Findings of New Mechanism
MRV Demonstration Study &
Feasibility Study Programme
on GHG Mitigation Projects in 2012

--- based on MOEJ/GEC JCM/BOCM DS/FS Programme ---

Ministry of the Environment, Japan  Global Environment Centre Foundation

June 2013
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Introduction

Japan’s Proposal for New Market Mechanisms towards Low Carbon Growth

In order to effectively address the issue of climate change, it is necessary for both developed and developing countries to achieve low-carbon growth all around the world by fully mobilizing technology, markets and finance. Recognizing this necessity, the Government of Japan proposes the Joint Crediting Mechanism (JCM)/Bilateral Offset Credit Mechanism (BOCM) as a means to facilitate the diffusion of leading low-carbon technologies, systems, and so forth in developing countries.

Japan has held consultations for the JCM/BOCM with developing countries (e.g. Mongolia, Bangladesh, Indonesia, and Vietnam) since 2011, and made briefings to interested countries as well. Mongolia and Japan signed the bilateral document for the JCM in January 2013, and Bangladesh also signed in March 2013. Japan will continue consultations/briefings with any countries interested in the JCM/BOCM.

Basic Concept of the JCM/BOCM

The basic concepts are summarised as follows:

- Facilitating diffusion of leading low-carbon technologies, products, systems, services, and infrastructure as well as implementation of mitigation actions, and contributing to sustainable development of developing countries.
- Appropriately evaluating contributions to GHG emission reductions or removals from Japan in a quantitative manner, by applying measurement, reporting and verification (MRV) methodologies, and using them to achieve Japan’s emission reduction target.
- Contributing to the ultimate objective of the UNFCCC by facilitating global actions for GHG emission reductions or removals, complementing the CDM.

[Diagram: JAPAN - Leading low carbon technologies, etc., and implementation of mitigation actions - MRV Methodologies will be developed by the Joint Committee - Credits - Host Country - JCM Projects - MRV - GHG emission reduction/removal]
Approaches of the JCM/BOCM

Based upon the basic concept above, the JCM/BOCM should be designed and implemented, taking into account the following:

1. Ensuring the robust methodologies, transparency and environmental integrity
2. Maintaining simplicity and practicality
3. Promoting concrete actions for global GHG emission reduction or removal
4. Preventing uses of any mitigation projects registered under the JCM/BOCM for the purpose of any other international climate mitigation mechanisms, to avoid double counting on GHG emission reductions or removals.

Key Features of the JCM/BOCM methodology

The major outcomes of FS and MRV DS are draft JCM/BOCM MRV methodologies for each project. The key features of the JCM/BOCM methodologies are summarised as follows:

- The JCM/BOCM methodologies are designed in a way that project participants can use them easily and verifiers can verify the data easily.
- In order to reduce monitoring burden, default values are widely used in a conservative manner.
- Eligibility criteria clearly defined in the methodology can reduce the risks of rejection of the projects proposed by project participants.

<table>
<thead>
<tr>
<th>Eligibility criteria</th>
<th>• A “check list” will allow easy determination of eligibility of a proposed project under the JCM/BOCM and applicability of JCM/BOCM methodology to the project.</th>
</tr>
</thead>
</table>
| Data (parameter)    | • List of parameters will inform project participants of what data is necessary to calculate GHG emission reductions/removals with JCM/BOCM methodologies.  
                    | • Default values for specific country and sector are provided beforehand. |
| Calculation         | • Premade spreadsheets will help calculate GHG emission reductions/removals automatically by inputting relevant values for parameter, in accordance with methodologies. |
Along with the government consultation with interested countries, the Government of Japan launched and implemented Feasibility Studies, MRV Demonstration Projects, and JCM Demonstration Projects as well as capacity building efforts in developing countries as summarised in the following figure.

The Ministry of the Environment, Japan (MOEJ) launched “Feasibility Study (FS) Programme on New Mechanisms” in 2010, in order to solicit GHG mitigation projects/activities supposed to be implemented under the New Mechanisms in the post-2012 framework. The Global Environment Centre Foundation (GEC) has been the commissioned secretariat of the FS Programme ever since. This booklet summarises the results of both Feasibility Studies for JCM/BOCM projects/activities and MRV Demonstration Studies (DS) using Model Projects (i.e. MRV Demonstration Projects) implemented under the Programme in 2012.

**MRV Demonstration Studies using Model Projects (MRV DS)**

The MRV Demonstration Studies were conducted for ongoing projects/activities in 2012. The studies were expected to develop appropriate MRV methodologies, which would be applied to the respective projects/activities in order to measure, report and verify the amount of GHG emission reductions in cooperation with local counterparts in host countries. The results thus obtained were subsequently used to improve the original methodologies; thereby more practical methodologies applicable to the JCM/BOCM were developed.
JCM/BOCM Feasibility Studies (JCM/BOCM FS)

The targets of the JCM/BOCM Feasibility Studies are potential projects/activities that can be part of the JCM/BOCM. The purposes of these Feasibility Studies are the following:
1. To develop MRV methodologies applicable to the respective projects/activities;
2. To assess the possibility of each project/activity to be implemented under the JCM/BOCM;
3. To accumulate knowledge and experience acquired through the above-mentioned processes.

The expected outputs of the JCM/BOCM Feasibility Studies are the following:
1. Development of specific eligibility criteria for each methodology proposed;
2. Identification of data and formula(s) necessary for the calculation of the total GHG emission reductions.

Outcomes of MRV DS and JCM/BOCM FS in JFY2012

Outcomes of MRV DS and JCM/BOCM FS are summarised in this booklet as follows:

1. Description of Project/Activity
2. Results of the study
   (1) Eligibility Criteria for MRV Methodology Application
   (2) Reference Scenario and Project/Activity Boundary
   (3) Calculation Method Options
   (4) Default Value(s) Set in MRV Methodology
   (5) Monitoring Method
   (6) Quantification of GHG Emissions and its Reduction (using Model Project)
   (7) Verification of GHG Emission Reductions
   (8) Ensuring Environmental Integrity
   (9) Contribution to Sustainable Development in Host Country
3. Toward Implementation/Future prospects and issues

For further information, please visit the following websites:

- Global Environment Centre Foundation (GEC)
  JCM/BOCM DS/FS Study reports database
- New Mechanism Information Platform
  Information about Japan’s initiative for new mechanism
  http://www.mmechanisms.org/e/index.html
**Overview of Demonstration Projects**

**Mongolia:**
- ◆ Replacement of Coal-Fired Boiler by Geo-Thermal Heat Pump for Heating
- ◆ Upgrading and Installation of High-Efficient Heat Only Boilers (HOBs)

**India:**
- ◆ Bagasse-based Power Generation including Waste Heat Utilisation

**Moldova:**
- ◆ Biomass Boiler Heating using Agricultural Waste as Fuel

**Sri Lanka:**
- ◆ Biomass-based Thermal Energy Generation to Displace Fossil Fuels

**Lao PDR:**
- ◆ Transportation Improvement through introduction of Efficient Buses and Provision of Good Services
- ◆ Introduction of Mechanical Biological Treatment (MBT) of Municipal Solid Waste, and Landfill Gas (LFG) Capture, Flaring and Utilisation

**Indonesia:**
- ◆ Solar-Diesel Hybrid Power Generation to Stabilise Photovoltaic Power Generation
- ◆ Prevention of Peat Degradation through Groundwater Management, and Rice Husk-based Power Generation
- ◆ REDD+ for Conservation of Peat Swamp Forest, and Biomass-based Power Generation using Timber Mill Waste to Process Indigenous Trees derived from Conserved Forest

**Cambodia:**
- ◆ Methane Recovery and Utilisation from Livestock Manure by using Bio-digesters
- ◆ Small-scale Biomass Power Generation with Stirling Engine
- ◆ REDD+ in Tropical Lowland Forest

**Viet Nam:**
- ◆ Integrated EE Improvement at Beer Factory
- ◆ Biogas-based Cogeneration with Digestion of Methane from Food/Beve Factory Wastewater
- ◆ Improvement of Vehicle Fuel Efficiency through Introduction of Eco-Drive Management System
- ◆ REDD+ through Forest Management Scheme, and Biomass-based Power Generation using Timber Industry Waste Iraq, and Indonesia
- ◆ Promotion of Modal Shift from Road-based Transport to MRT System

**Viet Nam, and Indonesia**

**Notes:**
- EE = Energy Efficiency
- MRT = Mass Rapid Transit
Mexico:
- Small-scale Wind Power Generation with Remote Monitoring System

India:
- Bagasse-based Power Generation including Waste Heat Utilisation

Sri Lanka:
- Biomass-based Thermal Energy Generation to Displace Fossil Fuels

Thailand:
- Bagasse-based Cogeneration at Sugar Mill
- Transport Modal Shift through Construction of MRT System
- Energy Savings through Building Energy Management System (BEMS)
- Waste Heat Recovery System with Cogeneration
- Introduction of Electronic Gate to International Trade Port to Improve Port-related Traffic Jam

Viet Nam:
- Integrated EE Improvement at Beer Factory
- Biogas-based Cogeneration with Digestion of Methane from Beverage Factory Wastewater
- Improvement of Vehicle Fuel Efficiency through Introduction of Eco-Drive Management System
- REDD+ through Forest Management Scheme, and Biomass-based Power Generation using Timber Industry Waste

Viet Nam, and Indonesia
- Promotion of Modal Shift from Road-based Transport to MRT System

Cambodia:
- Methane Recovery and Utilisation from Livestock Manure by using Bio-digesters
- Small-scale Biomass Power Generation with Stirling Engine
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Colombia:
- Geothermal Power Generation in a Country with Suppressed Demand

Lao PDR:
- Transportation Improvement through introduction of Efficient Buses and Provision of Good Services
- Introduction of Mechanical Biological Treatment (MBT) of Municipal Solid Waste, and Landfill Gas (LFG) Capture, Flaring and Utilisation

Indonesia:
- Solar-Diesel Hybrid Power Generation to Stabilise Photovoltaic Power Generation
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- REDD+ for Conservation of Peat Swamp Forest, and Biomass-based Power Generation using Timber Mill Waste to Process Indigenous Trees derived from Conserved Forest

Moldova:
- Biomass Boiler Heating using Agricultural Waste as Fuel

NOTE: EE= Energy Efficiency
MRT= Mass Rapid Transit
MRV Demonstration Study using a Model Project
“Methane Recovery and Utilisation from Livestock Manure by using Bio-digesters”

By Japan NUS Co., Ltd.


1. Description of Project/Activity

This activity is to utilise methane from livestock manure by anaerobic digestion of bio-digesters for electricity, cooking stove, and gas lamp at three typical livestock farms in Kampong Speu Province, Cambodia. Each farm raises some 5,000 cattle, some 10 cattle and 10 swine, and some 10 swine respectively. Bio-digesters were taken advantage of by technologies from Thai, India, and China. In addition, waste slurry is utilised as organic fertilizer.

2. Results of the study

(1) Eligibility Criteria for MRV Methodology Application

Case 1 Farms where livestock populations, comprising of cattle, buffalo, and/or swine, are bred continuously under the condition that the number of livestock can be counted such as in a livestock barn.

Case 2 Farms where manure from livestock is dealt with by an open lagoon type animal waste treatment system.

Case 3 Structure of bio-digesters prevents any unintentional leakage with high sealability.

Case 4 Bio-gas, mainly methane, from bio-digesters should be used as fuel for cooking, lighting, and/or power generation.

Case 5 Farms where the project is implemented shall not be registered as a CDM project or any other voluntary emission allowance creating project.

Case 6 (Case applies to electricity generation only) Bio-gas flow meter is installed, e.g., differential pressure, ultrasonic, vortex shedding, turbine type, etc.

(2) Reference Scenario and Project/Activity Boundary

Reference scenario is defined as follows: “Livestock farm which will be the project site uses an open lagoon type animal waste management system and would have continued to use the same system in the future.”

The project boundary shall include the following GHG emission sources and GHG emissions.

- GHG emissions from animal waste management system including bio-digesters
- GHG emissions from facilities where bio-gas is burned and used for cooking, lighting and/or electricity generated
- In case of a power generation project, GHG emissions from grid or non-grid electricity

(3) Calculation Method Options

<table>
<thead>
<tr>
<th>Application of bio-gas</th>
<th>Calculation method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power generation</td>
<td>Calculation method 1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooking and/or lighting device</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

(4) Default Value(s) Set in MRV Methodology

- Annual methane conversion factor for the reference scenario: 80%
Maximum methane producing potential of the volatile solid generated by livestock: swine: 0.29, cattle: 0.1, buffalo: 0.1 (m$^3$CH$_4$/kg dm)

Fraction of livestock manure handled in system j in the reference scenario: swine: 100%, cattle: 64%, buffalo: 51%

Annual volatile solid excretion on a dry-matter basis for a defined livestock population: swine: 195.5, cattle: 315.8, buffalo: 599.4 (kg-dm/head/y)

Methane density of bio-gas: 50%

(5) Monitoring Methods
Monitoring methods of calculation method 2 are described in table 1 below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N$_{LT}$</td>
<td>Total number of daily stock of livestock in the farm</td>
<td>Record by project owner</td>
</tr>
<tr>
<td>T$_{application}$</td>
<td>Operating hours of application</td>
<td>Record by project owner</td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions using a Model Project
Monitoring was conducted during 16 July 2012 and 16 December 2012 (154 days). In site 1, calculation method 1 was applied. Reference emissions became 1,465 tCO$_2$e, project emissions became 405 tCO$_2$e, and emission reductions became 1,060 tCO$_2$e. In site 2, calculation method 2 was applied. Reference emissions became 2.4 tCO$_2$e, project emissions became 0 tCO$_2$e, emission reductions became 2.4 tCO$_2$e. In site 3, calculation method 2 was applied. Reference emissions became 2.4 tCO$_2$e, project emissions became 0.3 tCO$_2$e, emission reductions became 2.1 tCO$_2$e.

<table>
<thead>
<tr>
<th>Monitoring site</th>
<th>Unit</th>
<th>Reference emissions</th>
<th>Project emissions</th>
<th>Emission reductions</th>
<th>Estimated annual emission reductions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring site 1</td>
<td>tCO$_2$e</td>
<td>1,465</td>
<td>405</td>
<td>1,060</td>
<td>2,512</td>
</tr>
<tr>
<td>Monitoring site 2</td>
<td>tCO$_2$e</td>
<td>2.4</td>
<td>0</td>
<td>2.4</td>
<td>5.6</td>
</tr>
<tr>
<td>Monitoring site 3</td>
<td>tCO$_2$e</td>
<td>2.4</td>
<td>0.3</td>
<td>2.1</td>
<td>4.9</td>
</tr>
</tbody>
</table>

(7) Verification of GHG Emission Reductions using a Model Project
Third party verification was conducted by TÜV Rheinland Cambodia. The validity of MRV methodology, onsite assessment, and development of verification report were conducted. Verification consisted of three verification team, two technical experts, and two internal reviewers. Several remarks were raised and corrections of MRV methodology were made as needed.

(8) Ensuring Environmental Integrity
It is expected by introducing bio-digester that prevention of solid pollution, reduction of forest resource aimed to collect firewood, and the reduction of chemical fertilizer can be achieved. On the other hand, there are concerns over the corrosion of metal parts of application and the effect on the health of bio-gas users by hydrogen sulfide.

(9) Contribution to Sustainable Development in Host Country
Reduction of kerosene as fuel for light, the saving of time and money, and the increase of agricultural output by using slurry as fertilizer are expected by installing bio-digesters.

3. Toward Implementation / Future prospects and issues
Bio-digesters using Japanese technology has high sealability and effectiveness. Since the price gap between general models among Cambodia and Japanese models is rather large, it is necessary to develop more reasonable models so that it meets the demand of Cambodia.
1. Description of Project/Activity

This study is conducted on the bagasse-based power generation project including waste heat utilisation in the Dhampur sugar mills factory located in the Uttar Pradesh state, Northern India. In 2006, the sugar factory generated its power with 7 low pressure boilers and 4 turbines utilising bagasse produced in the sugar production, and utilised the power for the operation of the factory. Since 2008, 2 high pressure boilers and high pressure turbines (30MW x 2) have been installed additionally, in order to initiate a cogeneration system utilising waste heat produced from the turbines. The power generated by the cogeneration system has been utilised in the factory, and the other power has been sold to the grid.

2. Results of the study

(1) Eligibility Criteria for MRV Methodology Application

Case 1 The types of biomass to be used as fuel should be bagasse and can include other biomass residues. However, bagasse should be the dominant fuel. Domestic wastes or other wastes shall not be used. The co-combustion of fossil fuel can be accepted within 15% at calorie base.

Case 2 The project shall be an installation of a new plant or the expansion of an existing plant for bagasse-based power generation, or the upgrade of an existing power cogeneration plant.

Case 3 Bagasse shall not be stored for more than one (1) year.

Case 4 The project shall not only replace consumption of grid electricity and/or fossil fuel, but also supply electricity to the grid.

Case 5 Specification of installed boiler in the project shall be more than 45kg/cm².

(2) Reference Scenario and Project/Activity Boundary

Reference Scenario In this methodology, there are reference scenarios below.

(i) Installation of new plant or expansion of existing plant: The possible reference scenario is a low pressure bagasse based co-generation system to sufficiently meet the requirement of heat and power of sugar mill factory, and (ii) Existing Cogeneration Plants: The power and heat demand of the sugar mill factory is met by bagasse based cogeneration plant/s. Some fossil fuels may be used for heat and power generation. There may be power import/export from grid.

Project/Activity Boundary The project boundary shall include: (i) The bagasse-based power generation plant, including waste heat utilization plant and (ii) All grid connected power stations.

(3) Calculation Method Options

To calculate the reference emission, the project participants must refer to the calculation method best-suited for his/her project using the (i) project type, (ii) available data on fossil fuel use for co-combustion and (iii) available default values.

