Reference material
(The 4th workshop material)
Needs and Positioning of the Action Plan

- Cambodia has been identified as a country which will be strongly affected by climate change due to global warming.
- With cooperation of international agencies, etc., the Cambodian government launched the Cambodia Climate Change Strategic Plan 2014-2023, as the first comprehensive national plan to respond to climate change issues in November 2013 (Phase 1). This was followed by Phase 2 (mid-term), where individual central governmental agencies established action plans (2015-2018). However, specific measures were not implemented and a specific project for the reduction of GHG is needed.
- Kitakyushu City concluded sister city accord with Phnom Penh City on March 29, 2016, and plans to provide technical cooperation in fields which are strong points of Kitakyushu City, such as environmental conservation, water supply and sewerage systems. As one specific approach, support in the formulation of the Phnom Penh City version of the action plan (Phnom Penh City Climate Change Strategic Action Plan), based on plans with higher priority, is carried out.
Positioning of Phnom Penh City Climate Change Strategic Action Plan

**Upper Level Plan (National Plan)**

**Rectangular Strategy for Growth, Employment, Equity, and Efficiency**
A comprehensive national strategy with the development goals of sustainable economic growth and reduction of poverty. Growth strategies in four fields (agriculture, private sector, infrastructure development, and human resource development) will be shown.

**National Strategic Development Plan (NSDP) 2014-2018**
Strategic plan for implementing the quadrilateral strategy. In order to balance development and Environmental Conservation, an action plan for the purpose of strengthening natural resources management is shown.

**National Adaptation Programme of Action (NAPA)**
Plans for countering immediate needs to adapt to climate change.

**Cambodia Climate Change Strategic Plan 2014 - 2023 (CCCS)**
The first comprehensive national policy document for the purpose of responding to the challenges of climate change, it shows strategic objectives and directions for 2014 to 2023.

**Climate Change Action Plan of Each Department (CCAP) 2015 - 2018**
Plans related to climate change.

**Reference:**
- Cambodia Climate Change Strategic Plan 2014-2023 (1/2)
- Cambodia Climate Change Strategic Plan 2014-2023 (2/2)

**Vision Goals Strategic Objective**

**Goal 1:** Reducing vulnerability to climate change impacts of people, in particular the most vulnerable, and critical systems (natural and societal).

**Goal 2:** Shifting towards a green development path by promoting low-carbon development and technologies.

**Goal 3:** Promoting public awareness and participation in climate change response actions.

**Reference:**
- Rectangular Strategy

**Immediate term (2013 – 2014)**
- Institutional and financial arrangements;
- Develop action plans (2014-2018) by concerned line ministries and agencies;
- Develop a Climate Change Financing Framework;
- Establish a national M&E framework;
- Develop a Climate Change Legal Framework.

**Medium term (2021 – 2018)**
- Establish a nationally accredited mechanism for the Adaptation Fund and Green Climate Fund;
- Research and knowledge management activities;
- Develop capacity;
- Mainstream climate change at various sectoral levels;
- Operationalize M&E and data management system;
- Increase the climate change finance for national and sub-national planning, budgeting and implementation modalities;
- Establish appropriate institution with sufficient capacity and full credibility for direct access to the Adaptation Fund and Green Climate Fund.

**Long term (2019 – 2023)**
- Scale-up successful pilots and carry on with the mainstreaming of climate change at national and sub-national levels;
- Increase the use of budget support for national programmes, including implementation of climate change response measures through sub-national administrations.
The Implementation of Phnom Penh Land Use Basic Plan

The Plan Name: The Implementation of Phnom Penh Land Use Basic Plan (Appendix of sub-decree No. 181)

Approval Authority and Date: Council Ministers Plenary Meeting on December 23, 2015

Target Year: 2035

Planned Population: 100 million people (These are 6 million people in zones covering areas approximately 100km from Phnom Penh)

Development Strategy:
Phnom Penh City will become a central city of social economic development in Southeast Asia by preserving her identity, environment, and international standard.
1. Central development base in Southeast Asia (Urban development corresponding to the rapid population increase)
2. City of the international quality standard
3. Improvement of important infrastructure (national highway, harbor, railroad, the airport and dryport)
4. Development preparations of the great city level (building of a network in a public space, a road and a green tract of land)
5. Patrimony of Special zone and city view (Development policy of each zone, Construction of sewage purification plants, new landfills, and incineration facilities, etc.)

Action Plan:

1. Dissemination of the development strategy
2. Crucial projects required urgent approval
   - Regulation and planning regarding public facilities, main roads, railway and drainage in suburban area
   - Setting location for railway station and dry port
   - International Railway project (Ho Chi Minh - Phnom Penh)
   - Expanding of Phnom Penh International airport
   - Constructing of Shone of Bassac River as development base
   - Setting the area where skyscrapers are led or restricted
   - Construction of new landfills and improvement of the existing landfills
   - Setting ecological area
   - Preservation and Development in the historical center area
3. Urbanization regulation of each area
4. Continued development activities and public investment

