project owner), and penalties for violations. EIA will be implemented for each project of the Master Plan stipulated under these laws.

(7) Other Indirect Effects
Each traffic policy included in the Master Plan will contribute to activate physical distribution and service, and improve income and quality of life. Furthermore, provision of safe public transport and formulation of traffic policy will reduce traffic accidents which currently increasing year by year.

(8) Stakeholders Comments
Questionnaire survey was conducted to the stakeholders of the Master Plan, in total of 55 people including relevant road administration and local administration, and project owners of the public transport. Contents of the questionnaire include recognition of the Master Plan, expectation, issues on the implementation, and so on.

Results of the survey are as follows: the Master Plan has been recognized well. However it is rather understood as “Public Transport Development”, especially “Bus Traffic Development”. With regards to the expectation, “Bus Traffic” is expected for “Punctuality” and “Convenience for accessing to the service”. “Road Development” is expected for “Comfort and convenience for road user”. “Traffic Control” is expected for “Reduction of Traffic Congestion”. On the other hand, “Budget” is listed as an issue of implementation for all the Master Plan projects.
As seen above, stakeholders have high expectations on the Master Plan, on the other hand, have a concern on “Budget” for the project implementation.

**Table 4-5 Expectations and Issues for the Master Plan projects**

<table>
<thead>
<tr>
<th></th>
<th>Road Network Development</th>
<th>Public Transport Development</th>
<th>Traffic Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expectations</strong></td>
<td>Comfort and convenience for road user (98.2%)</td>
<td>Punctuality (80.0%)</td>
<td>Reduction of Traffic Congestion (83.6%)</td>
</tr>
<tr>
<td></td>
<td>Reduction of accident and traffic congestion (25.2%)</td>
<td>Convenience for access to service (58.2%)</td>
<td>Enhanced safety (27.3%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cleanliness (56.4%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Safety on board (47.3%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Comfort (40.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Issues</strong></td>
<td>Budget (100%)</td>
<td>Budget (98.2%)</td>
<td>Budget (89.1%)</td>
</tr>
</tbody>
</table>
(9) Implementation Body of the Projects:
The master plan was formulated by MPWT with assistance of JICA. Each project of the Master Plan will be conducted by each project owner such as DOR, VCSBE under MPWT and Vientiane Authority.

![Diagram of Implementation Structure of the Master Plan]

(10) Financing Plan
Trial calculation of the financing plan was conducted in order to formulate the Master Plan. Project funds for the Master Plan projects such as the Road Network Development and the Public Transport Development are required for USD 99 million for short term, USD 114 million for medium term, and USD 143 million for long term. Implementation of the projects will be assisted by loans until 2016.

![Graph of Funds for the implementation of the Master Plan]

The government fund of Lao PDR is not sufficient for the implementation of the Master Plan projects. Therefore loans will be applied to cover the shortage of project costs. The Road Network Development will be implemented with loans based on future economic growth. Assistance for the Public Transport Development requires understanding on the fact that the significant small amount of the project core such as the management scale and financial condition of Vientiane Capital Bus Enterprise comparing to the entire project costs. With this background, ODA of Japan and assistance of donor countries are crucial for the project implementation.

After the formulation of the Master Plan, JICA has implemented following assistances relating to the
Master Plan: Training for trainee, Data collection survey for public transport improvement in Vientiane, Procurement of bus vehicles.

ADB has also implemented surveys in Asia countries aiming for EST. Currently a fund of USD 15 million is planned for the preparatory study of “Vientiane Sustainable Urban Transport Project” in Lao PDR. This preparatory study will compose a part of the Master Plan projects and ADB submitted a draft report of this study to JICA on February 2010.

(11) Approaches for introducing Japanese technologies
Each technology proposed in the Master Plan is a standard conventional technology and not always requires for technology specific to Japan (Table2-1). Followings approaches will be taken for adoption of Japanese technology for the implementation of the Master Plan.

(Competitive technologies on performance and quality)
Many conventional technologies of Japan are known on their performance and quality. For example, Vientiane Capital State Bus Enterprise (VCSBE) has been running bus vehicles made in Japan over the last twenty years, and its durability and competitiveness on maintenance cost have been recognized already. Furthermore, member of staff of VCSBE already mastered maintenance skill for Japanese bus vehicles. Therefore the procurement of bus vehicles made in Japan is highly expected by MPWT and VCSBE.