(4) Default Value(s) Set in MRV Methodology

As for the setting of default values, the content of the study, the basis of adaptation and the reason of
(5) Monitoring Methods

The Dhampur sugar mill factory started operations in 2008 with high pressure boiler and supplied surplus power generated by the factory to the grid. Therefore the factory has established a monitoring framework with accuracy and transparency. The framework of the Dhampur factory is presented below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGim-proj,y</td>
<td>Amount of power use from grid in year y after the project [MWh/y]</td>
<td>Record of grid electricity purchase [Measurement]</td>
</tr>
<tr>
<td>EGex-proj,y</td>
<td>Amount of power supply to grid in year y after the project [MWh/y]</td>
<td>Record of grid electricity supply [Measurement]</td>
</tr>
<tr>
<td>FCproj,i,y</td>
<td>Fuel i consumption in the plant in year y [kL, t, 1000Nm3/y etc]</td>
<td>Record of fuel consumption fossil fuel i [Measurement]</td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions using a Model Project

Reference emissions (REy) and project emission (PEy) are calculated with the following. As for REy, (Upgrading of existing bagasse-based cogeneration plant with power supply to grid and available data on fossil fuel use on co-combustion) is only presented below.

\[
RE_y = RE_{grid-import,y} + RE_{grid-export,y} + RE_{fossil-fuel,y} = \{(EG_{im-hist,y} - EG_{im-proj,y}) \times EF_{grid,y}\} + \{(EG_{ex-proj,y} - EG_{ex-hist,y}) \times EF_{grid,y}\} + \Sigma (FC_{hist,i,y} \times NCV_i \times COEF_i)
\]

\[
PE_y = \Sigma PE_{fuel,y} = \Sigma (FC_{proj,i,y} \times NCV_i \times COEF_i)
\]

Based on the data monitored, GHG emission reduction of the project is calculated as 54,515 [tCO2/year], with the power generated to the grid from the project (187,870 [MWh/year]) etc.

(7) Verification of GHG Emission Reductions using a Model Project

In the verification, one Corrective Action Request (CAR) and three Clarification Requests (CLs) were received. They are relating to the thorough monitoring activities and are not serious ones. During the study, they were already closed properly by the study team and project participant.

(8) Ensuring Environmental Integrity

Dhampur Sugar Mills Ltd. acquired a certification of EIA in 2007, which started the cogeneration system in the factory. It also conducts monitoring of waste water and effluent gas from the factory, and any infractions is not confirmed to the present. In turn, GHG emission reduction by bagasse power generation and the contribution to the local economy through the generation of job opportunities is considered a positive impact.

(9) Contribution to Sustainable Development in Host Country

Host country (India) has seen rapid economic growth, and has issues with energy demand. To respond to it, bagasse power generation seems to be a good candidate because of less dependent fossil fuels and activation of existing local industry. In particular, MoNRE focus on biomass power generation including bagasse in the Strategic Plan for new and renewable energy sector (2011-17).

3. Toward Implementation/Future prospects and issues

To maintain MRV methodology in the Indian sugar industry, the following should be considered properly.

(i) To adapt actual bagasse-based power generation technology in the Indian sugar industry, further study on current and/or prospective technologies shall be implemented periodically, such as specification of installed boiler etc.

(ii) To identify the suitable default values, the setting of conservative values and consideration of the situation of the Indian sugar industry are taken into account properly.
1. Description of Project/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>Project and Activity</td>
<td>Introduction of new public bus vehicles and replacement Strengthening of the quality and the quantity of bus services</td>
</tr>
<tr>
<td>Project Scale</td>
<td>42 bus vehicles Technical assistance for bus operation</td>
</tr>
<tr>
<td>Schedule of the Activity</td>
<td>New bus operation has begun from July 2012</td>
</tr>
<tr>
<td>Applied Technology on the Project</td>
<td>New bus vehicles granted by JICA Technical assistance for bus operation</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>Project Owner</td>
<td>Vientiane Capital State Bus Enterprise</td>
</tr>
</tbody>
</table>

The replacement of existing bus vehicles with new bus vehicles will improve fuel consumption. Moreover, the quality and quantity improvement for public bus services will promote the shift from private cars, motor cycles and para-transit to public transport. It is expected that the improving efficiency of traffic activities will reduce GHG emission. The Project and Activity is considerably significant for the public and society.

2. Results of the study

   (1) Eligibility Criteria for MRV Methodology Application
   The study team prepared two groups of criteria: criteria defining category and condition of a project, and criteria defining the possibility of MRV.

   (2) Reference Scenario and Project/Activity Boundary
   If the Project were not carried out, the bus vehicles would maintain the same state or decline. Therefore the continuation of the state just before the project is a conservative reference scenario.

   (3) Calculation Method Options
   (Improvement of fuel efficiency)
   Method1: fuel consumption is monitored continuously.
   Method2: fuel efficiency (L/km) is sampled.

   (Improvement of bus services: modal shift)
   Method1: simple method with bus operation records
   Method2: moderate method with small survey
Method 3: detailed method with traffic demand forecast

(4) Default Value(s) Set in MRV Methodology
“Net Calorific Value” and “Emission Factors” are set as a default value.

(5) Monitoring Methods

Table 1: Monitoring Parameter (Energy Efficiency Improvement)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$D_{Pro,y,k}$</td>
<td>Distance travelled by the project bus in year $y$ on route $k$</td>
<td>Operation logs and route maps of the project owner are available.</td>
</tr>
<tr>
<td>$\eta_{Pro,y}$</td>
<td>Fuel efficiency of the project bus in year $y$</td>
<td>Sampling</td>
</tr>
</tbody>
</table>

Table 2: Monitoring Parameter (Improving Transport Efficiency on Buses by Operational Improvements)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_{Pro,y,k}$</td>
<td>The number of passengers of the project bus in year $y$ on route $k$</td>
<td>Operation logs are referred.</td>
</tr>
<tr>
<td>$dp_{Pro,y,k}$</td>
<td>Average trip distance travelled by the project bus in year $y$ on route $k$</td>
<td>Operation logs (in case that riding/alighting data can be obtained.)</td>
</tr>
<tr>
<td>$D_{Pro,y,k}$</td>
<td>Distance travelled by the project bus in year $y$ on route $k$</td>
<td>Operation logs and route maps of the project owner are available.</td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions using a Model Project

Table 3: Quantification of GHG Emissions and its Reductions

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Calculation method</th>
<th>Estimated GHG reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Efficiency Improvement</td>
<td>2: Sampling method</td>
<td>58.3 tCO2/y</td>
</tr>
<tr>
<td>Improving Transport Efficiency on Buses by Operational Improvements</td>
<td>1: Simple method</td>
<td>267 tCO2/y</td>
</tr>
<tr>
<td></td>
<td>3: Detailed method (traffic demand forecast)</td>
<td>361 tCO2/y</td>
</tr>
</tbody>
</table>

(7) Verification of GHG Emission Reductions using a Model Project
The host country has no designated operational entities (DOE) and certification bodies of ISO in the host country. In this study, the National University of Laos implemented the verification in terms of the expert of traffic engineering and the third party entity. When verification work is done continuously in the host country, teamwork between a DOE and technical body is desired. The capacity development for a third party entity or a specialist of CDM and JCM/BOCM is desired in the host country.

(8) Ensuring Environmental Integrity
The Project and Activity has been positioned in one of the environmental measures. Therefore it is expected that the Project and Activity will hardly impact the environment.

(9) Contribution to Sustainable Development in Host Country
The Project and Activity is highly public and socially significant. A public bus project is low cost compared with other large-scale transport projects such as railways. It is appropriate to be in the initial stage to shift to large-scale transport. Moreover GHG reduction by the project is highly expected.

3. Toward Implementation/Future prospects and issues
The Project and Activity needs more bus vehicles. Some kinds of assistance such as a loan will realize this. Most monitoring work for MRV verification can be implemented by the host country. However, Japanese assistance is needed on the plan and the management of survey and traffic analysis so far. Moreover the verification work for the monitoring has just begun. It is recommended that a verification entity is established soon.
1. Description of Project/Activity

This project is about the small-scale wind power generation projects phased in multiple locations, such as factories and isolated grids in remote areas, using 300kW wind turbines to replace grid generated power. In these projects, the emission reduction will be remotely monitored from offsite (i.e. Japan and Mexico City) through the remote monitoring system. They are expected to expand the wind energy market by improving the financing through the easier acquisition of emission credits for CO2 in small wind power generation projects, such as communities and remote areas or for the self-consumption, thus promoting GHG mitigation activities.

The demonstration study was carried out using the wind project site at La Ventosa, Oaxaca, Mexico, which was built by the United Nations Development Program and currently operated by Instituto Investigaciones Electricas (IIE), Electric Research Institute of Mexico.

2. Results of the study

(1) Eligibility Criteria for MRV Methodology Application
In the proposed MRV Methodology, the project must meet all of the following criteria in order to be qualified as a JCM project.

1) The project shall be the installation of a new wind turbine generator.
2) The electricity generated by the project shall be supplied to the national energy grid and/or independent mini-grid in Mexico to replace grid electricity.
3) The wind turbine system shall be equipped with a remote monitoring system that is connected to a computer system of a single entity responsible for the monitoring of all systems installed by the project.
4) The wind turbine systems shall be equipped with an inductive generator and AC-DC-AC link converter, be able to limit the output power by signals and control reactive power, as well as be able to secure system reliability and smooth output in vulnerable and low capacity grids.
5) The wind turbine generator systems should have obtained a certification of design type issued by an internationally recognized assessment body (i.e. Germanischer Lloyd)

(2) Reference Scenario and Project/Activity Boundary
The Reference Scenario is “the power supplied to the grid by the project, other alternate power to be supplied to the system.” The Project Boundary is the whole of Mexico where wind turbines are connected to the remote monitoring computer system of the project participants (institution/organization one). In addition, the boundary includes all wind power plants and all other power generation facilities connected to them physically through the electrical system.

(3) Calculation Method Options
To calculate the reference emission, the project developer must refer to the calculation method best-suited for his/her project using the flow chart below.
In Mexico, it does not seem reasonable to fix the grid emission factor to the default value. Then, on the assumption that after a certain period of time they are reviewed, the default value in the JCM/BOCM was calculated as follows with reference to the reduction target of the Mexican Government:

1. It is assumed that the grid CO2 emission will change according to the CO2 emission reduction scenario set by the Mexican Government, and that the grid emission factor will follow the same curve as the total CO2 emission reduction curve.
2. Assuming that the grid emission factor of 2012 in the BAU scenario (public comment on April 28, 2012, registered on 5 December) is the combined margin of 0.603tCO2/MWh, that is the latest registered CDM project

### (5) Monitoring Methods

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>$EGB_{Ly} (EGPJ_{Ly})$</td>
<td>Electricity supplied to the grid by the project (MWh/y)</td>
<td>Electricity meter connected to national grid or the mini-grid.</td>
<td>Continuously</td>
</tr>
<tr>
<td>$WT_{Ply}$</td>
<td>Operation of the wind turbine.</td>
<td>Operation log of the wind turbine through a computer system of a single entity responsible for the monitoring of all systems installed by the project.</td>
<td>Continuously</td>
</tr>
<tr>
<td>$N$</td>
<td>Number of wind turbines included in the project.</td>
<td>Operation log of the wind turbine through a computer system of a single entity responsible for the monitoring of all systems installed by the project.</td>
<td>Continuously</td>
</tr>
<tr>
<td>$EFCO2,specific,y$ (Calculation Option 2)</td>
<td>Project specific CO2 emission factor of the grid electricity replaced by the project (tCO2/MWh)</td>
<td>Calculate using the most recent publicly available data by using the emission reduction calculation sheet.</td>
<td>Annually</td>
</tr>
</tbody>
</table>

### (6) Quantification of GHG Emissions and its Reductions using a Model Project

Emission reductions are the monitored amount of the reference emissions.

$ER_y = RE_y - (ER_y \cdot CO2 Emission Reductions (tCO2/y), RE_y \cdot Reference Emissions [tCO2/y])$

The amount of CO2 emission reductions during the monitoring period has become a 68t-CO2.

### (7) Verification of GHG Emission Reductions using a Model Project

The verification was conducted by IIE and the calculated emission reduction in the monitoring report has been confirmed to be accurately reasonable in the validation.

### (8) Ensuring Environmental Integrity

The project will go through either official or voluntary environmental assessment.

### (9) Contribution to Sustainable Development in Host Country

It is expected that the proposed projects will enhance the regional development and green economy.

### Toward Implementation/Future prospects and issues

As there is much potential for projects, the discussion between governments is expected to proceed.
1. Description of Project/Activity
Many communities in poor rural and agricultural regions are experiencing difficulty securing a source of heating in the winter season, due to the rising price of fossil fuels in Moldova. To respond to this problem, JICA and UNDP have begun a program to assist these communities in switching from fossil fuels such as coal to biomass fuel in Moldova. Straw-fired boilers funded by the Grant Aid for Grass-roots Human Security Project program of the Japanese Ministry of Foreign Affairs and the World Bank, and pellet boilers funded by the Moldova Social Investment Fund were selected as target facilities for this study. Greenhouse Gas (GHG) emissions will be reduced by switching from fossil fuels such as coal to biomass fuel.

2. Results of the study
(1) Eligibility Criteria for MRV Methodology Application
Case 1 Fossil fuel used for boilers shall be replaced by biomass residues.
Case 2 The project activity involves installation of (a) new boiler(s) to make energy use of biomass residue including biomass pellet for heat generation, whose capacity is larger than 45 kW and energy efficiency is higher than 80%.
Case 3 The biomass residue would otherwise be unutilized without the project activity.
Case 4 The heat generated in the boiler would not be used for power generation.

(2) Reference Scenario and Project/Activity Boundary
Identified alternative scenario regarding how to handle generated heat and biomass residue, and established the most appropriate reference scenario by barrier analysis.
- Without the project, existing boilers would continue to operate using the same fossil fuels.
- Without the project, biomass residue would be thrown away or left in a farm field to decompose under aerobic conditions, or burned without management and not utilized for energy.

Project boundaries are as follows.
- GHG emissions related to operation of agricultural machinery to collect, bale, and transport biomass residue used for the project.
- GHG emissions related to the transportation of biomass burned in a boiler.
- GHG emissions related to the operation of a pelletizing system (crushing, drying, pelletizing)
- GHG emissions related to use of electricity or consumption of fossil fuel at the project site – e.g. use of a tractor to place biomass residue into a boiler or a shredder for biomass residue. However, fossil fuels mixed with biomass are not included.

(3) Calculation Method Options
Four different calculation methods were prepared as follows.
1-1: Use heat meter to estimate reference emission. Use default values for emissions related to transportation process etc.
1-2: Use heat meter to estimate reference emission. Use project specific value for emission related to transportation process etc.

2-1: NOT use heat meter to estimate reference emission. Use default values for emission related to transportation process etc.

2-2: NOT use heat meter to estimate reference emission. Use project specific value for emission related to transportation process etc.

(4) Default Value(s) Set in MRV Methodology

<table>
<thead>
<tr>
<th>Default values</th>
<th>Project specific value</th>
</tr>
</thead>
<tbody>
<tr>
<td>· CO₂ emission factor for fossil fuel: Coal (Anthracite): 0.0983 tCO₂/GJ, Diesel Oil: 0.0741 tCO₂/GJ</td>
<td>· Grid electricity CO₂ emission factor: 0.4434 tCO₂/MWh</td>
</tr>
<tr>
<td>· CO₂ emission factor for diesel trucks: 0.0011 tCO₂/km</td>
<td>· Boiler efficiencies: Existing boiler (values were provided by Carbon Finance Unit); 0.92 (natural gas), 0.67(coal) /Straw boiler (based on manufacturer catalog); 0.81(Hirtopul Mare G*), 0.80(Hirtopul Mare K*), 0.815(Viisoara G., Chiscareni L) /Biomass pellet boiler (based on manufacturer catalog); 0.86 (Moldagrotechnica, Fundurii Vechi Community Center and Balatina Community Center)</td>
</tr>
<tr>
<td>· Net calorific value of diesel: 35.7 GJ/kg</td>
<td>[*G=Gymnasium, K=Kindergarten, L=Lyceum]</td>
</tr>
<tr>
<td>· Boiler efficiency under the reference scenario: 1.0 to ensure conservativeness</td>
<td>Taking into account the variations in boiler efficiency caused by the operational variation of boilers, we adopted 0.5 as the correction factor of boiler efficiency and multiplied the boiler efficiency by the factor.</td>
</tr>
<tr>
<td>· Moisture content of biomass residue: Biomass pellet; 11%, Straw (Indoor storage, Covered storage); 20%, Straw (Open field storage); 30%, Fuel wood; 40%</td>
<td></td>
</tr>
<tr>
<td>· Project emission factor: Non-processed biomass residue; 0.02, Biomass pellet; 0.10</td>
<td></td>
</tr>
<tr>
<td>· Net calorific value of biomass residue (GJ/t): Wheat straw; 18.04, Soya straw; 18.04, Corn; 17.95, Sunflower shell; 20.02, Reed; 17.60, Wood (elm); 19.10, Wood (acasia); 20.11, Vine; 18.92, Wood (pine); 19.99, Wood (poplar); 19.18, Wood (wicker); 19.18, Weeping willow; 18.94, Furniture fabrication residues; 18.92</td>
<td></td>
</tr>
</tbody>
</table>

(5) Monitoring Methods
Cumulative heat generated by a boiler (QBM,y)[GJ/y]: Measured continuously via heat meter.
Weight of biomass residue inputs (PCBM,y)[t/y]: Count straw bales or pellet buckets fed into boiler after determining average bale weight or bucket weight of pellets.

(6) Quantification of GHG Emissions and its Reductions using a Model Project
Emission reductions based on second monitoring period data (unit: tCO₂)

Table 1  Emission reductions at Hirtopul Mare Kindergarten

<table>
<thead>
<tr>
<th>Calculation Method</th>
<th>RE,2</th>
<th>PE,2</th>
<th>ER,2</th>
<th>RE,y</th>
<th>PE,y</th>
<th>ER,y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>25.29</td>
<td>0.51</td>
<td>24.78</td>
<td>74.93</td>
<td>1.51</td>
<td>73.42</td>
</tr>
<tr>
<td>1-2</td>
<td>25.29</td>
<td>0.35</td>
<td>24.93</td>
<td>74.93</td>
<td>1.04</td>
<td>73.87</td>
</tr>
<tr>
<td>2-1</td>
<td>27.70</td>
<td>0.55</td>
<td>27.14</td>
<td>82.07</td>
<td>1.63</td>
<td>80.41</td>
</tr>
<tr>
<td>2-2</td>
<td>27.70</td>
<td>0.35</td>
<td>27.35</td>
<td>82.07</td>
<td>1.04</td>
<td>81.04</td>
</tr>
</tbody>
</table>

[RE=Reference Emissions, PE=Project Emission, ER=Emission Reductions]

Note: (2); Second monitoring period (54 days), y (yearly value) calculated by set the boiler annual operation date as 160 days.

(7) Verification of GHG Emission Reductions using a Model Project
We entrusted the verification to two Third-party entities (Verifiers). One verifier in Moldova had no experience in CDM related projects, and the outputs were not sufficient. On the other hand, the other verifier in Romania had experience enough to do the verification. Verifiers commented on the monitoring reports and all of them were solved with evidences provided by the Carbon Finance Unit.

(8) Ensuring Environmental Integrity
Due consideration must be given to straw boiler smoke stack height and the selection of boiler sites in order to reduce the emission of smoke/particulate matter. Boiler ash is to be utilized as fertilizer in farm fields.