The Flow of Supporting to develop the Strategic Action Plan

<table>
<thead>
<tr>
<th>Items of Consideration</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Baseline Assessment</td>
<td>Collect data and resources for each field related to GHG emissions, understand the actual conditions, and clarify any issues involved.</td>
</tr>
<tr>
<td></td>
<td>Understanding items which should be considered, such as the plan with higher priority and legal regulations.</td>
</tr>
<tr>
<td>2) Formulation of Strategy</td>
<td>Based on the climate change strategy plan of the country, establish the vision of sustainable development in Phnom Penh City, specific numerical goals included GHG reduction, and indications to evaluate goal achievement, etc.</td>
</tr>
<tr>
<td>3) Detailed Policies and measures</td>
<td>To achieve the vision and goals described above, specific measures which should be worked on are determined, and their short, mid, and long term priorities should be considered.</td>
</tr>
<tr>
<td></td>
<td>For the projects which should be carried out in a short term, a pilot project is considered, as well as applicable operations such as JCM, the implementation system, GHG emission reduction effect, environment improvement effect, approximate costs, an operations schedule, etc.</td>
</tr>
<tr>
<td>4) Verification of the strategy and measures</td>
<td>Consider the feasibility, risk, appropriateness as verification and approaches for continuous improvement of the plan.</td>
</tr>
<tr>
<td>5) Ordering / fund procurement</td>
<td>To promote specific measures, consider the ordering / fund procurement method focusing on short and mid term projects, as well as the overall schedule for the measures.</td>
</tr>
<tr>
<td>6) Organization of the plan</td>
<td>Organize documents of the plan in a visually, easy to understand way.</td>
</tr>
</tbody>
</table>

The Plan Name: The Implementation of Phnom Penh Land Use Basic Plan (Appendix of sub-decree No. 181)
Baseline Assessment

Natural Condition/Temperature

- Mean Annual Temperature during 1951-2001 in Cambodia
  - Uptrend during 50 years
  - Source: Heng Chan Thoeun, Observed and projected changes in temperature and rainfall in Cambodia, Weather and Climate Extremes 7 (2015) 61–71

- Mean Annual Temperature during 2010-2013 in Phnom Penh

Climate Projection (CCCSP)
- Mean monthly temperature will increase between 0.013 and 0.036°C per year by 2099.
- Rice grain yield will decline by 10% for each 1°C increase in growing-season.

Mean Annual Temperature (Cambodia)

- In recent years, Temperature is higher level compared with before in 1990’s

Natural Condition/Rainfall

- Slightly decreasing trend
- Mean annual rainfall indicates an increase
- Rainfall will get higher in the provinces at higher elevation during wet season, but it will get drier during the dry season.
- The coastline is vulnerable to sea-level rises and the severe impacts of more frequent typhoon.
- Coastal zones would be affected by tropical cyclones while the central plains would experience seasonal flooding.

Climate Projection (CCCSP)
- Mean annual rainfall indicates an increase
- Rainfall will get higher in the provinces at higher elevation during wet season, but it will get drier during the dry season.
- The coastline is vulnerable to sea-level rises and the severe impacts of more frequent typhoon.
- Coastal zones would be affected by tropical cyclones while the central plains would experience seasonal flooding.

Mean Annual Rainfall during 2004-2013 in Phnom Penh


Climate Projection (CCCSP)
- Mean annual rainfall indicates an increase
- Rainfall will get higher in the provinces at higher elevation during wet season, but it will get drier during the dry season.
- The coastline is vulnerable to sea-level rises and the severe impacts of more frequent typhoon.
- Coastal zones would be affected by tropical cyclones while the central plains would experience seasonal flooding.
Because of the short time period in which the data was collected, the trend of the water level is not seen.

Impact of flood and drought on agriculture

- Based on data from the past 20 years, losses in production were mainly due to flooding (about 62%) and drought (about 36%).
- Floods have not always coincided with high rainfall in Cambodia. Most flooding occurs due to increased water levels in the Mekong River and Tonle Sap Lake between early July and early October.
- In the last 30 years, the most devastating floods were in 1984, 1996 and 2000. The 1984 and 2000 floods were due to increased water levels in the Mekong River, rather than heavy rainfall in Cambodia.
- Floods destroy infrastructure, including irrigation facilities, and can result in loss of life.

Socioeconomic Situation /Population

- The future population of Phnom Penh for 2016, 2020 and 2035 are forecasted in this study based on the population forecasts by the Ministry of Planning (MOP) in January 2011. However, the population forecasted by the Ministry of Planning was only confined to the old city area.
- In this study, the 2008 population census is also used to correct this shortcoming for estimating the future population of the city inclusive of the new city areas. The population of Phnom Penh City at 2012 which is the base year in this study, is set at 1.85 million. The population for the medium-term target year of 2020 is forecasted at 2.41 million and for the final target year of 2035, 2.87 million.

Socioeconomic Situation /GDP・Economic Growth

- GDP (Current Prices) Annual Growth Rate

- GDP (Constant Prices) Annual Growth Rate

- GDP Capital (Current Prices) Annual Growth Rate

Source: International Monetary Fund, World Economic Outlook Database, April 2016
Social infrastructure

- Road maintenance is insufficient, such as a discontinuous national highway, low road density and non-paved roads in the suburbs, etc. In addition, public transportation consists of only 3 bus routes and railway service has been suspended for the entire line. Because of this, traffic congestion in the capital is severe.
- There are four water purification plants and the population with water supply in the capital is about 85%.
- Daily life wastewater is released virtually untreated into waterways and ponds, so environmental pollution is progressing.
- Power is supplied mainly from Vietnam or diesel generators in the capital, and supplied to the capital via three substations, and power supply is unstable with power outages, etc. In addition, electricity prices are high compared to neighboring countries.
- In the capital, there is only one landfill. Due to rapid population growth and economic development, the landfill is filling up at a speed that far exceeds the plan.