(Increasing Master Plan effects by introduction of Japanese advanced technologies)
Introduction of advanced Japanese technologies on such as environment, energy saving and ICT technologies, will increase further GHG reduction effects of the Master Plan. JICA have already introduced some of Japanese advanced technologies, such as introduction of ICT for public transportation fare, low emission public transportation in some Asian cities, which will increase the utilization of public transport and protect against environmental deterioration.

As seen from the above points, there are potential needs for Japanese technologies in Lao PDR. It is essential to promote Japanese technology accompanying with such as maintenance and operation knowhow including capacity development, in order to differentiate its performance and quality, and utilize hard aspect. The scale of market in Lao PDR is still small and private sector investment is still difficult. Public and private financed approach is required considering with future deployment to ASEAN countries which have same issues under similar conditions.

(12) Future prospects and issues
(Implementation of the Master Plan projects)
The “Master Plan on Comprehensive Urban Transport in Vientiane Capital in Lao PDR” is the upper level plan of urban traffic and public transportation sector under the national strategies in Lao PDR, and is one of plans that deliver EST strategies. The Master Plan has three practical terms: Short term (2008 to 2013), Mid-term (2014 to 2018), Long-term (2019 to 2025). A part of paving, widening and repairing of road has been already implemented, and the procurement of bus vehicles has been undertaken by the end of 2011.

The major issue on the implementation of the Master Plan is the project budget. Overseas assistance is indispensable for the success of the Master Plan projects implementation. So far, with the assistance of some donor countries including Japan, projects are going ahead along with the Master Plan schedule.

(Issues as New Mechanism)
CDM on the traffic sector has not been workable sufficiently, because quantification of GHG reduction and monitoring are difficult, and expected reduction are less considering project costs. This survey recommended the calculation method of GHG emission based on the traffic demand forecast which is conventional analysis method of traffic sector. And also it recommended the method of verifying and correcting the forecast values by the monitoring including the traffic survey.

In many developing countries, periodic traffic surveys have not been implemented until now. Therefore, it is said to the lack of the traffic data. Building the monitoring organization of the host country and the periodic verification of the project efficiency are important for not only the calculation of GHG reduction but also accomplishing the long term target of the low carbon development in the host county. Furthermore, the assistance of the developed countries, such as the technical transfer and the capacity development, is
important for implementing such monitoring. New mechanism is hoped to solve the issues of CDM and assist mitigation policies of Lao traffic sector. Consistency of the estimated GHG reduction and the assistance of each project will deliver formulating the New Mechanism.

5. Survey on Co-benefit
Primary intention of the urban transport master plan is following: improvement of convenience and economic efficiency by shortening travelling time, securing road safety, improvement of urban environment by securing roadside. Reduction of traffic volume would also reduce contaminants included in vehicle emission and dust on the road. On this survey, the reduction volume of NOx through the implementation of the Master Plan was estimated. A calculating procedure is as same as that of the GHG reduction using link length, vehicle speed, type and number of vehicles and emission factors of NOx. Emission factors of NOx of Thailand data was also used as same as GHG. Table 5-1 shows the results.

<table>
<thead>
<tr>
<th>Table 5-1 Reduction volume of NOx by M/P implementation</th>
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<tbody>
<tr>
<td>Emission Volume</td>
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<tr>
<td>(ton/day)</td>
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<tr>
<td>Reduction Volume</td>
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<tr>
<td>Reference Scenario</td>
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<td>Project Scenario</td>
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<tr>
<td>Public Transport Development</td>
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<td>Public Transport Development + Influx Regulation</td>
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</table>

Implementation of Project Scenario will reduce NOx emitted from Vientiane transportation from 440 to 880 ton/year against Reference Scenario.

6. Survey on contributing to sustainable development
In Lao PDR, improvement of urban environment is planned by MPWT under “Environmentally Sustainable Transport” (EST) Strategy. The “Master Plan on Comprehensive Urban Transport in Vientiane Capital in Lao PDR”, is also one of plans which deliver EST strategy of Lao PDR.

The Master Plan is the comprehensive urban transport plan and the GHG reduction is one of many effects of it. The prospective effects of the Master Plan includes; economic utilization by shortening of travel time and reduction of travel length, securement of residential environment including pollution protection, and securement of road safety. These effects are highly expected. CCO staff predicts that in Lao PDR, proportion of transport sector on GHG emission will increase from now on. From this point, the Master Plan is also expected as a one of means to deliver the sustainable development.