(9) Contribution to Sustainable Development in Host Country
· Effective use of unutilized domestic resources
· Creation of new industry
· Job creation
· Positive economic impact of domestic investment as outbound currency flows are reduced

3. Toward Implementation/Future prospects and issues
There are several varieties of biomass, and heating values change depending on moisture content, so it is difficult to estimate the quantity of fossil fuel displaced by biomass fuel with the data of biomass consumption alone. We need to ensure transparency for biomass fuel suppliers and raw material storage condition, and the reliability for the catalog value of boiler efficiency.
MRV Demonstration Study using a Model Project
“Replacement of Coal-Fired Boiler by Geo-Thermal Heat Pump for Heating”

By Shimizu Corporation

1. Description of Project/Activity
This project intends to install geo-thermal heat pumps in buildings for heating, especially with public buildings in local cities in Mongolia, for the purpose of emission reduction and reducing air pollution.

![Schematic of the project](image)

2. Results of the study
(1) Eligibility Criteria for MRV Methodology Application
Case 1: The existing heating boilers that supply hot water for heating shall be replaced by heat pumps that supply hot water for heating.
Case 2: All the fuel of the existing boilers before the project was fossil fuel.
Case 3: The existing secondary heating system shall continue to be used after the project without any modifications.
Case 4: The project shall pass the “check list.”
Case 5: The project shall satisfy the following formula.
\[
\text{Average annual COP of heat pumps} > \frac{\text{efficiency of the existing boilers}}{\text{emission factor of fuel of the existing boilers}} / 3.6 * \text{emission factor of the grid}
\]
In order to satisfy the above formula, efficiency of the existing boilers, the emission factor of fuel of the existing boilers, and the emission factor of the grid shall be known.
Case 6: Rooms are heated.
Case 7: If the project applies geothermal heat pumps, a know-how support on designing and construction shall be provided by developed countries.

(2) Reference Scenario and Project/Activity Boundary
Reference Scenario
In the reference scenario, the existing boilers consuming fossil fuel only continue to be used, and heat pumps are not used during the project period envisaged. This shall be demonstrated by using the “Check list for determining the reference scenario.”

Project/Activity Boundary
The project boundary shall include the following GHG emission sources and GHG emissions.
- CO$_2$ emitted when fuel is combusted at the existing boilers in the reference scenario.
- CO$_2$ emitted at the time of generating power that supply the heat pumps in the project scenario.

(3) Calculation Method Options
The MRV methodology provides two calculation methods.
- Calculation method 1: Calorie meters and watt hour meters need to be installed. A strict, accurate but costly method. This method can be applied to the first project (Called “reference project”) in the climate
zone where the project is located.

Calculation method 2: Calorie meters and watt hour meters are not needed. Instead, receiving climate data from a climate agency is needed. An inaccurate but cheap method. This method can be applied to the projects other than the reference project.

(4) Default Value(s) Set in MRV Methodology
There is no default value stipulated in the methodology.

(5) Monitoring Methods
(5-1) Calculation method 1
Mainly calorie supplied by the heat pumps and watt hour consumed by the heat pumps shall be monitored.

(5-2) Calculation method 2
Mainly outdoor temperature shall be monitored. The data doesn’t need to be monitored by the project participant itself, but can be received from the climate agency.

(6) Quantification of GHG Emissions and its Reductions using a Model Project
(6-1) Calculation method 1
Reference emission=Calorie/boiler efficiency*emission factor of fuel (=coal in case of Mongolia)
Project emission=Watt hour*emission factor of grid
Emission reduction= Reference emission - Project emission

(6-2) Calculation method 2
Reference emission=Standard reference emission*degree day/standard degree day
Project emission= Standard project emission*degree day/standard degree day
Emission reduction= (Reference emission - Project emission)*conservativeness factor

<table>
<thead>
<tr>
<th>Project site</th>
<th>Monitoring period</th>
<th>Reference emissions</th>
<th>Project emissions</th>
<th>Conservativeness factor</th>
<th>Emission reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kindergarten</td>
<td>2012/9/15-10/31</td>
<td>36.0 tCO₂</td>
<td>21.1 tCO₂</td>
<td>0.6543</td>
<td>9.7 tCO₂</td>
</tr>
<tr>
<td>School</td>
<td>2012/9/26-10/31</td>
<td>57.3 tCO₂</td>
<td>33.6 tCO₂</td>
<td>0.5957</td>
<td>14.1 tCO₂</td>
</tr>
</tbody>
</table>

(7) Verification of GHG Emission Reductions using a Model Project
Verifiers selected were “Japan Consulting Institute (JCI),” as a Japanese DOE, and “Building Energy Efficiency Centre (BEEC),” as a Mongolian verifier candidate. Monitoring report was submitted to the verifiers by Shimizu on 2012/11/5. On-site investigation was implemented during 2012/11/27-11/29. Both verifiers submitted their own verification report separately to Shimizu on 2012/12/21. As the result of verification, it was demonstrated that the proposed methodology is applicable and workable, and the emission reduction in the above table was verified.

(8) Ensuring Environmental Integrity
Geo-thermal heat pump technology is key for Mongolia not only to reduce CO₂ emission, but to reduce air pollution as well. Geo-thermal heat pumps have negative environmental impacts such as noise and vibration, but the impacts are not so strong and uncontrollable. MRV methodology provides conservative calculation method even in the case of the simplified calculation method 2.

(9) Contribution to Sustainable Development in Host Country
Geo-thermal heat pump technology not only reduces CO₂ emission, but reduces air pollution and saves coal resources in Mongolia. Geo-thermal heat pumps are one of the renewable energy sources that the Mongolian Government wishes to increase.

3. Toward Implementation/Future prospects and issues
Due to the low price of coal and high price of electricity and high installation cost of geo-thermal heat pumps, this project shall be financially supported by the Mongolian Government for the purpose of not only CO₂ emission reduction, but air pollution reduction and the dissemination of renewable energy. In addition, Japanese heat pump manufacturers need to develop heat pumps that are suitable for the Mongolian climate and usage conditions.
MRV Demonstration Study using a Model Project
“Upgrading and Installation of High-Efficiency Heat Only Boilers (HOBs)”

By SUURI-KEIKAKU Co., Ltd

1. Description of Project/Activity
The concepts of this MRV-DS are as follows; (1) JCM, which should be complementarily of the CDM, should be robust and a simple mechanism, which can ensure the “verified mitigation outcome” of "Various approach" of COP17&18. (2) In this MRV-DS, the Mongolian PPs (Project Participants) and Verification Body autonomously implemented their Activity, and Japanese Team acted as a supporter for them to demonstrate these activities. (3) Through the Integrated MRV Activity, developing the Form of the MRV Report on the basis of the Monitoring Plan fulfilling the provisions of Verification was proposed in this MRV-DS, and it was used in implementing the MRV by Mongolian PPs and Verification Body. The Project/Activity is to upgrade inefficient boilers to the latest efficient boilers or to newly install the latest boilers. The target facility is a coal-fired Heat Only Boiler (HOB) with a capacity of “0.10 to 3.15 MW” based on the Mongolian National Standard (MNS5043). The improved HOBs consume less coal; as a result, reduce not only the GHG but also air pollutants emissions.

2. Results of the study
(1) Eligibility Criteria for MRV Methodology Application
Case 1 The project activity is to (1) switch from old type coal HOBs (of low energy efficiency) to new type ones (of high energy efficiency) in existing Heat Water Supply Systems in District and/or (2) to introduce new type ones in association with a new construction of Heat Water Supply Systems in Districts.
Case 2 The HOB to be targeted for the Project/Activity is defined as a boiler used for heat supply which has a capacity of 0.10 MW – 3.15 MW.
Case 3 Objective HOBs are limited to coal-fired boilers for hot water supply.
Case 4 The HOBs to be introduced shall have the performance specifications including boiler efficiency higher than 75% as the manufacturer’s catalog value.
Case 5 The HOBs to be introduced shall have a dust collector. In case of a HOB with no dust collector set up, the dust collector shall be additionally installed in the HOB for a pollution-abatement measure.

(2) Reference Scenario and Project/Activity Boundary
In the Reference Scenario, the low-energy-efficiency conventional HOBs will be continuously used even after those are upgraded if no foreign aid can be obtained. In case of the construction of new systems, the same-type boilers will be introduced if no foreign aid can be obtained.

(3) Calculation Method Options
The calculation method option is as follow;
GHG emission reductions = \frac{1}{\text{Boiler Efficiency of Reference Boiler}} - \frac{1}{\text{Boiler Efficiency of Project Boiler}} \times \text{Heat Amounts supplied to Building} \times \text{Emission Factor.}

The Heat amounts are monitored by the “Heat meter.” This monitoring method is simplest/most exhaustive.
method and meets Mongolian National Standards.

(4) Default Value(s) Set in MRV Methodology
Default Values are the Project Boiler Efficiency, Reference Boiler Efficiency and CO₂ emission factor. These values are set on the basis of lessons learnt from this MRV-DS implemented.

(5) Monitoring Methods
The simplest Monitoring Method is as follows;

Table 1: Monitoring Method

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH</td>
<td>Direct Measuring Method: Net Heat</td>
<td>Heat meter (according to Mongolian National Standard)</td>
</tr>
<tr>
<td></td>
<td>Quantity supplied by the Project HOB</td>
<td></td>
</tr>
<tr>
<td>Indirect Measuring Method:</td>
<td>Indoor and</td>
<td>Thermometer and Building Volume, etc.</td>
</tr>
<tr>
<td></td>
<td>Outdoor Temperature Estimation Method</td>
<td></td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions using a Model Project
In this MRV-DS, the EEC (Project Participants) constructed the data collection system of every minute values, using the portable telephone system (remote data collection system). This system is the first of its kind in Mongolia. This achievement is highly important, although the monitoring period was very short in this Model Project. As a consequence, the value of GHG emission reduction is smaller due to the short monitoring period, and the values monitored were rounded up and down for the purpose of conservativeness. However the annual emission reduction is expected around 100 (tCO₂/year), taking into account the annual operation of HOBs, of which time is approximately 5,500 hours.

Table 2: GHG Emission Reductions using this Model Project

<table>
<thead>
<tr>
<th>Emission Reductions</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net heat quantity supplied by the Project HOB</td>
<td>56</td>
</tr>
<tr>
<td>Total hours during the monitoring period</td>
<td>201</td>
</tr>
<tr>
<td>Reference Emissions (boiler efficiency is 50%)</td>
<td>10</td>
</tr>
<tr>
<td>Project Emissions (boiler efficiency is 67%)</td>
<td>9</td>
</tr>
</tbody>
</table>

(7) Verification of GHG Emission Reductions using a Model Project
The verification was implemented on the Monitoring Report and its report was produced. As a result, the MRV activity was practically verified. “National Renewable Energy Centre” autonomously implemented the verification in Mongolia for the first time.

(8) Ensuring Environmental Integrity
The coal consumption was also reduced through the Project/Activity and therefore no adverse influence on the environment is especially observed.

(9) Contribution to Sustainable Development in Host Country
The effect of reducing air pollution on human health is estimated to correspond to about US $12 million. The policies are advanced including the one to consolidate HOBs, and the Project/Activity matches the development policy and strategy of the host country.

3. Toward Implementation/Future prospects and issues
The verification process should not be back-and-forth and the offset/credit should be issued with high quality. Since it is most important to make the Monitoring Plan based on the Verification (see the right side figure), the Form of the Verification Report by which the integrated MRV Activity operated was proposed by this MRV-DS, and should be promoted. JCM should support the development of MRV Activity which PPs will help do the self-directed and sustainable implementation. “JCM of the Mongolian People, JCM by the Mongolian People and JCM for the Mongolian People”
MRV Demonstration Study using a Model Project
“Biomass-based Thermal Energy Generation to Displace Fossil Fuels”

By EX Research Institute Limited

1. Description of Project/Activity
This study was implemented with the purpose of development of a methodology, which is applicable to projects designed to consume biomass fuels such as wood fuel, agricultural residues, etc., produced in Sri Lanka as alternative fuel resources to fossil fuels consumed in Sri Lanka. This biomass replaces fossil fuels currently used at the project site and reduces greenhouse gas emissions compared with those of the reference scenario.

![Figure 1. Firewood at Factory](Image)

2. Results of the study
(1) Eligibility Criteria for MRV Methodology Application

<table>
<thead>
<tr>
<th>Case</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>Fossil fuel use shall be replaced by biomass resources used for power generation and/or thermal energy generation</td>
</tr>
<tr>
<td>Case 2</td>
<td>The amount of power and/or thermal energy substituted by the project activity shall be measurable.</td>
</tr>
<tr>
<td>Case 3</td>
<td>The biomass resources used in the project complies with the national guideline set by the Government of Sri Lanka</td>
</tr>
<tr>
<td>Case 4</td>
<td>The technology, equipment and facilities introduced in the project are not common in the host country; moreover, the project entails introduction of biomass using equipment possessing more than a certain plant capacity.</td>
</tr>
<tr>
<td>Case 5</td>
<td>The projects shall be implemented voluntarily by the project owners but not implemented based on legislation or regulations in the host country.</td>
</tr>
<tr>
<td>Case 6</td>
<td>Project activity satisfies environmental standards and regulations of the host country (“Gazette no 772/722 of 24th June 1993” and “Gazette no 859/14 of 23rd February 1995”)</td>
</tr>
</tbody>
</table>

(2) Reference Scenario and Project/Activity Boundary
1) Reference Scenario

- **Power Generation (On Site/Supply to the National Grid)**
  Grid emission factor of Sri Lankan DNA (http://www.energy.gov.lk/sub_pgs/elibrary_spe_pub.html)
- **Thermal Generation**
  The most conservative figure of 100% is adopted as efficiency of fossil fuel-utilizing equipment.

<table>
<thead>
<tr>
<th>Industrial Division</th>
<th>Reference Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>I  Industries traditionally &amp; conventionally utilize biomass as source of energy</td>
<td>Biomass</td>
</tr>
<tr>
<td>II Industries other than categorized as I &amp; III</td>
<td>1) If an advanced technology not common in Sri Lanka (co-generation, high efficiency facility) is applied, reference scenario is fossil fuel.</td>
</tr>
<tr>
<td>III Industries where existing biomass utilization technologies in Sri Lanka are not applicable</td>
<td>2) Amount of biomass to be consumed &lt; 0.75t/hour: Biomass &gt; 0.75t/hour: Fossil fuel</td>
</tr>
</tbody>
</table>

2) Boundary
The project boundary shall be the physical and geographical boundary of the project site, including the power generating and thermal energy generating equipment to be introduced in the project.

(3) Calculation Method Options
Two methods are set: one entails quantification based on measurement from the output side, and the other entails quantification based on measurement from the input side (onsite and grid connection). Options have been set upon combining use of default values, project-specific values and monitored values under each approach.

(4) Default Value(s) Set in MRV Methodology
In addition to utilization of default values recognized under the CDM, default values concerning emissions arising from biomass cultivation and procurement, specific values, and default values concerning the heating value of used biomass, etc. have been set based on sampling, statistical information and theoretical values, etc.

(5) Monitoring Methods
Two types of monitoring activities were considered. Those are, monitoring at input and output side. The table below indicates details of parameters and measurement methods for each parameter (for monitoring at output side).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pout</td>
<td>Pressure of outlet steam</td>
<td>Hourly by manual recording</td>
</tr>
<tr>
<td>F_p,thermal</td>
<td>Heat Medium Amount (Amount of Steam generated from the boiler)</td>
<td>Hourly by manual recording</td>
</tr>
<tr>
<td>Tin</td>
<td>Temperature of Inlet Water</td>
<td>Hourly by manual recording</td>
</tr>
<tr>
<td>EQ_grid,y &amp;</td>
<td>Grid connected electricity consumption used for biomass pretreatment in the project</td>
<td>Daily by manual recording</td>
</tr>
<tr>
<td>EQ_aux_grid,y</td>
<td>Grid connected electricity consumption for auxiliary purpose in year y</td>
<td>Daily by manual recording</td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions
The following values are obtained as reference emission, project emission and emission reduction (unit: tCO2/y) at MAPA Lalan (Pvt) Ltd (monitoring project site).

<table>
<thead>
<tr>
<th>Monitoring Pattern</th>
<th>Reference Emission</th>
<th>Project Emission</th>
<th>Emission Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output/Default Value</td>
<td>3,923</td>
<td>1,071</td>
<td>2,852</td>
</tr>
<tr>
<td>Output/Measured Value</td>
<td>4,327</td>
<td>166</td>
<td>4,161</td>
</tr>
<tr>
<td>Input/Default Value</td>
<td>2,812</td>
<td>849</td>
<td>1,963</td>
</tr>
<tr>
<td>Input/Measured Values</td>
<td>2,812</td>
<td>166</td>
<td>2,645</td>
</tr>
</tbody>
</table>

(7) Verification of GHG Emission Reductions
Verification Body : Sri Lanka Standards Institution (SLSI)
Monitoring Period : October 22, 2012 – January 15, 2013 (86 days)
Monitoring Report : Biomass based thermal generation to displace fossil fuel at MAPA LALAN (pattern A-2) version2.0/2013/02/22
Status : 2013/02/28 Under Verification (on going)
2013/02/20 1st Draft Verification Report submitted by SLSI
2013/02/07 On site Assessment
2013/01/22 Receipt of Monitoring Report & Start of Desk Review

(8) Ensuring Environmental Integrity
GHG emission reduction and mitigation of air pollution caused by fossil fuels combustion are expected. In addition, a suitable way for optimization for land and biomass utilization will be introduced by “biomass guidelines” which was prepared under the project, and whose introductions are considered to be eligible (case 3) under the methodology.

(9) Contribution to Sustainable Development in Host Country
1) The following contribution through promotion of renewable energy:
   • Energy security enhancement by increasing the proportion of indigenous energy sources
   • Outflow of foreign currency reduction due to reduction of imported fossil fuel
   • Economy vitalization and job creation
2) Income generation of rural farmers by promotion of biomass cultivation

3. Toward Implementation/Future prospects and issues
   Mutual Agreement between the Government of Sri Lanka and the Japanese Government to be made is essential for the project implementation under JCM/BOCM.
   There are a lots of potential projects to be implemented under JCM/BOCM in Sri Lanka.
MRV Demonstration Study using a Model Project
“Bagasse-based Cogeneration at Sugar Mill”

By Mizuho Information & Research Institute, Inc.

1. Description of Project/Activity
In this project, biomass residues (bagasse) generated from a sugar mill and operated by Mitr Phol Sugar Corporation, are utilized as fuel to replace grid electricity in order to achieve GHG emission reductions (hereinafter referred to as “Dan Chang Block 2 project”).