Greenhouse Gas (GHG)

Estimated GHG emission from Energy sources (excluding biomass) (2000-2050)

<table>
<thead>
<tr>
<th>Year</th>
<th>Energy Transformation</th>
<th>Industry</th>
<th>Transportation</th>
<th>Household, Commercial</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>2.6</td>
<td>4.1</td>
<td>5.5</td>
<td>6.0</td>
<td>7.6</td>
</tr>
<tr>
<td>2005</td>
<td>13.2</td>
<td>10.3</td>
<td>11.6</td>
<td>14.0</td>
<td>17.1</td>
</tr>
<tr>
<td>2010</td>
<td>20.8</td>
<td>21.5</td>
<td>25.5</td>
<td>20.8</td>
<td>25.5</td>
</tr>
</tbody>
</table>


Current status and tasks

(1) General remarks
- The water supply adoption rate is about 85%, and development is progressing with it being possible to drink the water directly from the tap except for some areas. On the other hand, development of infrastructure such as roads, sewerage, waste management, etc. is delayed, and environmental pollution and public health are progressively getting worse. In order to improve the life of citizens, infrastructure development is urgently needed.
- Supplying power faces the challenges of power outages, voltage instability, etc. In addition, because electricity prices are high, the impact extends to the entrance of countries from abroad and economic activities of companies. The development of diverse power sources including renewable energy such as solar power, biomass power generation, etc. is necessary.
- In addition, since Phnom Penh is in a low-lying coastal area and is thus susceptible to the effects of rising water levels, it is desirable to actively introduce renewable energy and suppress emissions of greenhouse gases.
- It is necessary to suppress the energy demands, water demands, and greenhouse gas emissions that are expected to accompany future rapid economic development and population increases.
- As can be seen from the example of Kita Kyushu which has experienced green growth, it is possible to carry out environmental improvements while undergoing economic expansion, and in order to overcome severe pollution, sustainable development with harmony between the economy and the environment is necessary.

(2) Administration
- Part of the organization of the central government is incorporated into the Phnom Penh administration structure, so the chain of command has become more complex and in one aspect speedy administration operations have become difficult.
- For solving problems in the capital area, in addition to a top-down approach, a bottom-up approach based on proposals from the level of the person in charge is also important, and nurturing of personnel who can offer specific solutions is necessary.

(3) Company
- Although it is currently in the development stage focusing on light industry, in the future, nurturing of local industries to increase the industrial level and attracting overseas companies for the introduction of technology and knowhow is required.
- In particular, when evolving from light industry to heavy industry, pollution prevention measures and clean production efforts are necessary so that air, water, soil, etc. do not become contaminated.

(4) Citizens
- With the problem of waste becoming serious, raising the environmental consciousness level of citizens, promotion of garbage sorting and recycling, and prevention of illegal dumping is necessary.
- Air pollution and increases in CO2 are progressing because of traffic congestion due to automobiles and gasoline motorcycles, and a shift to public transportation use is required.
Formulation of Strategy

Vision of the Plan

The capital city of Phnom Penh will realize sustainable development by handling climate change wisely and becoming a model for an Asian environmental capital city.

Basic policy (1/3)

- **Waste field**: Reliable waste collection/proper treatment and construction of a resource cycle society and economy
  - Waste will be reliably collected and properly treated. In addition, a cyclic societal and economic system in which waste is reused as resources will be constructed, and development of recycling business is planned.
  - The occurrence of environmental problems due to waste will be thoroughly prevented and suppressed. Lifestyles and industrial structures/production activities which generate small amounts of waste will be achieved, and GHG from waste will be reduced.

- **Energy field**: Efficient use of energy and active utilization of renewable energy
  - The currently unstable power supply will be corrected, efficient energy utilization and energy conservation will be actively promoted, and GHG which are forecast to increase in the future will be reduced.
  - Renewable energy such as solar energy using the sunlight with which Phnom Penh is blessed, biomass, etc. will be actively promoted and at the same time a framework that can achieve both environmental and economic goals such as solar power generation business will be constructed.

Basic policy (2/3)

- **Transportation field**: High-convenience, low-carbon public transportation system
  - In order to improve traffic congestion and air pollution which has become a major problem from societal, economic, and environmental aspects, a highly convenient public transportation system using low-pollution vehicles will be developed.
  - Together with the development of hardware such as roadways, signal systems, etc., the software side such as a vehicle inspection system, exhaust gas restrictions, etc. will be enhanced, and these will be reliably implemented to relieve traffic congestion.

- **Waterworks/sewerage and rainwater drainage**: Expansion of drinkable waterworks area and thorough treatment of sewage and rainwater
  - Together with expanding the area where waterworks water can be drunk directly, sewage from households and offices will be properly treated to regenerate and create a good waterside environment free from water pollution.
  - Flooding of areas which are still subject to frequent flooding will be eliminated so that citizens can live safely. In addition, in order to maintain functions as the capital, infrastructure development such as rainwater drainage facilities, etc. will be promoted so that the flood damage risks due to the increasing frequency of heavy rains because of climate change can be reduced.
### Basic Policy (3/3)

- **Environmental conservation: Maintenance of an environment level suitable for an environmental capital city and coexistence with the natural environment**
  - Planning and comprehensive implementation of measures to reduce the negative impact of environmental problems (waste, sewerage, exhaust gas, noise, etc.) due to socioeconomic activities and maintain and improve the environmental level suitable for the environmental capital that Phnom Penh is aiming for.
  - Expansion of measures to preserve the natural environments of the capital, such as forests, green spaces, and wetlands, ensure biodiversity for inherent coexistence with the natural environment, and foster a sense of values for the Cambodian culture which has been carefully handed down.

- **Green production: Construction of low-carbon, environmentally friendly industrial structures**
  - Actively promote environmentally friendly production activities such as introducing cleaner production (production processes that efficiently use raw materials and energy and reduce environmental loads) with the aim of becoming low-carbon.
  - Planning the transition to environmentally friendly structures in agriculture and also in other industries.
  - Development human resources who will actively promote environmentally friendly societal and economic activities.

### Numerical Goals (Draft)

#### Numerical Goals (Draft)

Numerical goals in the table below were set referring to the numerical goals of Cambodia's Second National Communications (MoE, Nov. 2015) and various master plans and indicates of other cities.

<table>
<thead>
<tr>
<th>Items</th>
<th>Target Year</th>
<th>2017-2023</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG</td>
<td>Amount of emissions</td>
<td>7,149GgCO₂ (2025) (= BuU 9,601 - 2,452)</td>
<td>1,0313GgCO₂ (2025) (= BuU 14,043 - 3,730)</td>
</tr>
<tr>
<td></td>
<td>Reduction Amount</td>
<td>2,452GgCO₂ (26% reduction Compared to BuU)</td>
<td>3,730GgCO₂ (27% reduction Compared to BuU)</td>
</tr>
<tr>
<td>GHG</td>
<td>Amount of emissions</td>
<td>3,053GgCO₂</td>
<td>4,403GgCO₂</td>
</tr>
<tr>
<td></td>
<td>Reduction Amount</td>
<td>1,047GgCO₂</td>
<td>1,593GgCO₂</td>
</tr>
<tr>
<td>Waste Collection Rate</td>
<td>City Solid Waste: 90% or more Industrial Waste: 85% or more</td>
<td>City Solid Waste: 100% Industrial Waste: 100%</td>
<td></td>
</tr>
<tr>
<td>Waste Recycle Rate</td>
<td>City Solid Waste: 50% or more Industrial Waste: 85% or more</td>
<td>City Solid Waste: 95% or more Industrial Waste: 90% or more</td>
<td></td>
</tr>
<tr>
<td>Reduction Amount of GHG by Utilizing Renewable Energy</td>
<td>100.8GgCO₂ (2025)</td>
<td>99.9GgCO₂</td>
<td></td>
</tr>
<tr>
<td>Automobile Inspection Rate</td>
<td>50% or more</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Achievement Rate of the Exhaust Standard (Cars, bikes, etc.)</td>
<td>50% or more</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

### Basis for setting numerical goals (proposal) (1/4)

1. GHG emissions amount and reduction amount for the entire country

   For the numerical goals for the emissions amount and reduction amount for the entire country, it was decided to use the Total Baseline Emissions and Total Savings stated in Cambodia's Second National Communications (MoE, Nov. 2015)

   GHG emissions amount (numerical goal) = Total Baseline Emissions - Total Savings

   GHG reduction amount (numerical goal) = Total Savings

2. Phnom Penh GHG emissions and reductions

   Phnom Penh GHG emissions amount and reduction amount

   = Entire country GHG emissions amount and reduction amount × Income ratio (42.7%)²"
Cambodia’s Second National Communications (MoE, Nov. 2015)