2. Results of the study
(1) Eligibility Criteria for MRV Methodology Application

<table>
<thead>
<tr>
<th>Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>The project activity replaces electricity from grid or fossil fuel-based generators through introducing highly-efficient facilities for electricity and heat supply using biomass residues, which are equipped with any one of technologies as shown below:</td>
</tr>
<tr>
<td></td>
<td>High-pressure boiler: Equipment Pressure Level ≥ 70 bar 500 °C</td>
</tr>
<tr>
<td></td>
<td>High-efficient boiler: Boiler Efficiency ≥ 90%</td>
</tr>
<tr>
<td></td>
<td>Fluidized bed boiler</td>
</tr>
<tr>
<td>Case 2</td>
<td>The biomass residues used in the project are not used other than in the project.</td>
</tr>
<tr>
<td>Case 3</td>
<td>No biomass types other than biomass residues are used in this project plant.</td>
</tr>
<tr>
<td>Case 4</td>
<td>In case of co-combustion with fossil fuels, input amount of fossil fuels can be recorded.</td>
</tr>
<tr>
<td>Case 5</td>
<td>In case of co-combustion with fossil fuels, the amount of fossil fuels co-combustion does not exceed 80% of the total fuel fired on an energy basis.</td>
</tr>
<tr>
<td>Case 6</td>
<td>The biomass residues used in the project facility are not stored for more than one year.</td>
</tr>
</tbody>
</table>

(2) Reference Scenario and Project/Activity Boundary
●Reference scenario
This methodology is applicable to project activities for installation or replacement of biomass-based power generators and/or boilers. Reference scenarios for heat supply and electricity supply are defined as shown below.
<Reference scenario for heat supply>
✓ Heat supply scenario 1: Heat demand on project site would be covered by high-efficiency fossil fuel-based boiler during a time period of project implementation.
* In the case where there would be an existing biomass-based boiler in project site, “Heat supply scenario” should be chosen.
<Reference scenario for electricity supply>
✓ Electricity supply scenario 1: Electricity demand on project site would be covered by grid electricity during a time period of project implementation.
✓ Electricity supply scenario 2: Electricity demand on project site would be covered by high-efficient fossil fuel-based generator during a time period of project implementation.
* In the case where project site is connecting to the Thailand national grid, “Electricity supply scenario 1” should be chosen. If NOT, “Electricity supply scenario 2” should be chosen.
●Boundary
Boundaries for the MRV methodology developed in this study include:
(1) All plants generating electricity and/or heat located at the project site,
(2) All electricity generation plants with grid connection
(3) All plants with means to transport biomass residues to the project site.

(3) Calculation Method Options
- Calculation options for emissions from electricity/heat supply
  ✓ Conservative default values only can be used for calculation.
  ✓ Calculation method diverges depending on the scenario applied.
- Calculation options for emissions associated with transport of biomass residues
  ✓ Basically, calculation can be done by using activity data only.
  ✓ Activity data used for calculation can be selected from a number of deliveries, input of biomass
residues and steam generation. In addition, default values are provided to be used for each calculation.

(4) Default Value(s) Set in MRV Methodology
- Reference efficiency of fossil fuel-based boiler: 100%
- Reference efficiency of electricity generation of fossil fuel-based electricity generating facilities: 50%
- Average distance to transport biomass residues in return trip: 200km

(5) Monitoring Methods

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELbio,y</td>
<td>Net power supply from biomass residues in year y</td>
<td>Continuous direct measurement by electricity meter with aggregating data as appropriate</td>
</tr>
<tr>
<td>N y, k</td>
<td>Total trip number of biomass residues type k in year y</td>
<td>Record data from transport sales slip with aggregating data at least per month</td>
</tr>
<tr>
<td>FC PJ, y, f</td>
<td>Quantity of fossil fuel type f fired in year y on-site</td>
<td>Direct measurement continuously by mass/weight meter or sales slip</td>
</tr>
<tr>
<td>ELPJ, grid, y</td>
<td>Quantity of electricity purchased from grid in year y</td>
<td>Direct measurement continuously by electricity meter or electricity purchased slip</td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions using a Model Project
As a result of verification, 4,986 tCO₂ is recognized as emission reduction from implementation of the project activities under this study over the period from 1st to 31st of October, 2012.

(7) Verification of GHG Emission Reductions using a Model Project
SGS (Thailand) Ltd., a DOE under the CDM in Thailand, is commissioned as the verifier for this research, considering its experience of verification works on GHG emission reductions in the past.

(8) Ensuring Environmental Integrity
The introduction and expansion of renewable energies will contribute to reducing emissions of environmental pollutants (NOx, SOx, wastewater, etc.) generated from fuel consumption for fossil fuel-fired electricity generation.

This project has been developed and operated after the screening of the Thai Environmental Impact Assessment (EIA), and no major problem has occurred under the EIA. Therefore, implementation of this project activity would not cause any adverse impacts.

(9) Contribution to Sustainable Development in Host Country
This project will contribute to sustainable development in Thailand in terms of the following aspects:
- emissions reductions of environmental pollutants (NOx, SOx, soot dust, etc.)
- ease of fossil fuel dependence in the power sector
- support for Thai policy to promote renewable energies
- improvement of economic efficiency through efficient utilization of abundant farming residues
- creation and increase of local employment
- stabilization of electricity supply

3. Toward Implementation/Future Prospects and Issues
It is tough to sell major facilities on their own to Thailand under the current situation, where price battles continue with China and India. Therefore, in the MRV methodology developed, conditions that would lead to introducing Japan’s advantageous technologies are added into the eligibility requirements.

On the other hand, further research needs to be conducted for indicators to improve the eligibility requirements that will facilitate Japan’s technologies to be introduced in Thailand in a more secured manner. We consider this to be a challenge for the next step.
MRV Demonstration Study using a Model Project
“Transport Modal Shift through Construction of Mass Rapid Transit (MRT) System”

By JWA & Almec Consortium for MRV Demonstration Study

1. Description of Project/Activity

   Table 1: Contents of Project

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization cooperating with study</td>
<td>OTP (Office of Transport and Traffic Policy and Planning)</td>
</tr>
<tr>
<td></td>
<td>SRTET (SRT Electrified Train Co., Ltd)</td>
</tr>
<tr>
<td>Host country and region</td>
<td>Bangkok metropolitan region, Thailand</td>
</tr>
<tr>
<td>Technical field targeted</td>
<td>Transport</td>
</tr>
<tr>
<td>Overview of project and activities</td>
<td>This project and activities will establish MRT networks in Thailand’s</td>
</tr>
<tr>
<td></td>
<td>Bangkok metropolitan region, which is expected to contribute to a modal</td>
</tr>
<tr>
<td></td>
<td>shift and a reduction in traffic congestion on the roads, thus reducing</td>
</tr>
<tr>
<td></td>
<td>GHG emissions and generating offset credits.</td>
</tr>
</tbody>
</table>

2. Results of the study

   (1) Eligibility Criteria for MRV Methodology Application
   - The project introduces a new urban MRT, including its extension.
   - The MRT is for passenger transport.
   - The MRT is a rail-based transport system.
   - There is a traditional transportation system along the MRT routes in the reference scenario.
   - Technology transfers and/or financial support from Japan and/or other developed countries are provided for the construction or operation of the MRT.

   (2) Reference Scenario and Project/Activity Boundary
   Reference scenario: BaU scenario (the MRT line does not exist.)
   Boundary: The boundary for the effect of the passenger modal shift shall be, the MRT line used for a trip from the entry station to exit station by MRT passengers. The boundary for the effect of the change in vehicle speed shall be the roads affected by the establishment of the MRT line. This refers only to the roads running parallel on both sides of the MRT line.

   (3) Calculation Method Options
   - Calculation option 1-1: Passenger modal shift (No interview survey required)
   - Calculation option 1-2: Passenger modal shift (Interview survey required)
   - Calculation option 2: Change in vehicle speed

   (4) Default Value(s) Set in MRV Methodology
   In calculation option 1-1, the share of passengers for the most conservative transport mode in terms of CO2 emissions per passenger kilometer (for example, buses) shall be set at 100%. In calculating the share of passengers using the transport mode in the reference scenario; the default value shall not be set in the calculation option 1-2.
   The default value used for the CO2 emission factor per passenger kilometer for transport mode i shall be the lower of the literature data presented in the MRV methodology, in both calculation options 1-1 and 1-2.
(5) Monitoring Methods

Table 2: Monitoring parameters (Calculation Option 1-1)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPKM&lt;sub&gt;y&lt;/sub&gt;</td>
<td>Passenger kilometer of MRT in year y (passenger km/year)</td>
<td>Data or statistics prepared by MRT operator (every year) *In case the data is not available, estimated by P&lt;sub&gt;y&lt;/sub&gt; and BTDP&lt;sub&gt;y&lt;/sub&gt;.</td>
</tr>
<tr>
<td>P&lt;sub&gt;y&lt;/sub&gt;</td>
<td>Number of MRT passenger in year y (passenger/year)</td>
<td>In case BPKM&lt;sub&gt;y&lt;/sub&gt; is not available, data or statistics prepared by MRT operator (every year)</td>
</tr>
<tr>
<td>MS&lt;sub&gt;i,y&lt;/sub&gt;</td>
<td>Share of passengers using transport mode i in the reference scenario in year y (%)</td>
<td>Default value: The most conservative transport mode in terms of emission among the target city should be set as 100%</td>
</tr>
<tr>
<td>BTDP&lt;sub&gt;y&lt;/sub&gt;</td>
<td>Average distance traveled by MRT passenger in year y (km)</td>
<td>In case BPKM&lt;sub&gt;y&lt;/sub&gt; is not available, data or statistics prepared by MRT operator (every year)</td>
</tr>
<tr>
<td>ECMRT&lt;sub&gt;y&lt;/sub&gt;</td>
<td>Electricity consumption associated with MRT operation (MWh/year)</td>
<td>Data or statistics prepared by MRT operator’s normal operations (every year)</td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions using a Model Project

Table 3: Calculation Results (Unit: tCO<sub>2</sub>/year)

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Calculation option 1-1</th>
<th>Calculation option 1-2</th>
<th>Calculation option 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project emissions</td>
<td>6,302</td>
<td>6,302</td>
<td>152,430</td>
</tr>
<tr>
<td>Reference emissions</td>
<td>11,618</td>
<td>24,167</td>
<td>155,872</td>
</tr>
<tr>
<td>Reduction in emissions</td>
<td>5,316</td>
<td>17,865</td>
<td>3,442</td>
</tr>
</tbody>
</table>

(7) Verification of GHG Emission Reductions using a Model Project

- Improve the traceability of data activity flow from its source to aggregated data.
- Improve the transparency of all calculation spreadsheets by providing linkages to source data and applied equations.
- Improve the data management system with internal self-verification controls (i.e., QA/QC) and put in place appropriate control systems and methodologies to ensure the robustness, effectiveness, accuracy, completeness, consistency and timeliness of its data collection and management systems.
- Improve its existing monitoring plan and ensure that they describe comprehensively the requirements of the Monitoring Manual for Bilateral Offset Credit Mechanism Demonstration/Feasibility study Programme.

(8) Ensuring Environmental Integrity

This is a priority project to achieve the GHG emission reduction targets in the transportation sector. Moreover, appropriate environmental impact assessments were carried out since the project fell under the remit of Thailand’s environmental impact assessment program; this assessment determined that there would be no negative impact on the environment.

(9) Contribution to Sustainable Development in Host Country

Technology manufactured in Japan has the edge in areas on the software side as well as the infrastructure side. This includes the redevelopment of the front of the station to improve the bus service for better access to the railway station, including a joint use of Sony’s Felica system. Also, NOx reductions can be expected through ARL operations, estimated from monitoring results.

3. Toward Implementation/Future prospects and issues

Calculations of emission reductions targeting MRT in the Mass Rapid Transit Master Plan in Bangkok Metropolitan Region (M-MAP) by the Thai Government overall in the MRV methodology, indicate that major emissions reductions can be expected. However, there are several issues in using the JCM/BOCM framework for MRT.

- Cabinet approval of JCM/BOCM in Thailand
- Establishment of a data management system by a railway company that can satisfy third-party verification
MRV Demonstration Study using a Model Project
“Energy Saving through Building Energy Management System (BEMS)”

By PricewaterhouseCoopers Co., Ltd

1. Description of Project/Activity
The objective of the project is to develop a measurement, reporting and verification approach for total energy consumption of commercial buildings using Building Energy Management System (BEMS), as well as manage the operation of energy-consuming equipment to reduce both energy consumption and CO₂ emissions. In Thailand’s metropolitan Bangkok area, this project is targeting four categories of building: hotels, offices, hospitals, and shopping centers. The project aims to achieve reductions in emissions in 12 cases, achieving a total reduction of 11,538t CO₂ per year.

2. Results of the study
(1) Eligibility Criteria for MRV Methodology Application
Case 1 BEMS shall be installed into existing buildings
Case 2 Reduction of energy consumption shall be made by the operation and control of equipment and facilities by BEMS based on the indoor environment, not just through equipment upgrades
Case 3 The result of performance improvement shall be reported regularly (at least once every six months) by the BEMS provider to beneficiaries of energy saving e.g. building owners after the introduction of BEMS. This shall be secured by contracts.

(2) Reference Scenario and Project/Activity Boundary
With regard to reference scenarios, the following 2 scenarios are used:
· Scenario 1: it is Business as Usual (BaU) with the current situation, continuing with no introduction of BEMS
· Scenario 2: buildings become highly efficient as a result of non-BEMS effects
The rationale behind Scenario 1 is that there are almost no cases of BEMS introduction in Thailand, and that the current situation, where there are limited economic incentives for BEMS introduction, is assumed to continue. Scenario 2 is set based on the assumption that buildings will be more efficient than BaU as a result of non-BEMS effects. This scenario is based on the “Energy Efficiency Development Plan (2011-2030)” published by the Ministry of Energy in Thailand.

(3) Calculation Method Options

(4) Default Value(s) Set in MRV Methodology
Assessments of commercial buildings energy efficiency were performed to understand the status of facility operation and energy consumption. Results of assessments were used in the determination of default values. In
Thailand, there are a limited number of cases of BEMS introduction, with no cases of it being installed for a long period of time. As a result, assessments try to define quantitative and manageable defaults (percentage efficiency improvement of energy usage) by collecting information on past energy consumption of the whole building and detailed information on the building operation. In addition, there is an analysis of energy conservation following introduction of the BEMS.

### (5) Monitoring Methods

#### Table 1: Monitoring Methods

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EER&lt;sub&gt;i&lt;/sub&gt;</td>
<td>Percentage of Energy efficiency improvement by EMS [%]</td>
<td>Default value</td>
</tr>
<tr>
<td>EER&lt;sub&gt;k&lt;/sub&gt;</td>
<td>Percentage of Energy efficiency improvement by introducing individual technologies and controls k of BEMS [%]</td>
<td>Default value</td>
</tr>
<tr>
<td>PEC&lt;sub&gt;y&lt;/sub&gt;</td>
<td>Project electricity consumption during the period of year y</td>
<td>Data record from BEMS, Electric Meter, Electricity bills</td>
</tr>
<tr>
<td>PFC&lt;sub&gt;d&lt;/sub&gt;,&lt;sub&gt;y&lt;/sub&gt;</td>
<td>Project diesel fuel consumption during the period of year y</td>
<td>Data record from BEMS, Gas Flow Meter, Fuel Meter, Gas/Fuel bills</td>
</tr>
<tr>
<td>PFC&lt;sub&gt;L&lt;/sub&gt;,&lt;sub&gt;y&lt;/sub&gt;</td>
<td>Project LPG consumption during the period of year y</td>
<td>Data record from BEMS, Electric Meter, Electricity bills</td>
</tr>
<tr>
<td>PFC&lt;sub&gt;k&lt;/sub&gt;,&lt;sub&gt;y&lt;/sub&gt;</td>
<td>Project kerosene consumption during the period of year y</td>
<td>Data record from BEMS, Gas Flow Meter, Fuel Meter, Gas/Fuel bills</td>
</tr>
</tbody>
</table>

### (6) Quantification of GHG Emissions and its Reductions using a Model Project

#### Table 2: GHG Emission and Reduction

<table>
<thead>
<tr>
<th>Building</th>
<th>Total Floor Area (m²)</th>
<th>Reference Emission (t-CO₂)</th>
<th>Reduction in Emission (t-CO₂)</th>
<th>Percentage Reduction in Emission by BEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building A</td>
<td>67,962</td>
<td>4,995</td>
<td>524</td>
<td>Implemented at 10.5%</td>
</tr>
<tr>
<td>Building B</td>
<td>213,311</td>
<td>27,917</td>
<td>6,554</td>
<td>Implemented at 10.5%</td>
</tr>
<tr>
<td>Building C</td>
<td>9,952</td>
<td>1,693</td>
<td>18</td>
<td>Implemented at 1.1%</td>
</tr>
<tr>
<td>Building D</td>
<td>27,886</td>
<td>49,349</td>
<td>5,335</td>
<td>Implemented at 10.8%</td>
</tr>
</tbody>
</table>

### (7) Verification of GHG Emission Reductions using a Model Project

#### Table 3: The result of Trial Verification

<table>
<thead>
<tr>
<th>Building</th>
<th>Verification Type</th>
<th>Date of Execution (Date of Submitting the Monitoring Report)</th>
<th>Date of Submitting the Verification Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building A</td>
<td>On site review Calculation Method 1</td>
<td>November 26, 2012</td>
<td>December 7, 2012</td>
</tr>
<tr>
<td>Building B</td>
<td>Desk-top review Calculation Method 1</td>
<td>1st Verification: November 30, 2012 2nd Verification: December 12, 2012</td>
<td>December 17, 2012</td>
</tr>
</tbody>
</table>

### (8) Ensuring Environmental Integrity

The environmental impacts of the manufacture of BEMS systems are considered to be lower than other products. Similarly, during the overall life cycle of BEMS, the potential for increased environmental impacts e.g. release of hazardous chemicals, etc., is considered to be very low.

### (9) Contribution to Sustainable Development in Host Country

Introduction of BEMS acts as a driver for reduction in peak power consumption, supports energy efficiency related technology transfer and human resource development, etc. These benefits are in line with the current Thai mid-term development policy and strategy.

3. Toward Implementation/Future prospects and issues

Calculation Method 3 of MRV methodology uses total floor area as key operations data in emissions calculations. In office and shopping malls, tenant occupation data is used to define the operation state to control the effects of factors other than the introduction of BEMS on energy consumption. However, if the operation rate is not appropriately monitored, or variations in factors impacting energy consumption other than BEMS introduction are not captured, significant errors in calculating emission reduction could occur. Therefore, to improve the accuracy of operating ratio, it is necessary to consider establishing different operating ratios for different usages of the building.
1. Description of Project/Activity

The Project is aiming at developing a methodology for a utility plant of DCAP (District Cooling System and Power Plant Co., Ltd.) in Bangkok Thailand and demonstrating the methodology’s usability for future BOCM/JCM projects. DCAP plant is providing electricity and chilled water to Bangkok Suvarnabhumi International Airport and its adjacent facilities, by utilizing waste heat from gas turbine and steam absorption chillers to reduce CO2 emissions. The plant generates electricity from gas-turbine and high-temperature waste heat from gas turbine used to generate electricity. Residual steam is used to generate chilled water with absorption chillers.

2. Results of the study

(1) Eligibility Criteria for MRV Methodology Application

<table>
<thead>
<tr>
<th>Case</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>This methodology is applicable for projects using waste heat, with discharge to the atmosphere following its primary usage in absence of the project activity. (Common to all calculation options)</td>
</tr>
<tr>
<td>Case 2</td>
<td>Electric chillers replaced with this project shall be without malfunction. After the project implementation, the electric chillers are either to be disposed, used for chilled water’s demand control, and/or used for back-up purposes. (Renovation project with calculation option 1, 2, 3 &amp; 4)</td>
</tr>
<tr>
<td>Case 3</td>
<td>Absorption shall use steam and has a better performance than the double-effect. (Common to all calculation options)</td>
</tr>
<tr>
<td>Case 4</td>
<td>Heat source shall use either gas-turbine or gas-engines. (Common to all calculation options)</td>
</tr>
<tr>
<td>Case 5</td>
<td>If the project uses ax-ante chiller’s operational record to derive PCF, the record shall be furnished longer than 3 months. (Renovation project, option 1 &amp; 2)</td>
</tr>
<tr>
<td>Case 6</td>
<td>The project shall identify rated electricity consumption of gas turbine and/or waste heat recovery steam turbine. (Both Renovation and Greenfield project, option 2 &amp; 4)</td>
</tr>
<tr>
<td>Case 7</td>
<td>The project shall continuously record and monitor production amount of chilled water, and chilled water’s inlet/outlet temperature. (Common to all calculation options)</td>
</tr>
<tr>
<td>Case 8</td>
<td>Project’s emission factor for electricity shall be smaller than grid electricity’s emission factor. (Renovation project, option, 1, 2, 3 &amp; 4)</td>
</tr>
<tr>
<td>Case 9</td>
<td>Project’s emission factors for heat and electricity shall be smaller than grid electricity’s emission factor. (Greenfield project)</td>
</tr>
<tr>
<td>Case 10</td>
<td>Absorption chiller shall be inspected periodically by vendor or equivalent. (Common to all options)</td>
</tr>
</tbody>
</table>

(2) Reference Scenario and Project/Activity Boundary

The reference scenario is to supply electricity and chilled water with an electric chiller powered by grid-electricity. For Greenfield projects, an electric-chiller is powered by a gas-turbine/gas-engine to supply electricity and chilled water. The project’s boundary includes gas-turbine, waste-heat recovery steam turbine and chillers, but excludes demand side cooling facilities.

(3) Calculation Method Options

The calculation method should be chosen by determining whether the project is a Greenfield or renovation project. For renovation projects, the options are split by whether the project has a historical
operational record of electric chillers or not, and is then further split based on whether direct measurement of replaced equipment would be performed. Greenfield projects do not have any option. In total, 5 calculation options are available.

(4) Default Value(s) Set in MRV Methodology

For renovation projects without data of rated capacity of electric chillers, PCF shall be determined as 0.504kWh/USRT or COP 7.00, as a default value. The value is 20% higher than the Ministry of Energy of Thailand’s minimum COP standard in 2009, 0.620kWh/USRT. The value is also 7% higher than the representing value of an actual installation in 2010, through consideration of a project’s additionality to BAU cases. For Greenfield projects, a default value of system efficiency is set at 51.9%, which is derived from Thailand’s Small Power Producer’s average energy efficiency in cogeneration facilities including chilled water production.

(5) Monitoring Methods

Continuous hourly monitoring is performed for key parameters, which include production amount of chilled water and average temperature of inlet and outlet of chilled water by utilizing DCS. Applying DCS data set eases monitoring activity and reduces chance of human errors.

(6) Quantification of GHG Emissions and its Reductions using a Model Project

Annual GHG emission amount accounts 371,873tCO2. Emission reduction amount is 55,886tCO2 with option 1 of the method, while 47,364tCO2 is set with option 4.

(7) Verification of GHG Emission Reductions using a Model Project

Bureau Veritas Thailand (BVT) is appointed as a verifier and performed monitoring data verification. The verification opinion has not been completed due to lack of documentation to demonstrate project’s applicability of proposed methodology.

(8) Ensuring Environmental Integrity

The DCAP facility has been operating as a vital utility supply facility of Suvarnabhumi Airport since its commission. The facility meets Thailand’s relevant environmental standards in operation. Adjacent land area is left for future expansion of the airport. Taking these factors into consideration, the facility has minimum environmental impacts.

(9) Contribution to Sustainable Development in Host Country

Thailand is pursuing harmonized economic development with emission reductions and energy efficiency for the next 5 years. The project contributes to reducing GHG emissions and toward realizing energy efficient utility supply to the major commercial buildings in Thailand’s growing economy.

3. Toward Implementation/Future prospects and issues

There are two prospects along with DCAP and cogeneration supply in Thailand. Bangkok Airport has a plan to expand its capacity in the near future, and the DCAP facility is expanded its utility supply capacity as well. The developed methodology can be applicable for expanded DCAP facilities to claim GHG reductions. The Thai Government has a plan to reinforce Small Power Producer’s capacity for utility supply to industrial parks and/district cooling supply projects. On the other hand, there are another two concerns on promoting BOCM/JCM. First, the manufacturer has to engage Thai markets with appropriate size of gas turbines for the SPP programs. Second, the BOCM/JCM has to closely communicate with the Thai Government with respect not only to the GHG, but also industry rules and Thailand’s domestic regulations.

<table>
<thead>
<tr>
<th>Table 1. List of Monitoring Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters (All parameters are monitored and recorded via DCS)</td>
</tr>
<tr>
<td>Chilled water amount by absorption chillers</td>
</tr>
<tr>
<td>Chilled water amount by electric chillers</td>
</tr>
<tr>
<td>Electricity generated by gas turbine</td>
</tr>
<tr>
<td>Electricity Generated by Waste Heat Recovery Gas Turbine</td>
</tr>
<tr>
<td>Electricity Consumption of gas Turbine</td>
</tr>
<tr>
<td>Electricity Consumption of Waste Heat Recovery Gas Turbine</td>
</tr>
<tr>
<td>Amount of Gas Consumption by Gas Turbine</td>
</tr>
</tbody>
</table>
MRV Demonstration Study using a Model Project
“Integrated Energy Efficiency Improvement at Beer Factory(Vietnam)”

By Recycle One, Inc.

1. Description of Project/Activity
This business uses the Thanh Hoa Factory of Habeco, a major beer company in the Socialist Republic of Vietnam, as a model case. The business intends to reduce GHG drastically by introducing energy savings and low-carbon device systems in the manufacturing process where a significant amount of energy is consumed, and by making overall reductions in energy consumption.
In the object factory, devices are introduced that contribute to a reduction in fuel and power such as a vapor recompression and a recycling steam system in the preparation process, and a cascade cooling system in the cooling process.

2. Results of the study
(1) Eligibility Criteria for MRV Methodology Application

Case 1 Two or more of the following technologies shall be introduced in implementing the project and shall be maintained periodically.
Vapor recompression system (VRC), CO2 recovery and liquefaction system, cascade cooling system, heat pump system for pasteurizer, bottle washer heat recovery system, biogas recovery boiler.

Case 2 The applicable factory shall include manufacturing of, either or both of, beer and carbonated beverages.

Case 3 No drastic changes made in the manufacturing process and products before and after the project implementation.

Case 4 Fossil fuels and electricity consumption within the boundary including production of products shall be measureable after the project implementation.

Case 5 In case existing equipment are replaced by project activities, the equipment shall not be used in other locations.

Case 6 In case of using new biomass sources, the biomass shall be proven to be unused prior to the project implementation.

Case 7 In case of using renewable energy, electricity shall be generated solely from biomass sources and used for energy consumption within the project boundary.

(2) Reference Scenario and Project/Activity Boundary
The boundary covers the whole factory so that the effect of emission reduction of GHG can be reflected in operations improvement. As for the reference scenario, since (1) achievement of energy savings control, (2) realization of reductions through a voluntary energy savings plan in the target factory, and all the rest are considered other than the BaU scenario, they do not exist, and therefore the BaU scenario was decided as a reference scenario.

(3) Calculation Method Options
Calculation option 1: Available for expansion and renewal of existing installations
Simple calculation method that uses original units of energy consumption defaulted in the calculation of reference emissions.
Calculation option 2: Available for renewal of existing installations
Simple calculation method that uses project eigenvalue in the calculation of reference emissions.

(4) Default Value(s) Set in MRV Methodology
GHG emission original unit of fossil fuel : Utilization of IPCC default value
Power emission factor : Utilization of value published by the Vietnamese Government
Energy consumption original factor in reference scenario : Calculated on a questionnaire conducted in
cooperation with a local beer industry group

(5) Monitoring Methods

Table 1: Monitoring parameters for available default values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EL_{PJ}</td>
<td>Project electricity consumption in year ( y ) ([\text{MWh/y}])</td>
<td>Electric meter</td>
</tr>
<tr>
<td>(F_{fuel,i,PJ})</td>
<td>Project consumption of fossil fuel ( i ) in year ( y ) ([1000\text{Nm}^3/y \text{ or t/y or kL/y}])</td>
<td>Current meter, truck scale</td>
</tr>
<tr>
<td>PO_{y,PJ,Beer}</td>
<td>Beer production volume from project activity in year ( y ) ([\text{kL/y}])</td>
<td>Production control records</td>
</tr>
<tr>
<td>PO_{y,PJ,BiaHoiBase}</td>
<td>Original BiaHoi production volume from project activity in year ( y ) ([\text{kL/y}])</td>
<td>Production control records</td>
</tr>
<tr>
<td>PO_{x,PJ,carbonated beverage base}</td>
<td>Original carbonated beverage production volume from project activity in year ( y ) ([\text{kL/y}])</td>
<td>Production control records</td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions using a Model Project

Table 2: Result of Monitoring Activity

<table>
<thead>
<tr>
<th>Parameter (Unit)</th>
<th>Monitoring pattern</th>
<th>Original data</th>
<th>Value</th>
<th>Reference</th>
<th>Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase amount of power(MWh)</td>
<td>Pattern B</td>
<td>Bill from power company</td>
<td>2,036</td>
<td>2,433</td>
<td></td>
</tr>
<tr>
<td>Purchase amount of coal (t)</td>
<td>Pattern B</td>
<td>Contract document</td>
<td>1,393</td>
<td>1,409</td>
<td></td>
</tr>
<tr>
<td>Shipping volume of beer (kL)</td>
<td>Pattern B</td>
<td>Shipping ticket</td>
<td>7,134</td>
<td>17,329</td>
<td></td>
</tr>
<tr>
<td>Shipping volume of Bia Hoi (kL)</td>
<td>Pattern B</td>
<td>Shipping ticket</td>
<td>8,790</td>
<td>8,262</td>
<td></td>
</tr>
</tbody>
</table>

GHG Emissions and its Reductions

- Reference emission 7,443 t-CO2
- Project emission 4,594 t-CO2
- Reduction amount 2,849 t-CO2

(7) Verification of GHG Emission Reductions using a Model Project

8 CARs were pointed out.

(8) Ensuring Environmental Integrity

Comments were obtained from the Ministry of Natural Resources and Environment that toxic substances were not exhausted by implementing this business. Instead, improvement in air pollution due to effluent processing loads and a reduction is expected in the amount of fossil fuel used.

(9) Contribution to Sustainable Development in Host Country

It is thought that this business will lead to a stable supply of energy and a reduction in GHG emissions, through overall energy savings in the beer factory. Also, a reduction in fuel and power costs is realized along with productivity improvement, and the result of waste reduction is expected as well.

3. Toward Implementation/Future prospects and issues

Points to generalize proposed technologies in Vietnam are consolidated in the following two points.

- Cost reduction due to localization of assembly and plant installation work
- Differentiation from other countries by supply of intangible services including engineering and plant maintenance of which Japan is superior

It is necessary to consider the implementation in the form of finance of ESCO business etc., in the future, because these intangible services are not yet popular in Vietnam.
1. Description of Project/Activity

The purpose of the Project is to reduce Green-house gas (GHG) emissions by displacing diesel fired power generation at small rice mills through the dissemination of low-cost and easy-to-operate stirling engines using biomass as fuel in Cambodia.

![Figure 1. Project concept](image)

2. Results of the study

(1) Eligibility Criteria for MRV Methodology Application

<table>
<thead>
<tr>
<th>Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>The technology introduced involves installation of a biomass electricity generation technology in rice mills, where there was no such technology installed prior to the implementation of the project activity.</td>
</tr>
<tr>
<td>Case 2</td>
<td>The project activity shall replace fossil fuel used in a captive power plant not connected to grid.</td>
</tr>
<tr>
<td>Case 3</td>
<td>The fuel used in the project activity consists solely of renewable biomass.</td>
</tr>
<tr>
<td>Case 4</td>
<td>The technology installed under the project activity does not generate toxic substance as byproduct through processes, such as reforming of gas.</td>
</tr>
<tr>
<td>Case 5</td>
<td>Project participants are able to monitor the amount of net electricity generated by the project activity.</td>
</tr>
</tbody>
</table>

(2) Reference Scenario and Project/Activity Boundary

The reference scenario is continuous use of fossil fuel based fuel by existing electricity generation for the duration of the proposed project. The project boundary includes industrial and commercial facilities consuming energy generated by the system.

(3) Calculation Method Options

![Figure 2. Calculation Method options](image)
(4) Default Value(s) Set in MRV Methodology

For Calculation Method 2, the default value for CO2 emission per unit of electricity generated by diesel engine is conservatively set at 0.8 kgCO2/kWh.

(5) Monitoring Methods

Table 1: Monitoring parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( E_{G_{PJ,y}} )</td>
<td>Quantity of net electricity generated by the renewable energy unit installed under the project activity (MWh)</td>
<td>Measurements are undertaken using a metering device that can operate continuously. The net electricity displaced is the gross energy generation by the project activity power plant, minus the auxiliary electricity consumption. Data may be compiled remotely.</td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions

Table 1: Estimated emission reductions

<table>
<thead>
<tr>
<th>Case</th>
<th>Annual average GHG emission reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per installation site (50kW)</td>
<td>175.2 tCO2</td>
</tr>
<tr>
<td>Potential in 3 Study provinces (135kW) (Kampong Speu, Kandal, Kampong Cham)</td>
<td>613.2 tCO2</td>
</tr>
</tbody>
</table>

(7) Verification of GHG Emission Reductions

The net electricity generated by the project activity will be verified by a third party. The accuracy level of the monitoring equipment used will be confirmed to determine whether calibration is required.

(8) Ensuring Environmental Integrity

Stirling engines have greater environmental benefits compared to conventional biomass power generation systems such as lower noise, NOx and SOx emission levels, and no harmful substances emitted into the surroundings.

(9) Contribution to Sustainable Development in Host Country

The Study found that the proposed Project using renewable biomass as energy source conforms with the mitigation actions in the energy sector stipulated in the Cambodia Climate Change Strategic Plan, as well as to the energy policy objectives including rural electrification.

3. Toward Implementation/Future prospects and issues

Project implementation schedule is planned as follows.

| FY 2012 | 1 unit for demonstration |
| FY 2013 | 5 units per system for 10 sites… 175kWh/50 units for F/S and Promotion |
| FY 2014 | Sales phase; 10 units per system for 100 sites…3500kWh/1000 units |

Issues to be tackled include confirmation of the monitoring technology, selection of project sites, minimizing technology cost and establishing a sales channel.
1. Description of Project/Activity

Targeting the REDD+ project in the Prey Long Area, located in the northeast part of Cambodia, the project continued to resolve pending issues based on last year’s result. Although the final boundary of Protected Forest has not been finalized, the expected area is about 400,000ha.

In the Prey Long area, deforestation is continuing due to small-scale conversion to farmlands, and due to large-scale agro-industry development by companies obtaining concessions. The results of a current analysis have found that the rate of deforestation in the Prey Long Area is much higher than the average rate per year for Cambodia, which has been reported to be 0.8%. This supports the urgency of conservation in this area, as well as the potential for the REDD+ project. The REDD+ project aims to reduce deforestation by the establishment of Protected Forest, strengthening law enforcement and involvement of local communities through, e.g., Community Agreements.

2. Results of the study

(1) Eligibility Criteria for MRV Methodology Application

| Case 1 | The activities in the reference scenario are not planned deforestation or degradation |
| Case 2 | Target areas have been forested for at least 10 years |
| Case 3 | Target areas do not include peat land forests |

(2) Reference Scenario and Project/Activity Boundary

Based on the deforestation driver’s workshop held in 2011, the reference scenario has been identified as the continuing deforestation. The project area is Prey Long Protected Forest and the reference region is four provinces where Prey Long Protected Forest is located; Kratie, Kampong Thom, Stung Treng and Preah Vihear. The project started in October 2011 when the deforestation driver’s workshop was held, and the historical period between 2001 and 2011 is set to be analyzed to determine the reference scenario.

(3) Calculation Method Options

Calculation Method 1: The Royal Government of Cambodia is under the process of setting reference levels at sub-national scale, and after they are set, it is anticipated that these reference levels will be adopted in the project. Calculation method 2: While small-scale conversions for agricultural land are significantly affected by location-based conditions such as population density, soil fertility and accessibility, large-scale plantation developments accompany the development of infrastructure and the mobility of workers. Since the dependency of deforestation on location-based conditions is different according to the type of deforestation, the MRV methodology provides two sub-methods under Calculation method 2. Calculation method 2-1, which is applied for large-scale plantation developments, does not require spatial analysis. On the other hand, Calculation method 2-2 requires spatial analysis of project’s future deforestation area in the project area.

(4) Default Value(s) Set in MRV Methodology

Allometric equations for estimating carbon stocks of above-ground and below-ground biomass pools and wood density for estimating carbon stocks of dead wood pools were set as default values, which could be applied to the area based on literature and data accumulated for near the target area. Also, a plot survey was carried out for the overall Prey Long area, and as a result, the value of forest carbon stocks for the Prey Long area specific to the project was established.
(5) Monitoring Methods

Forest area change will be monitored every few years by using remote sensing images. Forest carbon stock value developed by this feasibility study should be valid for ten years. It would be ideal for plot survey to be conducted within the National Forestry Inventory.

(6) Quantification of GHG Emissions and its Reductions

Preliminary estimated amount of GHG emission reductions from the REDD+ project in the Prey Long area was 4.5 million tonCO2 in a 10–year period.