Maximum reduction of CO₂ compared to baseline emissions

<table>
<thead>
<tr>
<th></th>
<th>Year</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Baseline Emissions</strong></td>
<td></td>
<td>6,533</td>
<td>6,987</td>
<td>7,551</td>
<td>9,601</td>
<td>11,599</td>
<td>14,043</td>
<td>17,075</td>
<td>20,848</td>
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<tr>
<td><strong>Energy Industries</strong></td>
<td></td>
<td>3</td>
<td>12</td>
<td>30</td>
<td>51</td>
<td>80</td>
<td>106</td>
<td>140</td>
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<tr>
<td>Grid Connection REEs</td>
<td></td>
<td>12</td>
<td>152</td>
<td>269</td>
<td>268</td>
<td>309</td>
<td>354</td>
<td>430</td>
<td>492</td>
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<tr>
<td>Grid Connection Auto Producers</td>
<td></td>
<td>21</td>
<td>61</td>
<td>61</td>
<td>41</td>
<td>21</td>
<td>0</td>
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<td></td>
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<td>Battery Charging Stations</td>
<td></td>
<td>51</td>
<td>21</td>
<td>61</td>
<td>61</td>
<td>41</td>
<td>21</td>
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<tr>
<td>Solar Power Plant</td>
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<td>50</td>
<td>85</td>
<td>193</td>
<td>285</td>
<td>354</td>
<td>443</td>
<td>557</td>
<td>702</td>
</tr>
<tr>
<td>Solar Home Systems</td>
<td></td>
<td>0</td>
<td>6</td>
<td>16</td>
<td>22</td>
<td>22</td>
<td>19</td>
<td>16</td>
<td>12</td>
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<tr>
<td>Solar Power Plant</td>
<td></td>
<td>50</td>
<td>85</td>
<td>193</td>
<td>285</td>
<td>354</td>
<td>443</td>
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<td>702</td>
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<tr>
<td>Solar Home Systems</td>
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<td>6</td>
<td>16</td>
<td>22</td>
<td>22</td>
<td>19</td>
<td>16</td>
<td>12</td>
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<tr>
<td><strong>Rice Husks for Electricity Generation</strong></td>
<td></td>
<td>27</td>
<td>67</td>
<td>167</td>
<td>417</td>
<td>445</td>
<td>463</td>
<td>481</td>
<td>498</td>
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<tr>
<td><strong>Energy efficiency end users</strong></td>
<td></td>
<td>22</td>
<td>55</td>
<td>138</td>
<td>344</td>
<td>592</td>
<td>797</td>
<td>1,002</td>
<td>1,264</td>
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<td><strong>Energy efficient buildings</strong></td>
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<td>50</td>
<td>85</td>
<td>193</td>
<td>285</td>
<td>354</td>
<td>443</td>
<td>557</td>
<td>702</td>
</tr>
<tr>
<td><strong>Sub Total Savings</strong></td>
<td></td>
<td>120</td>
<td>384</td>
<td>829</td>
<td>1,409</td>
<td>1,826</td>
<td>2,210</td>
<td>2,659</td>
<td>3,191</td>
</tr>
<tr>
<td><strong>% savings compared to Baseline</strong></td>
<td></td>
<td>2%</td>
<td>6%</td>
<td>11%</td>
<td>15%</td>
<td>16%</td>
<td>16%</td>
<td>16%</td>
<td>15%</td>
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<tr>
<td><strong>Transport Sector</strong></td>
<td></td>
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<td>6</td>
<td>15</td>
<td>37</td>
<td>92</td>
<td>229</td>
<td></td>
<td></td>
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<tr>
<td>Hybrid Cars</td>
<td></td>
<td>2</td>
<td>6</td>
<td>15</td>
<td>37</td>
<td>92</td>
<td>229</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Vehicle Inspection</td>
<td></td>
<td>62</td>
<td>154</td>
<td>192</td>
<td>238</td>
<td>297</td>
<td>369</td>
<td>461</td>
<td>574</td>
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<tr>
<td>Electric scooters and Bicycles</td>
<td></td>
<td>4</td>
<td>9</td>
<td>22</td>
<td>54</td>
<td>78</td>
<td>95</td>
<td>116</td>
<td>141</td>
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<tr>
<td><strong>Sub Total Savings</strong></td>
<td></td>
<td>66</td>
<td>163</td>
<td>216</td>
<td>298</td>
<td>390</td>
<td>501</td>
<td>668</td>
<td>944</td>
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<tr>
<td><strong>% savings compared to Baseline</strong></td>
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<td>1.2%</td>
<td>2.7%</td>
<td>3%</td>
<td>3%</td>
<td>3%</td>
<td>4%</td>
<td>4%</td>
<td>5%</td>
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<tr>
<td><strong>Other Sectors</strong></td>
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<td>7</td>
<td>17</td>
<td>39</td>
<td>96</td>
<td>136</td>
<td>160</td>
<td>170</td>
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<tr>
<td>Efficient Cookstoves, Biodigesters, Water Filters</td>
<td></td>
<td>3</td>
<td>7</td>
<td>17</td>
<td>39</td>
<td>96</td>
<td>136</td>
<td>160</td>
<td>170</td>
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<tr>
<td>Solar Lanterns</td>
<td></td>
<td>0.6</td>
<td>6.2</td>
<td>31</td>
<td>56</td>
<td>50</td>
<td>44</td>
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</tr>
<tr>
<td>Wind Water Pumping</td>
<td></td>
<td>0.0</td>
<td>0.4</td>
<td>3</td>
<td>5</td>
<td>9</td>
<td>11</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td><strong>Sub Total Savings</strong></td>
<td></td>
<td>4</td>
<td>14</td>
<td>51</td>
<td>100</td>
<td>155</td>
<td>181</td>
<td>218</td>
<td>260</td>
</tr>
<tr>
<td><strong>% savings compared to Baseline</strong></td>
<td></td>
<td>0.1%</td>
<td>0.2%</td>
<td>0.7%</td>
<td>1.0%</td>
<td>1.3%</td>
<td>1.4%</td>
<td>1.3%</td>
<td>1.1%</td>
</tr>
<tr>
<td><strong>Total Savings</strong></td>
<td></td>
<td>528</td>
<td>966</td>
<td>1,603</td>
<td>2,452</td>
<td>3,098</td>
<td>3,730</td>
<td>4,495</td>
<td>5,465</td>
</tr>
<tr>
<td><strong>% savings compared to Baseline</strong></td>
<td></td>
<td>9.5%</td>
<td>16.1%</td>
<td>21%</td>
<td>26%</td>
<td>27%</td>
<td>27%</td>
<td>26%</td>
<td>26%</td>
</tr>
</tbody>
</table>

**Source:** http://www.stat.go.jp/info/meetings/cambodia/e11f0mp1.htm

Annual Profit and Loss except Street Businesses by Provinces of Cambodia (2014)

The establishment profit of the whole establishment in the Phnom Penh city is outstanding in comparison with other states. (Phnom Penh city occupies 42.7% of the whole country)

**Distribution of the number of the Cambodian establishments (2011)**

**Distribution of the number of the Cambodian Persons engaged (2011)**
3. Waste collection ratio and waste recycling ratio
   The collection ratio for household solid waste in cities of the same scale as the future population of Phnom Penh (2020: 2,406,000 people; 2035: 2,868,000) is essentially 100%. Phnom Penh will work to also achieve a municipal solid waste collection ratio of 100% by 2035, and for the waste recycling ratio as well, they will work toward a ratio of more than 95%.

4. Renewable energy amount
   Cambodia’s Second National Communications (MoE, Nov. 2015) states the GHG reduction amount due to renewable energy for the entire country. This entire country GHG reduction amount was multiplied by the Phnom Penh income ratio (42.7%) to obtain the numerical goal.

   Table: GHG reduction amount (BaU ratio) due to use of renewable energy
<table>
<thead>
<tr>
<th>Item</th>
<th>Entire country CO2 reduction amount (GtCO2)</th>
<th>Phnom Penh CO2 reduction amount (GtCO2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Power Plant</td>
<td>2020</td>
<td>2035</td>
</tr>
<tr>
<td>Solar Home Systems</td>
<td>2020</td>
<td>2035</td>
</tr>
<tr>
<td>Mini and Micro Hydro</td>
<td>2020</td>
<td>2035</td>
</tr>
<tr>
<td>Biofuel</td>
<td>2020</td>
<td>2035</td>
</tr>
<tr>
<td>Solar Lamps</td>
<td>2020</td>
<td>2035</td>
</tr>
<tr>
<td>Wind Water Pump</td>
<td>2020</td>
<td>2035</td>
</tr>
<tr>
<td>Total</td>
<td>2020</td>
<td>2035</td>
</tr>
</tbody>
</table>

5. Public transportation utilization ratio
   The numerical goal is set referring to the target value of 30% by 2035 stated in the Cambodia Phnom Penh Urban Transport Master Plan (Dec. 2014).
   As a reference, the public transportation utilization ratio in cities of the same scale as the future population of Phnom Penh (2020: 2,406,000 people; 2035: 2,868,000) is around 40 to 70%.

6. Ratio of potable water direct from water supply taps
   The water supply system coverage (potable water) in cities of the same scale as the future population of Phnom Penh (2020: 2,406,000 people; 2035: 2,868,000) is essentially 100%.
   In Phnom Penh as well, they are working to achieve water supply coverage ratio of 100% (potable water supply ratio of 100%) by 2035.

Promotion system

1. Creation of a new organization for plan promotion
   Since this plan spans diverse themes and since cooperation and coordination with relevant agencies of the central government is necessary, a new organization (new department) for climate change and promoting this plan will be established to centrally oversee the promotion of this plan and carry out the creation of organizations that can consistently implement the plan.

2. Development of human resources with an eye on realizing an environmental capital
   Steady implementation of this plan requires a large number of personnel who are familiar with environmental policies. In order to realize becoming an environmental capital which is the aim of this plan and to become a model for the environmental policies of other states as the capital of Cambodia, the development of environmental policy professionals will be promoted in a planned and organized manner. The responsibility for this shall be a cooperative effort between the new department described above and the personnel management department.

3. Securing important financial resources for promotion of the plan
   Regarding important financial resources for plan promotion, not only will requests be made to the central government, private sector know-how and funds will be actively utilized through methods such as PPP (Public Private Partnerships), etc. from the viewpoint of environmental business development. In addition, by gaining approval of this plan as the formal plan of the capital, it can be utilized as the basis for receiving support from various international organizations. For this issue, the Finance Department shall take main responsibility, and shall cooperate with the new department in striving to secure financial resources.
Promotion system

4. Understanding trends in relevant state-of-the-art technologies and their applications

In order to improve and resolve the problems and issues faced by each sector, the new department shall gather information, application examples, etc. of relevant state-of-the-art technologies and work to understand their trends. Furthermore, it shall investigate applicable technologies and provide information to related organizations in a timely manner.

5. Providing and sharing of information

In order to carry out this plan more effectively and efficiently, the content of this plan and its progress status shall be made available to businesses, citizens, NGOs, NPOs, etc. by utilizing various media such as TV, the internet, etc. with the aim of providing and sharing of information. The main responsibility for this issue shall rest with the Public Relations and International Affairs Department, which shall work in cooperation with the new department.

Role of each principal

1. Government

(1) The government shall promote the development of infrastructure such as waste management, sewerage, roads, etc. which form the backbone of urban development, shall implement specific measures in each sector based on this plan in a planned and consistent manner, with the aim of achieving sustainable development for the realization of an environmental capital.

(2) The government shall fully explain to businesses and citizens the importance of environmental consciousness, shall make known the content, effects, and progress status of the measures positioned for implementation under this plan, and shall encourage the active participation and cooperation of businesses, citizens, etc.

(3) Furthermore, the government shall support the environmental protection activities (for example, cleanup activities in the capital, etc.) and environmental learning of businesses and citizens through provision of places, opportunities, funds, etc.

(4) The environmental improvement effects of measures which are relevant for businesses and citizens shall be publicized to businesses and citizens using examples of actual initiative results to promote their understanding in an effort to create an environment for obtaining further cooperation.