(7) Verification of GHG Emission Reductions

It is desirable to have a system for external reviews in order to ensure transparency and reliability, which is currently discussed as in UNFCCC.

(8) Ensuring Environmental Integrity

The project plans to adopt CCB standards in order to ensure environmental integrity. On the environmental aspect, positive effects will be achieved in stopping forest degradation within the target area, where biodiversity is at risk. Effects will be checked by monitoring selected species as an index of the health of biodiversity. In order to achieve forest conservation, and to minimize the impact of doing this outside the target area, a comprehensive societal approach will be adopted, considering aspects such as compensating for land ownership rights, and the provision and creation of livelihoods. In order to further understand local residents, and to further increase the effects of the project, training will be needed using training manuals in the future. Legal compliance will be ensured through close collaboration with the FA in Cambodia.

(9) Contribution to Sustainable Development in Host Country

The forest in the Prey Long Area is an important watershed for sustaining fishery and agricultural activities in Cambodia and Vietnam, and is also a source of non-timber forest products such as resin, which the economy in local communities depends on. Also, the Cambodian Government has positioned REDD+ as one of the strategic issues for prioritization in the National Forest Program (2010-2029). The Cambodian Government aims to maintain forest cover in the country at 60% until 2015, by enhancing forest law enforcement as well as by strengthening the governance structure. In conclusion, the implementation of the REDD+ project in the Prey Long area will contribute to achieving prioritized policies in the host country.

3. Toward Implementation/Future prospects and issues

The present feasibility study will be completed upon the submission of the report in March. However, it is important to commence bilateral negotiations with the Cambodian Government going forward, with the aim of implementing the REDD+ project in the Prey Long area, and to hold discussions with the aim of making substantial progress. On the REDD+ project, there has already been progress made with various types of bilateral work, within which support from Japan to Cambodia has been important and significant. The REDD+ roadmap in the area given in Section 3.3 of the detailed report shows that specific needs from the Cambodian Government can be effectively utilized with a view towards holding discussions on support as a next step.
1. Description of Project/Activity

This geothermal power project will build a facility with a capacity of 50 MW in the Nevado del Ruiz region. Geothermal power generation is seen as a promising alternative technology to thermal power generation, and this geothermal power project is the first of its kind in the country. Construction is set to start in 2014, and the plant is expected to go into operation in 2016. The project will achieve emission reductions mainly through its substitution for fossil-fuel power plants. In this study, we propose a method for setting the reference scenario widely applicable to electric power projects, and inclusion into the methodology considerations for countries recognized as having “suppressed demand.”

2. Results of the study

(1) Eligibility Criteria for MRV Methodology Application

This methodology is applicable under the following conditions:

The project activity is the installation of a new grid-connected geothermal power plant, or the retrofit of an existing geothermal power plant.

(2) Reference Scenario and Project/Activity Boundary

The reference scenario (alternative power source) is identified by taking into account a country's situation and conditions, such as plans of the government/operator, availability of technology, possibility for fuel procurement, and economics (general). For countries recognized as having “suppressed demand,” the calculation of the emission factor will take into account plans for future construction of power plants. In the case of Colombia, the envisioned reference scenario is one where there is suppressed demand, and the power sources that are expected to increase in the absence of the geothermal power generation project are those defined as “firm energy” (i.e. power distribution capacity in the worst scenario, meaning the drought period in Colombia).

(3) Calculation Method Options

There are three options for calculation of non-condensable gases (CO₂ and CH₄) contained in the produced steam, as follows:
(1) Fixed FS value obtained prior to start of the project, (2) the regional value, or (3) the IPCC value. There is significant variance in data on concentrations of CO2 and CH4 in the produced steam. If CO2 and CH4 are not monitored, a certain part of emission reductions will be subtracted from the emission reductions for a conservative calculation.

(4) Default Value(s) Set in MRV Methodology
The average emission factor of the power plants which have been successfully awarded a contract in the “firm energy” auctions in Colombia is set as the default reference emission factor.

(5) Monitoring Methods

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E_{G_{P,y}}$</td>
<td>Quantity of net electricity generation supplied by the project plant/unit to the grid in year $y$ [MWh/y]</td>
<td>Electricity meter(s)</td>
</tr>
<tr>
<td>$M_{steam,y}$</td>
<td>Quantity of steam produced in year $y$ [t-steam/y]</td>
<td>Venture flow meter(s)</td>
</tr>
<tr>
<td>$w_{steam,CO_2,y}$</td>
<td>Average mass fraction of carbon dioxide in the produced steam in year $y$ [tCO$_2$/t-steam]</td>
<td>Collection of non-condensable gas samples from the main steam line with glass flasks, filled with sodium hydroxide solution and additional chemicals to prevent oxidation.</td>
</tr>
<tr>
<td>$w_{steam,CH_4,y}$</td>
<td>Average mass fraction of methane in the produced steam in year $y$ [tCH$_4$/t-steam]</td>
<td>Gas chromatography etc.</td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions
69,766 t-CO$_2$/year

(7) Verification of GHG Emission Reductions
Local entities selected as candidate third-party verification entities, Colombian Institute for Technical Standards and Certification (ICONTEC), Optim Consult SAS, and the National University of Colombia.

(8) Ensuring Environmental Integrity
Based on basic environmental analysis, the Colombian Government has given permission for the feasibility studies for the project, including test drilling. Moreover, negative effects from the project can be appropriately averted by conducting environmental impact assessments as the development progresses.

(9) Contribution to Sustainable Development in Host Country
By introducing this geothermal power plant, the resulting reduction in air pollutants (from the fossil fuels necessary for the operation of the thermal power plant this project would replace) will contribute to the amelioration of environmental pollution in the host country.

3. Toward Implementation/Future prospects and issues
Feasibility studies for the power generation project are proceeding smoothly, with construction to start in 2014 and operation from 2016. Therefore, as of present, there are hardly any problems with conducting the geothermal power project under the JCM/BOCM. On the other hand, to promote the JCM/BOCM, it is important that the Japanese and Colombian Governments work together in taking specific actions to make this project a model case under the JCM/BOCM.
JCM/BOCM Feasibility Study
“Solar-Diesel Hybrid Power Generation to Stabilize Photovoltaic Power Generation”

By Hitachi Zosen Corporation

1. Description of Project/Activity
This project envisages electricity supply through the introduction of a MW class hybrid power generation system (see Figure 1) that combines PV and diesel engine power generation on the Indonesian Island of Nias, located approximately 140km off shore of North West Sumatra. (see Figure 2)

Introduction of the hybrid system will enable a reduction in fossil fuel consumption by offsetting it with PV power generation. Accordingly, through reduced fossil fuel consumption and increased efficiency in diesel engine operation, this project will result in a corresponding reduction in the amount of CO2 emissions. The hybrid system, through highly advanced integrated controls, stabilizes output fluctuations in PV power generation and also incorporates a low-load type diesel engine.

2. Results of the study

(1) Eligibility Criteria for MRV Methodology Application
Case 1 Provide base-load electricity by operating software to compensate for the fluctuation of PV power output and to stabilize the total power output of the hybrid system.
Case 2 Apply low-load type diesel power generator and CIS type PV panel.
Case 3 Keep the usage of battery for stabilizing the power output supplementary, or no usage at all.

(2) Reference Scenario and Project/Activity Boundary
It is planned to connect the hybrid system to the small grid (Island grid) on Nias Island. Currently only diesel engines are operating. Although there are plans to introduce a coal-fired plant, coal-gasification plant and the replacement of diesel engines in the near future, they are not yet fixed.

(3) Calculation Method Options
The method of setting a grid’s CO2 emission factor to calculate a reference emission factor (EF) varies according to the size of the grid. Here, the following two calculation methods have been selected:
1) Grid size
2) Use of default values

Using default values leads to a conservative estimate of CO2 reduction as a trade-off between simplicity and the amount of carbon credit. The default values have been decided for a modern diesel engine of the relevant capacity operating at optimal load, therefore it can be said to be conservative to use them.

(4) Default Value(s) Set in MRV Methodology
The default emission factor values for a large-scale grid that are regularly calculated and published by the Ministry of Energy and Mineral Resources and the National Council on Climate Change are applied. Having been supplied by the Indonesian Government for use in CDM, these values are considered appropriate for use in JCM/BOCM.

Further, the default values for the CO_2 emission factor of a small-scale grid power generation plant are calculated solely on the consumption of liquid fossil fuels. Under this scenario, and based upon a continuous 24hr/per day power supply, a mini-grid emission factor of 0.8 t-CO_2/MWh is deemed appropriate.

(5) Monitoring Methods
Monitoring Items are shown in Table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGP_{3y}</td>
<td>Yearly quantity of net electricity generation by the hybrid system (kWh)</td>
<td>Daily power supply monitoring.</td>
</tr>
<tr>
<td>EGD_{3y}</td>
<td>Yearly quantity of net electricity generation by the PV power generation system (kWh)</td>
<td>Daily power supply monitoring.</td>
</tr>
<tr>
<td>FCD_{y}</td>
<td>Quantity of fossil fuel consumed by the diesel engine (ton)</td>
<td>Daily fuel flow quantity monitoring.</td>
</tr>
<tr>
<td>EF</td>
<td>Emission factor of fossil fuel used for the diesel engine (kgCO_2/TJ)</td>
<td>Use of default values.</td>
</tr>
<tr>
<td>NCV</td>
<td>Net calorific value of fossil fuel used for the diesel engine (TJ/kg)</td>
<td>Use of default values.</td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions
With a 4MW hybrid power generation plant, assuming a capacity utilization for the PV power generation system on Nias island of 15.39% and an EF of 0.7 tCO_2/MWh (in accordance with calculations provided by Wärtsilä), a reduction in GHG emissions of 7,243 tCO_2/year is forecast.

(7) Verification of GHG Emission Reductions
Based upon the MRV methodology as outlined herein, an on-site investigation has confirmed that the required third party verifications will be able to be performed. As implementing bodies, in addition to the Indonesian DOE, it is assumed that approximately 10 companies or other entities that perform ISO certification etc., will perform the verifications.

(8) Ensuring Environmental Integrity
It is necessary to take into consideration that the installation of PV panels and diesel engines, through acquisition of a large amount of land for private use, will have an impact on land development and will influence the use of bio-fuels (in particular palm oils) as fuels for the diesel engine used as a part of this system.

(9) Contribution to Sustainable Development in Host Country
Through expanding the electricity supply capacity on Nias Island, attracting factory rollouts by both Indonesian and foreign companies through improvements in electricity quality and also through the use of bio-fuels creating employment opportunities on local plantations, this project will indeed contribute to local development.

3. Toward Implementation/Future prospects and issues
- A government grant is necessary for the purpose of obtaining CO_2 reductions, because the initial cost of the hybrid system is high since it uses a diesel engine and a solar power system.
- To reduce the usage of fossil fuel, the Indonesian Government does not allow the installation of additional diesel engines, except to replace old engines in order to improve efficiency.
- Requiring too high a power quality level may cause an increase of initial cost due to the large amount of batteries needed. Hereafter, we need to discuss with PLN about quality requirements and operational guidelines.
- Most importantly, the people of Nias Island strongly support the installation of the hybrid system to improve their standard of living.
JCM/BOCM Feasibility Study
“Prevention of Peat Degradation through Groundwater Management, and Rice Husk-based Power Generation”

By Shimizu Corporation

1. Description of Project/Activity
The purpose of the project is to restore groundwater levels, inhibit aerobic decomposition of peat that has been dried as a result of manmade drainage, and reduce CO₂ emissions in Jambi, Sumatra, through water level controls by such means as improving existing water gates and canals. The resulting increase in groundwater levels is expected to result in increased rice production.

2. Results of the study
(1) Eligibility Criteria for MRV Methodology Application
Case 1: This project controls groundwater levels for rewetting of peatlands by technical methods (installation of gates in canals and so forth) in tropical peatlands where manmade drainage was implemented prior to January 1, 2014
Case 2: The project site is tropical peatlands located at an altitude lower than 100m in the Republic of Indonesia, where thickness of peat should be more than 0.5 m in average
Case 3: The project area includes singular or multiple complete watersheds. It is clear that the project area has no hydrological relation to peatlands located outside of the project boundary, or if a relationship does exist, it exerts no adverse impact on the environment or local citizens
Case 4: It can be demonstrated that the peatlands inside the project area are influenced by drainage (for example, there is data indicating groundwater level lowering and/or peat subsidence)
Case 5: The reference groundwater level should be able to be evaluated with a hydraulic model, and groundwater levels during the project should be evaluated either by the hydraulic model or measurements
Case 6: The project implementation shall not cause additional nature destruction

(2) Reference Scenario and Project/Activity Boundary
BaU is adopted as the reference scenario on the basis that non-conservation of peatland will continue if the project is not implemented. The project boundary is the hydrologically and administratively defined delta formed between the Batang Hari and the Berbak Rivers.

(3) Calculation Method Options
No calculation options are considered for the peatland rewetting methodology.

(4) Default Value(s) Set in MRV Methodology
The methodology requires a peat decomposition emission factor to calculate CO₂ emissions from peat decomposition in relation to groundwater level. The plan for the present project is to use the value determined by the Indonesian Government. If the Indonesian Government does not determine a value, the default value should be
determined based on the latest edition of the IPCC Guidelines, or the latest peer-reviewed papers on tropical peat decomposition.

(5) Monitoring Methods
The following parameters shall be monitored.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Area of plot, where hydrology and peat conditions can be assumed uniform</td>
<td>Determined at the start of the project with a map made based on land survey and/or satellite data, and updated at least at the timing of each Verification.</td>
</tr>
<tr>
<td>PWT</td>
<td>Mean annual water level during the project implementation</td>
<td>Determined based on measurements or calculation with a hydraulic model confirmed with groundwater level measurements with RMSE less than 10cm.</td>
</tr>
<tr>
<td>DP</td>
<td>Mean annual peat depth</td>
<td>Peat depth of each plot shall be measured before project implementation. During project activity, peat depth shall be measured at the timing of each Verification, and DP can be determined assuming its change rate to be constant.</td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions
The conditions for the calculations are as follows; approximately 100 plots, each measuring 100 ha and surrounded by canals, on the site, and a rise in the annual average water level on each plot from GL-0.6 m to GL-0.3 m. The emission factor for emissions of CO₂ from peat decomposition is set to be EFPEAT-CO₂ = 69 tCO₂/ha/y/m based on Hooijer et al. (2012). Emissions of N₂O and CH₄ arising from the rise in water level, and increased rice cultivation are conservatively considered to be the maximums (using the emission factor given in the first order draft of the IPCC 2013 Guidelines referred to in 4(5)). Based on the above, the reduction potential of the 10,000 ha project site when the groundwater level is raised 0.3 m, is calculated to be 167,000 tCO₂/year. The emission reduction potential of the host country if the project/activity is expanded may be similarly estimated as follows. Assuming that one third of developed lowlands are peatlands, giving an area of 280,000 ha. The reduction of 167,000 tCO₂/y per 10,000 ha multiplied with 28, results in about 4.7 million tCO₂/y reductions.

(7) Verification of GHG Emission Reductions
As there are no local official organizations eligible for CDM Verification in Indonesia, a potential organization for JCM Verification was selected among those four ones. CDM Indonesia, which has been working for Validation/Verification of CDM under a Japanese DOE, was selected as trial executing organization for JCM Verification. Verification was conducted as follows; the Monitoring Report was made based on data taken in the pilot study area Plot-A (12 ha). The second version of the Peatland Rewetting Methodology developed in this study was applied, where groundwater levels (GWL) were determined by measurements (in the final 3rd version, GWL should be determined with a hydraulic model). Guidelines for Verification are those prepared by the Ministry of Environment of Japan. As Verification was the first experience for CDM Indonesia, communication was made for understanding concept of the process, and finally an appropriate Verification Report was submitted in which manual measurements of GWL was concerned for possible human error. As a conclusion, capacity building of organizations, which are interested to work as DOE for JCM, is necessary to facilitate JCM.

(8) Ensuring Environmental Integrity
The project/activity aims to restore groundwater levels through water management. Keeping groundwater levels in peatlands within -40 cm of the surface by means of appropriate water-level management should enable peat fires to be curbed as indicated in other studies (e.g., Osaki, 2011).

(9) Contribution to Sustainable Development in Host Country
Sustained water-level management on existing farmland, which has not been subject to such management, is highly likely to produce increased rice yields per unit of land area, thereby contributing to increased food production and improvements in rural living standards. Producing electricity by means of rice husk power generation contributes to renewable energy source increase, and at the same time increase soil fertility through use of burned rice husk ash as a soil stabilizer.

3. Toward Implementation/Future prospects and issues
Given the huge scale of CO₂ emissions from peatlands (around 1.0 billion tons per year), bilateral and multilateral frameworks must be urgently adopted to tackle them, and doing so requires that the value of emission reduction credits be determined. System design including public-private partnership and consistency with JCM/BOCM and NAMA, as well as the provision of finance by Japan, are also essential to implementation of the present project.
JCM/BOCM Feasibility Study

By Mitsubishi UFJ Research and Consulting

1. Description of Project/Activity
This project is implemented in Paduran Mulia Village, Central Kalimantan Province, Indonesia. The land use of the target site (Paduran Mulia Village) has changed into one that was strongly affected by human-caused factors, such as the building of drainage ditches and the impacts of large-scale forest fires (Figure.1). This study clarified the changes in land use, and identified those factors that greatly affected the changes in such use. The study brought into action the activities that lead to GHG emissions reduction and quantified the effect of such activities.

Figure 1. Land-use before project implementation (as reference scenario)

2. Results of the study
(1) Eligibility Criteria for MRV Methodology Application
Draft eligibility criteria are as shown below (Table 2 is in case on REDD+), which were created based on the situation in the target site and other peatlands.

Table 1. Eligibility criteria of REDD+ methodology

<table>
<thead>
<tr>
<th>Case</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>The project area can include forested wetlands. Peatland shall be defined as organic soils with at least 60% organic matter and a minimum thickness of 2 m.</td>
</tr>
<tr>
<td>Case 2</td>
<td>At project commencement, the project area shall include only land qualifying as “forest” for a minimum of 10 years prior to the project start date.</td>
</tr>
<tr>
<td>Case 3</td>
<td>The project area should be covered by middle resolution satellite images (e.g. Landsat TM) for at least 15 years before the start of the project. In addition, satellite images consist of over four times, and at least one image should be older than 10 years before the project.</td>
</tr>
<tr>
<td>Case 4</td>
<td>The project area can include different types of forest, such as but not limited to, old-growth forest, degraded forest, secondary forests, planted forests and agro-forestry systems meeting the definition of “forest” under definition of the most recent agreement of UNFCCC, or under definition of the most recent agreement of JCM/BOCM.</td>
</tr>
</tbody>
</table>

(2) Reference Scenario and Project/Activity Boundary
Reference levels for REDD+ were to be developed based on the results of forest monitoring and socio-economic surveys. In reflecting National Circumstances in the REDD+ reference level, as discussed at the UNFCCC, this survey needs to consider ways to reflect the impact of natural disturbances such as the large-scale forest fires that occurred across the island of Kalimantan in 1997 and 1998. We applied 2 methods; both Tier 1 using mean GHG emission values in the past, and Tier 2 using specific model considering National Circumstances. The boundary was classified into metes and bounds, carbon pools, and type of gas.