2. Businesses

(1) For businesses, it is necessary that they properly understand that their consumption of large amounts of energy and discharge of waste, exhaust gases, wastewater, etc. in their production activities leads to deterioration of the living environment of citizens and the natural environment.

(2) Therefore, businesses shall not just pursue economic benefits and efficiency in their production activities but shall also review their production processes in accordance with laws and regulations, and shall convert to production processes that minimize environmental loads as much as possible.

(3) The environmental consciousness of businesses shall in the end increase the value of products and the trust of society toward businesses, and lead to the sustainable development of businesses themselves.

3. Citizens

(1) For citizens, it is first necessary that they fully understand that their own daily activities and behavior have effects on their own living environment and the natural environment, in other words, that each individual citizen is part of the cause.

(2) With this awareness, they shall practice activities which will lead to improvements in public health and living environment (Eco Life) as citizens of an environmental capital, with their responsibility to pass down a good environment to future generations.

(3) Furthermore, citizens shall bear their fair share of costs (processing costs, etc.) related to waste disposal, rainwater/household wastewater treatment, etc. performed by public facilities.

- Eco Life
  1) Waste reduction, reuse, and recycling (Promotion of waste 3R)
  2) Utilization of ecological products and energy-conserving appliances.
  3) Practice of energy-conserving activities (saving power, etc.)
  4) Utilization of public transportation facilities such as buses, etc.
  5) Participation in environmental learning activities
  6) Urban cleanup activities
  7) Participation in volunteer activities such as environmental awareness, etc.
  8) Improving manners, etc.
Roles of each principal

4. Others (tourists, etc.)

(1) Recently, the number of domestic and international tourists and business visitors to Phnom Penh has been increasing, and economic activities are intensifying. On the other hand, the environmental loads from these activities have also been increasing, and it is necessary to reduce their effects as much as possible.

(2) In order to preserve the living environment, natural environment, and tourism resources of Phnom Penh, it is necessary to also ask visitors to bear some costs in the form of facilities fees or tourist taxes which will be used as financial resources devoted to infrastructure development, etc.

Tasks and Specific Measures by Field

Composition of specific measures

We propose the specific measures to be implemented to achieve the goals as follow.

<table>
<thead>
<tr>
<th>Field</th>
<th>Specific measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste</td>
<td>1. Reduction of final disposal volumes; 2. Administrative guidance to businesses; 3. Implementation of pilot project for waste sorting/recycling; 4. Establishment of &quot;Garbage bank&quot; for recycling; 5. Introduction of manifest system (industrial waste); 6. Development of Eco-Town projects (industrial waste); 7. Implementation of model project for proper treatment of hazardous waste + nurturing of human resources to spread proper treatment (government side); 8. Enhancement of legal system regarding hazardous waste; 9. Implementation of regeneration project at landfill sites such as landfill incineration disposal facilities, etc.; 10. Awareness-raising activities and human resource development</td>
</tr>
<tr>
<td>Energy</td>
<td>1. Energy conservation projects and projects for introduction of renewable energy targeting offices and commercial facilities; 2. Energy conservation projects and projects for introduction of renewable energy targeting public facilities; 3. Waste heat recovery power generation projects targeting factories; 4. Mega solar power generation projects; 5. Introduction of fixed-price purchasing system for renewable energy</td>
</tr>
<tr>
<td>Transportation</td>
<td>1. Introduction of public transport systems and development of transportation hubs; 2. Effective use of existing public transportation, such as railways and water transportation; 3. Road development; 4. Introduction of traffic management facilities; 5. Parking lot development; 6. Development of comfortable pedestrian space; 7. Driver education and traffic regulation enforcement; 8. Mobility management; 9. Increasing efficiency of logistics; 10. Measures against air pollution and vibration, or development of parks and green spaces in the city center for reducing CO2 emissions, etc.; 11. Roadway plan integrating water works development plan and waste recovery plan; 12. Establishment of appropriate transportation-related city organizations</td>
</tr>
</tbody>
</table>

Composition of specific measures

<table>
<thead>
<tr>
<th>Field</th>
<th>Specific measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterworks/ sewerage/ rainwater drainage</td>
<td>1. Introduction of metering equipment in the private water supply sector (suburbs); 2. Securing water sources and water quality preservation; 3. Introduction of energy-saving waterworks equipment and renewable energy; 4. Surface maintenance of sewers and early construction of sewerage treatment plants based on sewerage treatment master plan which is currently being compiled; 5. Strengthening of administrative guidance, clarification and proper operation of penalty regulations; 6. Urgent maintenance and improvement of rainwater drainage facilities; 7. Distributed wastewater treatment system development project</td>
</tr>
</tbody>
</table>
Tasks and Specific Measures by Field