The reference level on biomass power generation systems was established by considering current electric
power systems, which is supplied by diesel-fired power plants, and will be continued in the future.

(3) Calculation Method Options
A multi-tiered calculation method would be preferable. Specifically, it is important to make calculation possible using default values (Tier 1 or Tier 2) in IPCC, in cases where site specific factors (Tier 3) are not available. We decided to take into consideration the features of various peatlands rather than those in Indonesia alone, so that the methodology can be widely applicable.

(4) Default Value(s) Set in MRV Methodology
It was decided that GHG emissions and removals by implementing REDD+ would be calculated using emission factors published in scientific literature and in the IPCC Emission Factor Database (EFDB), and by using its own parameters accumulated through implemented projects.

(5) Monitoring Methods
An application technology based on a Japanese large-area forest monitoring technology using LiDAR was used to monitor land surface dynamics of peatlands (changes in the amount of peat soil), in order to develop a method to estimate GHG emissions from peatlands. From this study, we quantified GHG emission from peat soil after forest fires as 35.12Mg/ha/yr. As for biomass power generation systems, proposed activities are an alternative of the current system. Therefore, GHG emission reduction is the same quantity as an alternative supply of electric power.

(6) Quantification of GHG Emissions and its Reductions
In case of REDD+, GHG emission reduction is quantified by difference between reference level and results of REDD+ activities in our target site,

Tier 1 on REDD: From applying the Tier 1 reference level of 4,221Gg-CO₂/yr, GHG emission reduction from 2013 to 2032 (20 years) was estimated as 42,207Gg-CO₂ (annual mean value: 2,110Gg-CO₂/yr).

Tier 2 on REDD+: In the case of Tier 2, we included effects on ENSO as National Circumstances. From applying Tier 2 reference levels, GHG emission reduction from 2013 to 2032 (20 years) was estimated as 62,213Gg-CO₂ (annual mean value: 3,111Gg-CO₂/yr).

Biomass power generation system: GHG emission reduction by introducing biomass power generation system was 101.8Gg-CO₂ in 2015 and 136.4Gg-CO₂ in 2030. GHG emission reduction from 2013 to 2032 (20 years) was estimated as 389,080Mg-CO₂ (annual mean value: 19,454Mg-CO₂/yr).

(7) Verification of GHG Emission Reductions
It is difficult to assume a future verification system under UNFCCC. However, we analyzed verification systems from the various viewpoints of safeguard of REDD+, fund management and the situation of JCM/BOCM. In addition, this study would suggest that the User Friendly System of verification will be required to give incentive to stakeholders (including private-sectors) of REDD+.

(8) Ensuring Environmental Integrity
Curbing deforestation and forest degradation will lead to an improvement of the functions of the forest ecosystem, and is unlikely to have negative impacts of environmental integrity.

(9) Contribution to Sustainable Development in Host Country
REDD+ is expected to not only be a mitigation scheme, but also a way to contribute to the improvement of the lives of local and native residents dependent upon forest resources, as well as to the improvement of the conservation of biodiversity.

3. Toward Implementation/Future prospects and issues
Full-implementation of REDD+ from now on is also being coordinated with Palangkaraya University of Central Kalimantanan Province. Studies are being made based on the collaboration team, although trends in the JCM/BOCM have not been fully clarified at this stage.
1. Description of Project/Activity

The study aims at assessing the feasibility of two proposed projects in the waste management sector of Lao PDR with development of the MRV (Measurement, Reporting, verification) methodologies. These methodologies are user friendly for potential owners of the proposed projects on GHG emission reduction, and are based on the actual monitoring of key parameters for estimating the amount of GHGs emission in reference and project scenarios. The proposed projects assessed in this study are:

- Landfill Gas (LFG) capture, flaring and/or energy utilization from final disposal landfills of municipal solid waste
- Aerobic treatment of organic matters in municipal solid waste with mechanical biological treatment (MBT) technology.

2. Results of the study

(1) Eligibility Criteria for MRV Methodology Application

<table>
<thead>
<tr>
<th>Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>The project activity targets the municipal solid waste currently disposed at the final disposal landfills.</td>
</tr>
<tr>
<td>Case 2</td>
<td>The project activity does not store or treat the solid waste and product or any sub-products from the treatment process under anaerobic condition.</td>
</tr>
<tr>
<td>Case 3</td>
<td>The project activity does not result in the reduction of the amount recycled in the existing solid waste management system.</td>
</tr>
<tr>
<td>Case 4</td>
<td>If the project activity generates electricity, the source of power generation of which the energy sources are substituted by the project activity can be clearly identifiable, e.g. specific power plants/facilities, grid electricity, etc.</td>
</tr>
<tr>
<td>Case 5</td>
<td>If the project activity generates heat energy, the heat source (heat generation or plant) of which the energy sources are substituted by the project activity uses fossil fuels for heat generation.</td>
</tr>
<tr>
<td>Case 6</td>
<td>If the project activity generates heat energy, it will be utilized without any transport of LFG or heat by vehicles.</td>
</tr>
<tr>
<td>Case 7</td>
<td>The project activity does not use or transfer any facilities or equipment that are currently used for other activities.</td>
</tr>
<tr>
<td>Case 8</td>
<td>In the case of landfill gas capture/collection and flaring or energy utilization, the existing landfill must be improved to be operated as the controlled landfill.</td>
</tr>
<tr>
<td>Case 9</td>
<td>The project activity does not change the collection and transport of waste from the source to the final destination.</td>
</tr>
<tr>
<td>Case 10</td>
<td>All compost produced by the project is used as the soil cover at the landfill, where the project activity is carried out.</td>
</tr>
</tbody>
</table>

(2) Reference Scenario and Project/Activity Boundary

The reference scenario in relation to the proposed projects is defined as “Shallow uncontrolled landfill. The project boundaries are set for each proposed project as described in the table below respectively.

<table>
<thead>
<tr>
<th>Proposed Project</th>
<th>Project Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFG capture, flaring and/or energy utilization</td>
<td>Physical and geographical boundary of the project activity including the final disposal landfill where the LFG is captured, as well as all other facilities to flare and/or utilize LFG for energy purpose.</td>
</tr>
<tr>
<td>Aerobic treatment of organic matters in the municipal solid waste</td>
<td>Physical and geographical boundary of the project activity ranging from collection and haulage of waste, aerobic treatment, and utilization of produced compost. However, there will be no incremental emission of GHGs due to increased transport of waste or compost as far as the proposed project complies with the eligibility criteria 9 and 10. There is no leakage emission due to utilization or storage of compost under anaerobic condition, as all the produced compost is utilized as cover soil for the landfill after its complete decomposition.</td>
</tr>
</tbody>
</table>

(3) Calculation Method Options
(4) Default Value(s) Set in MRV Methodology
The default values set in this methodology are as follows:
- Grid emission factor
- Emission factors of fossil fuels consumption (by types)
- Methane correction factor (MCF) by types of landfill operations
- Amount of waste disposed per year (fixed)
- Amount of waste by types (fixed)

(5) Monitoring Methods
LFG capture, flaring and/or energy utilization

<table>
<thead>
<tr>
<th>Monitoring item</th>
<th>Monitoring method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of methane in LFG flared and/or used for energy purpose by the project</td>
<td>Gas flow meter, Methane</td>
<td>Continuously</td>
</tr>
<tr>
<td>activity (tonCH₄/yr)</td>
<td>meter</td>
<td></td>
</tr>
<tr>
<td>Amount of electricity substituted by LFG-based power generation (MWh/year)</td>
<td>Electricity meter,</td>
<td>Monthly</td>
</tr>
<tr>
<td></td>
<td>Electricity bill</td>
<td></td>
</tr>
<tr>
<td>Amount of heat substituted by LFG-based heat production (TJ)</td>
<td>Flow meter, Calorimeter</td>
<td>Continuously</td>
</tr>
<tr>
<td>Electricity consumption by the project activity (MWh)</td>
<td>Electricity meter,</td>
<td>Monthly</td>
</tr>
<tr>
<td></td>
<td>Electricity bill</td>
<td></td>
</tr>
<tr>
<td>Fossil fuels consumption by the project activity (TJ or volume or mass)</td>
<td>Fuel purchase receipt,</td>
<td>Monthly</td>
</tr>
<tr>
<td></td>
<td>Calorimeter</td>
<td></td>
</tr>
</tbody>
</table>

Aerobic treatment of organic matters in the municipal solid waste

<table>
<thead>
<tr>
<th>Monitoring item</th>
<th>Monitoring method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity consumption by the project activity (MWh)</td>
<td>Electricity meter</td>
<td>Monthly</td>
</tr>
<tr>
<td>Fossil fuels consumption by the project activity (TJ or volume or mass)</td>
<td>Fuel purchase receipt,</td>
<td>Monthly</td>
</tr>
<tr>
<td></td>
<td>Calorimeter</td>
<td></td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions
<Estimation results of GHG emission reduction by the proposed projects>
LFG capture, flaring and/or energy utilization

<table>
<thead>
<tr>
<th>Option of reference scenario</th>
<th>Estimated GHGs reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Shallow uncontrolled landfill</td>
<td>3,400 tonCO₂/yr</td>
</tr>
<tr>
<td>(2) Deep uncontrolled landfill</td>
<td>7,000 tonCO₂/yr</td>
</tr>
</tbody>
</table>

Aerobic treatment of organic matters in the municipal solid waste

<table>
<thead>
<tr>
<th>Option of reference scenario</th>
<th>Estimated GHGs reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Shallow uncontrolled landfill</td>
<td>5,714 tonCO₂/yr</td>
</tr>
<tr>
<td>(2) Deep uncontrolled landfill</td>
<td>17,040 tonCO₂/yr</td>
</tr>
</tbody>
</table>

(7) Verification of GHG Emission Reductions
No suitable third party verifier is yet identified. The National Authority of Science and Technology (NAST) of Lao PDR may have the potential capacity to conduct verification with considerable experience in standardized monitoring activities, and calibration of monitoring equipment.

(8) Ensuring Environmental Integrity
No serious negative environment impact is identified. Minor potential impacts such as emission from flare stack in the case of LFG capture and flaring, and offensive odors by aerobic treatment of waste will be properly addressed by the proposed projects.

(9) Contribution to Sustainable Development in Host Country
The study is fully compatible with the current policy of climate change and waste management in Vientiane Capital.

3. Toward Implementation/Future prospects and issues
If a financial assistance under JCM/BOCM becomes possible, and the methane emission from the landfill in the reference scenario can be established under the sanitary controlled landfill, aerobic treatment of waste with MBT technology may become financially viable. It is a critical issue to examine the possibility of establishing and authorizing such policy-based reference scenarios of landfill operation in Lao PDR.
JCM/BOCM Feasibility Study
“Introduction of Electronic Gate to International Trade Port to Improve Port-related Traffic Jam”

By Chuo Fukken Consultants

1. Description of Project/Activity
The Port Authority of Thailand (PAT), which is the administrator of Bangkok Port, plans to implement comprehensive environmental improvement measures at Bangkok Port in order to reduce GHG emissions through short-, medium- and long-term measures in stages. At present, PAT is working on electronic conversion of gates as a part of their comprehensive environmental improvement measures. In this study, we developed the MRV methodology centering on the following two measures:

- Measure 1: Electronic conversion of gates (introduction of E-gates)
- Measure 2: Promotion of E-gate utilization

By electronic conversion of gates, the processing time at the gates will be reduced, thus eliminating traffic congestion caused by freight trucks waiting at gates for loading or unloading at Bangkok Port, and also reducing idling GHG emissions.

2. Results of the study
(1) Eligibility Criteria for MRV Methodology Application
Condition 1: Introduction of the project or activity in the boundary will improve traffic flow and reduce GHG emissions.
Condition 2: Activities encouraging vehicles not to idle while stopped are not currently carried out in the host country.
Condition 3: [Only for Measure 1] E-gates will be newly introduced into the port.
Condition 4: [Only for Measure 2] E-gates are already in use and there are no dedicated lanes for vehicles without an E-card.

(2) Reference Scenario and Project/Activity Boundary
Reference Scenario
Measure 1: Electronic conversion of gates (introduction of E-gates)
Measures to improve the efficiency of gate processing, such as E-gates, are not introduced at all gates until the end of the credit period.
Measure 2: Promotion of E-gate utilization
The situation in which only some companies use the introduced E-gates continues (small- to medium-sized transport companies continue to use paper document processing).

Project/Activity Boundary
Vehicles passing through the gates of Bangkok Port (freight trucks and passenger cars) are covered. The geographical boundary is both the East and West gates.

(3) Calculation Method Options
Option 1: Using the “Queuing model”
A simple method in which GHG emissions can be calculated by only monitoring the total number of
vehicles going IN/OUT of the gates per day (by vehicle type). Option 2: Monitoring (only when implementing the project/activity)
The waiting time for each vehicle is monitored, and the GHG emissions upon implementing the project/activity are calculated from the monitored values.

(4) Default Value(s) Set in MRV Methodology
Default value set in MRV methodology is as shown in Table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idling CO₂ emission coefficient (CO₂ emission/hr. by vehicle type)</td>
<td>Vehicle emissions measured by the Pollution Control Dept. (PCD) were analyzed, and default values in Thailand were set up. The average value was used as the emission coefficient.</td>
</tr>
</tbody>
</table>

(5) Monitoring Methods
Option 1 for monitoring methods is a simple method that applies to the second year and after.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitoring Method</th>
<th>Monitoring Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of vehicles (by vehicle types) going through gates in one day</td>
<td>Traffic survey at the gates</td>
<td>Traffic survey shall be conducted only on one day/yr.</td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions
Emission reductions are calculated from specific reference emissions and project emissions. Here, reference and project emissions are calculated by the following formula:

\[
\text{Emission Reduction } y = \text{Reference Emission } y - \text{Project Emission } y - \text{Leakage Emission } y
\]

\[
\sum \left( \text{average waiting time (h/vehicle)} \times \text{average number of vehicles waiting (vehicle/day)} \right) \times \text{CO₂ emission coefficient per hour of idling by vehicle type (tCO₂/h)}
\]

Table 3: GHG emission reduction (t/CO₂/yr.) for Measure 1 and 2

<table>
<thead>
<tr>
<th>Reference Scenario</th>
<th>Project/Activity implementation</th>
<th>Reduction Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.13</td>
<td>4.08</td>
<td>46.05</td>
</tr>
</tbody>
</table>

(7) Verification of GHG Emission Reductions
In this study, the project-specific values, monitoring values and emission reduction amount are considered for the third-party verification that requires evidences as follows: 1) monitoring report, 2) information on the validity of the monitoring period, 3) information on screening of the monitoring results, 4) information on the method of applying the queuing model, and 5) information on calibration of the measuring instruments.

(8) Ensuring Environmental Integrity
Studies on environmental impact (air pollution, noise, vibration, etc.) have been conducted around Bangkok Port, and environmental integrity is ensured by reflecting the evaluation results on project planning.

(9) Contribution to Sustainable Development in Host Country
In addition to short-term measures for traffic at the gates, by developing the basis of the MRV methodologies for mid- to long-term measures regarding peripheral traffic and environmental measures, project implementation will progress smoothly in the future. This will contribute greatly not only to the reduction in GHG emissions, but also the sustainable development of the host country by eliminating traffic congestion around Bangkok Port and improving the air environment.

3. Toward Implementation/Future prospects and issues
Bangkok Port is working to attain integrated management by IT including E-gates, and aiming to complete the transition to the new system during 2013. However, there has been a delay due to bugs found during system development. Furthermore, there have been technical and human errors by workers in the department which had been using paper documents, indicating that there are many technical issues still to be solved. Similar problems are likely to occur if E-gates are introduced in other ports, and hence the introduction of port operation technologies utilizing IT systems, which is an area of specialty of Japan, will be inevitable. To develop the MRV system, measures such as capacity building through measurement and verification in the host country need to be implemented.
1. Description of Project/Activity

This project is to be implemented in the 3 food processing plants – 2 tapioca plants and 1 beer plant, located in the suburb of Hanoi, Hoa Binh Province and Bac Ninh Province, Vietnam.

Proposed technologies to be implemented:
(i) UASB: Removes organic substances and generates CH₄ effectively by anaerobic treatment of highly concentrated organic wastewater. It will mitigate offensive odors and reduce CH₄ emissions from anaerobic lagoons and discharged wastewater.
(ii) Micro cogeneration system: Generates electricity and heat using bio-gas generated from UASB. It will replace grid power and fossil fuel currently used in the plants, which will lead to CO₂ reductions.

![Figure 1: Project Outline](image)

2. Results of the study

(1) Eligibility Criteria for MRV Methodology Application

This methodology is applicable to projects that fully satisfy the following criteria.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To install high efficiency UASB and biogas generators and/or biogas boilers and/or biogas cogeneration systems.</td>
</tr>
<tr>
<td>2</td>
<td>To recover biogas from biogenic organic matter in waste water by high efficiency UASB. The COD removal efficiency of UASB is 85% or above.</td>
</tr>
<tr>
<td>3</td>
<td>The biogas that recovered through UASB should be used for electricity and/or heat generation. The biogas quality could be improved.</td>
</tr>
<tr>
<td>4</td>
<td>Unused biogas due to capacity or demand of the equipment should be released to the atmosphere after flaring.</td>
</tr>
<tr>
<td>5</td>
<td>The energy generated (electricity and/or steam and/or hot water) should be consumed at the project site (self-consumption) or supplied to grid.</td>
</tr>
</tbody>
</table>

(2) Reference Scenario and Project/Activity Boundary
The Reference Scenario is the scenario discharged from the effluent system, that should be used if this project is not implemented.

(3) Calculation Method Options
In this MRV methodology, calculation method options are provided. The options are chosen according to whether or not the actual measurement by measuring instruments is possible, both prior and after the project.

(4) Default Value(s) Set in MRV Methodology
Default values are shown in Table 2.

<table>
<thead>
<tr>
<th>CO₂ emission factor (electricity)</th>
<th>Private power generation: To be calculated using designated parameters. Grid power: Published value by Vietnamese Government.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂ emission factor (fossil fuel)</td>
<td>Published default value by Vietnamese Government or IPCC.</td>
</tr>
<tr>
<td>CH₄ correction factor</td>
<td>Published values in CDM methodology AMS-III.H.</td>
</tr>
<tr>
<td>CH₄ producing capacity</td>
<td>0.25 (IPCC)</td>
</tr>
<tr>
<td>Model correction factor</td>
<td>Published values in CDM methodology AMS-III.H.</td>
</tr>
<tr>
<td>CH₄ global warming potential</td>
<td>21</td>
</tr>
</tbody>
</table>

(5) Monitoring Methods
The simplest monitoring method in this MRV methodology only requires monitoring of the annual production output and generated electricity/steam/hot water after the project.

(6) Quantification of GHG Emissions and its Reductions
Estimated GHG emission reductions of the 3 plants are shown in Table 3.

<table>
<thead>
<tr>
<th>Plant</th>
<th>GHG reductions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tapioca plant A</td>
<td>Approx. 16,600 t-CO₂/year</td>
</tr>
<tr>
<td>Tapioca plant B</td>
<td>Approx. 9,400 t-CO₂/year</td>
</tr>
<tr>
<td>Beer plant</td>
<td>Approx. 400 t-CO₂/year</td>
</tr>
</tbody>
</table>

(7) Verification of GHG Emission Reductions
For cost reduction of the validation, its process should be as simple as possible. However, its accuracy must be secured. Especially when actually measured COD values, or other actually measured values or designed values are being adopted, its validity must be properly validated. Thus, the validation must be conducted by the third party validation entity familiar with water quality measurement and management.

(8) Ensuring Environmental Integrity
This project is to mitigate environmental pollutants, and so there are no controversial matters that could lead to new environmental pollution.

(9) Contribution to Sustainable Development in Host Country
Offensive odors, toxic gas (hydrogen sulfide), and air pollution by reducing fossil fuel consumption are expected to mitigated, and water environments in the surrounding areas such as rivers, lakes and ground water are also expected to be improved.

3. Toward Implementation/Future prospects and issues
According to this study, GHG emission reduction effect per investment cost does not increase drastically, if more than 20 cogeneration systems are to be implemented. When deciding the number of cogeneration systems to be implemented by this project activity, both global warming countermeasures and water quality improvement aspects must be carefully taken into account for the cost effective investment.
JCM/BOCM Feasibility Study
“Improvement of Vehicle Fuel Efficiency through Introduction of Eco-Drive Management System”

By Almec

1. Description of Project/Activity
The proposed program of activities targets the taxi operators in Hanoi, which have been rapidly increasing in the absence of adequate public transport means, and with accelerating urbanization and motorization. The promotion of eco drive activities aims to reduce fuel consumption and thereby improve profitability of taxi operation, while contributing to a reduction of GHG emissions by the taxi fleet. The project site is Hanoi Taxi, Inc., the leading member of the Hanoi Taxi Group (HTG), which is known to provide services of the highest quality in the city.

![Vehicle of HTG](image1)
![EMS (Smartphone)](image2)
![Eco-Drive Training](image3)

Figure 1: EMS device and Eco-Drive Training

2. Results of the study

(1) Eligibility Criteria for MRV Methodology Application
1) MRV methodology development is applicable to the proposed transport-sector program of multiple activities in which the taxi operation with distance-based fare system would be improved in fuel efficiency, with its GHG emissions reduced thereby.
2) MRV methodologies are applicable to internal-combustion engine vehicles (gasoline, diesel, gaseous fuels and biofuels), electric and hybrid cars.
3) The database of operated vehicle distance, vehicle occupancy rate and fuel consumption are well managed and available for analytical and monitoring purposes, or will be made available for such purposes.
4) The proposed program of activities expects to utilize the technical, manpower and financial supports from Japan.

(2) Reference Scenario and Project/Activity Boundary
The reference scenario is the continuance of the present taxi operation (vehicle type, fuel type, driving skills, dispatch method, fuel efficiency)
The Project Boundary is the following:
• The geographical boundary is the space encompassed by the administrative boundary in which the target taxi fleet is operated, namely Hanoi City.
• The physical boundary is the taxi fleet which will participate in the program of activities proposed for improving vehicle/fuel efficiency and transport efficiency.
• Emission calculation focuses on CO2. If gaseous fuels are used, CH4 will be included.

(3) Calculation Method Options

<table>
<thead>
<tr>
<th>Methodology 1</th>
<th>Vehicle/fuel efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methodology 2</td>
<td>Transport efficiency</td>
</tr>
<tr>
<td>Methodology 3</td>
<td>Combined efficiency</td>
</tr>
</tbody>
</table>

Option 1: Measurement of Target Taxis
The reference efficiency is measured before the start of project activities and is held constant throughout the project period.

Option 2: Rate of Improvement
The rate of improvement is determined on the basis of the field test conducted for one year before the start of project activities.

Option 3: Measurement of a Control Group of Taxis
A control group of taxis is designated, and the reference efficiency is obtained by regularly monitoring them throughout the project period.
(4) Default Value(s) Set in MRV Methodology
The default value for Option 2 of Methodology 1: The target taxi fleet is monitored before the start of project activities exactly like Option 1 of Methodology 1 to obtain the reference fuel efficiency. During the first year of project implementation, the target taxi fleet is monitored again to establish the rate of improvement vis-à-vis the reference efficiency.

(5) Monitoring Methods
Key parameters to be monitored and the procedure of monitoring are as follows.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitoring Method and Procedure</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDi,y: Vehicle Operated Distance (km)</td>
<td>1) The data are collected from the monthly operational reports of taxi companies 2) Or, monthly operated distance is outputted to the spreadsheet from the logs of odometers</td>
<td>Monthly</td>
</tr>
<tr>
<td>PFCi,x,y: With-Project Fuel Efficiency (L/km)</td>
<td>1) The basic data for fuel consumption are collected from monthly operational reports of taxi companies 2) Or, the fuel consumption is ascertained by checking the invoices of suppliers, and the operated kilometers are obtained by reading the logs of GPS and odometers</td>
<td>Monthly</td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions
Supposing that the number of taxis per population in Hanoi be applicable to the other major four cities, five cities have some 77,000 taxies plying their streets. If the eco drive activities are put into practice in all five cities, the expected emission reductions are shown below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Hanoi City Only</th>
<th>Vietnam (Five Cities)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE: With-Project Emissions</td>
<td>tCO2/y</td>
<td>85,860</td>
<td>367,290</td>
</tr>
<tr>
<td>RE: Reference Emissions</td>
<td>tCO2/y</td>
<td>95,400</td>
<td>408,100</td>
</tr>
<tr>
<td>ED: Emission Reductions</td>
<td>tCO2/y</td>
<td>9,540</td>
<td>40,810</td>
</tr>
</tbody>
</table>

(7) Verification of GHG Emission Reductions
Initial verification is carried out and a monitoring system is checked. Regular verification is carried out annually to check 1) procedure of monitoring plan, 2) serious errors or omissions of data 3) monitoring record which supports the amount of GHG emission reductions.

(8) Ensuring Environmental Integrity
The proposed program of activities is not expected to cause any serious environmental hazards and other adverse influences.

(9) Contribution to Sustainable Development in Host Country
The MRV methodology development by the present study focuses precisely on the issue of fuel shift. The fuel shift combined with the eco drive promotion will be very effective in energy conservation. The shift of gasoline and diesel to CNG will be made possible by fitting the existing vehicles with the apparatuses developed and manufactured in Japan. The integrated introduction and promotion of such hardware and eco drive activities would be assured of emission reductions, subject to the measurement, reporting and verification carried out in accordance with the MRV methodologies developed by the present Study.

3. Toward Implementation/Future prospects and issues
The present study proposed, as a JCM project, a bundle of eco drive activities. It considered the possibility of low-carbon vehicles which would have a much higher cost benefit ratio when introduced to the taxi fleet, and suggested a project scheme with its provisional operational entity, the EMS Center. It must be noted, however, that the suggested scheme would require a sizable capital outlay and some period of preparation. Instead of taking immediate steps towards the establishment of the Center, it is better, for the time being, to establish a procedure or an approach which will encourage self-governance of the taxi operators regarding eco drive activities.
JCM/BOCM Feasibility Study
“REDD+ through Forest Management Scheme, and Biomass-based Power Generation using Timber Industry Waste”

By Sumitomo Forestry Co., Ltd.

1. Description of Project/Activity
In Dien Bien Province, northwestern Vietnam, the project carries out forest preservation and revegetation activities combined with livelihood improvement measures. It quantifies the reduction in pressure on existing natural forest, and the increase in carbon accumulation by plantations and areas of revegetation in order to acquire emissions credits for reducing GHG emissions. Uses timber to be produced in the future as a result of this activity to engage in the timber processing business and biomass power generation, and reduce GHG emissions by using biomass to generate electricity instead of fossil fuels. The project will contribute to sustainable development in northwestern Vietnam, one of the country’s poorest regions, by helping to enhance forest functions of public benefit, such as cultivation of water resources, national land conservation, and biodiversity preservation.

2. Results of the study
(1) Eligibility Criteria for MRV Methodology Application
Forest Management Segment: 1 Forest preservation plans include activities in REDD+ scope; 2 Peatland not targeted; 3 Authority or permission for the project target area; 4 Distinguishable from A/R CDM etc.; 5 Safeguards; 6 Technology transfer and livelihood improvement measures.
Biomass Power Generation Segment: 1 Only biomass residues used as fuel; 2 Biomass residues obtained inside project boundary; 3 Little or no methane is generated; 4 No competition for biomass residues in surrounding regions; 5 Cogeneration systems not included. 6 Most recent emission factors for public power supply are used.

(2) Reference Scenario and Project/Activity Boundary
Forest Management Segment: Administrative boundaries shall be the boundary. The reference scenario assumes that forest management activities of this project are not implemented and that the current trend of forest depletion will continue.
Biomass Power Generation Segment: The project boundary shall be the power generating unit on the project site and regions/areas where the biomass residue originates, and shall also cover the crushing and transfer of biomass residue, as well as the transfer of fuel consumed for crushing and transport. The reference scenario assumes that public electricity supply is used and that GHGs are released from fossil fuels used to generate that electricity.

(3) Calculation Method Options
Forest Management Segment: Select from the following calculation approaches: 1) Default approach (DA) (without reference area); 2) Default approach (DA) (with reference area); 3) Unique approach. Biomass Power Generation Segment: Select calculation method according to whether or not fuel consumed in biomass
transportation is to be monitored.

(4) Default Value(s) Set in MRV Methodology
Forest Management Segment: Under the DA, methodologies and data officially established by local authorities (official methods) shall be used to calculate emission reductions resulting from national or sub-national level REDD+ activities.
Biomass Power Generation Segment: Official grid emission factors (t-CO2/MWh) for the target region and default CO2 emissions per unit of electricity production (t-CO2/MWh) for fossil fuels used in delivery can be used by default.

(5) Monitoring Methods
Forest Management Segment: Under the DA, forest distribution map data (land cover maps) and carbon stock data for the target year, as obtained by official methods, shall be the monitoring data.
Biomass Power Generation Segment: Monitor electricity production, electricity consumption and fuel travel distances, etc., using records or purchase slips.

(6) Quantification of GHG Emissions and its Reductions
Forest Management Segment: GHG emission reductions calculated based on a long-term vision for 2040. Under this scenario, project emissions will be zero; sequestration resulting from forest growth will be 46kt-CO2/yr; overall expected GHG emission reductions for forest management, after subtracting reference (emission) levels and leakage, will fall from 20 to 7kt-CO2/yr and a total of 425kt-CO2 by 2040.
Biomass Power Generation Segment: GHG emission reductions calculated using monitored values for 4MW biomass power generation. Calculated reductions, assuming truck transportation and on-site conveyance of biomass residues is required, are as follows:
Calculation method 1 (no transportation monitoring): Cal. method 2 (project unique values used):
ERt+ly = 8,729 – 686 = 8,043 (t-CO2/yr)          ERt+ly = 8,729 – 659 = 8,070 (t-CO2/yr)

(7) Verification of GHG Emission Reductions
The verification procedure shall be as follows. Step 1: Examination of formal requirements of the methodology. Step 2: Examination of validity of the methodology. Step 3: Examination of substantive requirements to be satisfied by the methodology.

(8) Ensuring Environmental Integrity
Forest Management Segment: The project activity will have few negative effects on the environment and will contribute greatly to environmental protection. However, compliance with domestic regulations and international guidelines relating to areas such as biodiversity and forest preservation and development is required. The contribution to biodiversity has been visualized.
Biomass Power Generation Segment: The introduction of facilities must comply with environmental standards and regulations.

(9) Contribution to Sustainable Development in Host Country
In addition to preserving the environment by increasing the area of forest through planting, and carrying out sustainable forest management, livelihoods of local residents will be improved. At the same time, a high value-added system for biomass use including power generation will be introduced, thus contributing to sustainable development in the host country.

3. Toward Implementation/Future prospects and issues
The prospects for full implementation of BOCM/JCM projects in northwestern Vietnam are that, through advancements in bilateral negotiations, collaboration with projects already being advanced, utilization of outputs, and continuation of study activities aimed at achieving synergistic effects, we will acquire information not yet obtained, make adjustments with communities and projects already being advanced, and advance other preparations and foundation-building for full implementation. Starting in 2013, we plan to implement demonstration projects (DPJ) with three-year terms.
JCM/BOCM Feasibility Study
“Promotion of Modal Shift from Road-based Transport to Mass Rapid Transit (MRT) System”

By Mitsubishi Research Institute

1. Description of Project/Activity
Introduction of a mass rapid transit (MRT) system to the three cities of Hanoi and Ho Chi Minh City (Vietnam) and Jakarta (Indonesia), which heavily rely on road-based transport systems such as motorcycles, automobiles, and buses, in order to reduce GHG emissions from such existing road transport systems through acceleration of the modal shift.

2. Results of the study
(1) Eligibility Criteria for MRV Methodology Application
Case 1 A project intended to introduce a mass passenger transport system
Case 2 A project using or planning to use non-private foreign capital, in part or in whole, for introducing a transport system

(2) Reference Scenario and Project/Activity Boundary
In the reference scenario, existing transport modes continue to be used without MRT being introduced. CO2 emission factor per person-kilometer and travel distance corresponding to access/egress zone are conservatively set to the lower limit of 95% confidence interval, and existing transport modes are assumed to achieve a 1% fuel consumption improvement annually.
The boundary covers (a) MRT zone (MRT station to MRT station) and (b) access/egress zones (departure point to MRT station, MRT station to destination).

(3) Calculation Method Options
Two methods are available for calculation:

<table>
<thead>
<tr>
<th>Option</th>
<th>CO2 emission factor (Reference scenario)</th>
<th>Access/egress zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Default</td>
<td>Default</td>
</tr>
<tr>
<td>2</td>
<td>Questionnaire survey after start of MRT operations</td>
<td>Questionnaire survey after start of MRT operations</td>
</tr>
</tbody>
</table>

(4) Default Value(s) Set in MRV Methodology
The applied default values and the basis for setting are shown in the table below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
<th>Basis for settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_{E,i,y}$</td>
<td>CO2 emission factor of fuel j [tCO2/ specific unit (e.g., l, Nm³)]</td>
<td>Diesel: 0.00279 tCO2/l, Gasoline: 0.00240 tCO2/l (to be updated annually)</td>
<td>Calculated using IPCC Guideline 2006 and other published documents</td>
</tr>
</tbody>
</table>
α Fuel consumption improvement factor [-] 1%/year (constant) Referred from CDM methodology “AM0031” and “ACM0016”.

\( \text{EF}_{\text{grid,y}} \) CO2 emission factor of grid power [tCO2/MWh] 0.5408 tCO2/MWh (to be updated annually) Based on published figures from MONRE

Loss,\( \text{y} \) Transmission and distribution loss in grid power [-] 10.1% (to be updated annually) Based on published figures from World Bank

(5) Monitoring Methods
The following shows the parameters, descriptions, and methods of monitoring under calculation option 1:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement Method (e.g.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( P_{m,n,y} )</td>
<td>Number of passengers between Station m and Station n [person/y]</td>
<td>Data recording IC cards Estimate based on fare revenues and number of passengers using a station</td>
</tr>
<tr>
<td>EC,( \text{y} )</td>
<td>Electricity consumption by MRT [MWh/y]</td>
<td>Electricity purchase slip</td>
</tr>
</tbody>
</table>

(6) Quantification of GHG Emissions and its Reductions
The following shows estimated emission reductions achieved by Hanoi Lines 1 and 2, Ho Chi Minh Line 1, and Jakarta North-South Line when calculation method option 1 is applied.

<table>
<thead>
<tr>
<th>Line</th>
<th>Reference emissions</th>
<th>Project emissions</th>
<th>Emission reductions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hanoi Line 1</td>
<td>92,466</td>
<td>54,199</td>
<td>38,267</td>
</tr>
<tr>
<td>Hanoi Line 2</td>
<td>69,434</td>
<td>27,855</td>
<td>41,579</td>
</tr>
<tr>
<td>Ho Chi Minh Line 1</td>
<td>144,669</td>
<td>55,990</td>
<td>88,678</td>
</tr>
<tr>
<td>Jakarta North-South Line</td>
<td>88,973</td>
<td>68,565</td>
<td>20,408</td>
</tr>
</tbody>
</table>

(7) Verification of GHG Emission Reductions
In option 1, the verification items are composed of (a) distance between stations (identification of the technique used to obtain the results), (b) number of passengers between stations (reliability verification of IC cards system), and (c) electricity consumption by MRT (verification of whether consumption other than MRT operation is included). In option 2, it is required in addition to option 1 to check entered values against those in the original questionnaire form. Abnormal values contained in the questionnaire survey results, problems with the questionnaire survey technique, and matters that need more attention would be solved if an appropriate methodology is determined. Then, there is no need to formulate specific techniques for each project.

(8) Ensuring Environmental Integrity
The project has environmental positive impacts on reduction in air pollutants (e.g. NOx, CO, HC, PM). And countermeasures have been implemented for major concerns such as emissions of dust and noise from the construction works, or vibration arising from MRT operation.

(9) Contribution to Sustainable Development in Host Country
Public transport systems are yet to be developed in the three cities, which mostly rely on automobiles. In addition, populations are growing in the cities. For these reasons, MRT will contribute to sustainable development by reducing air pollution and traffic congestion.

3. Toward Implementation/Future prospects and issues
Japan has decided to extend ODA loans for the four MRT projects addressed in this study, which are scheduled to start between 2017 and 2020. To start the project as scheduled, solving business-related issues (e.g. expropriation of land, acquisition of necessary financial resources, design risk) is required, as well as issues associated with the application of the JCM/BOCM (e.g. methodology approval by the Joint Committee, an additional study necessary to apply the methodology).