< Waste Field >

Waste / Current status and tasks

- In 2012, Phnom Penh and CINTRI concluded a 49-year concession agreement for collection/transportation. As a city, Phnom Penh recognizes that there are areas where collection is not performed or where the collection service is insufficient. On the other hand, CINTRI emphasizes that the contract between the company and the city covers only those districts with paved roads and that the waste collection coverage is approximately 80%, with the remaining 20% being districts which have been newly absorbed into the city and in which the roads are not paved, so that such districts are not subject to the collection agreement. In order to solve this problem, the document exchanged between Phnom Penh’s 12 districts and CINTRI based on Ordinance 113 is not an agreement on collection/transportation, but the contents are related to garbage collection plans, road cleaning, and transportation methods, and only part of the authority is delegated to the districts.
- Based on the disposal amount at Dangkor Landfill, the only final disposal site in Phnom Penh, the amount of waste generated in the city in 2013 was 1,550 t per day, and it is estimated that by 2015 it will reach 2,000 t per day because of population increases and expansion of collection areas due to the transfer of some regions from Kandal State to the capital. The amount of generated waste has increased almost 2.5 times from the 800 t at the time the disposal site was established in 2009. This trend is expected to continue in the future, so reducing waste generation and reducing the amount brought to the disposal site is an urgent issue.
- Although sorting of waste is not done, for a fee Ejay (a valuable material recycling agent) will collect cans, bottles, PET bottles, etc. from the garbage put out on the side of the road in front of each house. However, when garbage brought to the disposal site was checked, not only are there vinyl materials and plastics in the mainly raw household garbage, but also fairly large amounts of cans, bottles, PET bottles, etc. mixed in.

Waste / Current status and tasks

- Under the “Ordinance concerning solid waste management in urban area”, waste would be separated into general waste and hazardous waste, and hazardous waste other than medical waste would be accepted solely by Salom Trading Company with the approval of the Ministry of the Environment. The actual situation of industrial waste treatment and disposal is not grasped, and ensuring traceability using a manifest system, etc. is important.
- The industrial structure of Cambodia is at the stage focused mainly on light industry and there is little industrial waste requiring sophisticated treatment, but it is important to not just perform treatment and disposal but also to promote utilization of emitted industrial wastes through industrial waste resource recovery and conversion to resources, such as conversion to fuel for cement plants, etc.
According to a survey by the United Nations University, the per-person generation of electrical and electronic waste (E-waste) in East Asia and Southeast Asia in 2015 was about 10 kg, but in Cambodia it was 1.10 kg and in Vietnam, 1.34 kg. The Cambodia government is expecting rapid increases in the future due to economic growth and in addition to starting work on formulating laws concerning E-waste, they are also taking measures to prohibit the importation of E-waste and the importation of used electrical and electronic equipment. However, treatment is performed mainly by the informal sector, and the current situation is far from proper treatment.

In 2008, the "Ordinance concerning medical waste management" was issued, and although the system is that hospitals and clinics would separate medical waste from garbage and store it for a certain period of time, and it would then be collected by the Red Cross, problems such as hospitals and clinics disposing of medical waste together with general garbage have also been found. In addition, there is no system for separation and collection of mercury-containing fluorescent lamps from general garbage, and there is also a fear of contamination of the final disposal site.

Although the cooperation of citizens is indispensable for promoting suppression of waste generation, recycling and reuse as resources, sorting and 3R, etc., educational activities are insufficient for citizens.

How to reduce household waste in Kitakyushu

New recycling system was carried out

1. Carried out plastic container recycling


   (2006)

2. Increased the price of designated garbage plastic bag.

   (Before 2006)

   (2006)

Waste reduction civil awareness appears

We achieved a reduction of over 30% in household waste.

We launched the waste management project in 2004 in Surabaya, Indonesia's second largest city with a population of three million. The project entailed proactive steps to encourage residents to compost the organic matter that comprises over half of Surabaya's total waste. As a result of the project, more than 20,000 households now have composting baskets and more households are separating their rubbish into different types, leading to a reduction of over 30% in annual volume of household waste.

Development of Waste management Project in Surabaya

Surabaya's streets today

Increased greenery in parks and along roads using compost

City in 2001

Streets overrun by garbage
Waste: Introduction of efforts in Kitakyushu

Social and Environmental Impact Caused by the Promotion of Composting Practices

- Composting the kitchen waste hygienically at each household.
- Recycling waste in a small unit in a collection box.
- Hypothetical composting of kitchen waste at each household.
- Flowers can be generated from the sale of compost, as well as plants and vegetables grown using compost. Job creation at composting centers.

Recycling of electrical and electronic waste (Nippon Magnetic Dressing Co., Ltd.)

Nippon Magnetic Dressing has developed technologies for the concentrated recovery of rare and precious metals (secondary treatment) from household waste electronic circuit boards, mobile phones, and small electronic devices, and started plant operations in Kitakyushu Eco-Town in May 2012. As part of this project, Nippon Magnetic Dressing imports waste electronic circuit boards from overseas with the aim to treat this waste with electronic waste in Japan.

India
In order to prevent the improper recovery of rare metals that may have adverse impacts on health and the environment, waste electronic circuit boards, such as computers, are imported to Japan which possesses proper advanced recovery technologies.

Viet Nam
Expansion of recycling of electrical and electronic equipment waste, such as mobile phones and computers that generate large amounts of waste due to the rapid introduction of new products.

Philippines
Installation of collection boxes in communities and large-scale commercial facilities in Cebu and Manila for small electrical/electronic household waste, such as cell phones, and implementation of collection projects with the participation of the public.

Recycling of electrical and electronic waste from India and Viet Nam are the first cases in the world under the Basel Convention.

Waste/Specific Measures (Draft)

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
<th>Implementing entity</th>
<th>Timing of implementation</th>
<th>Evaluation index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Creation of waste management master plan</td>
<td>A waste management master plan will be created in order to construct a waste management system consisting of sorting/reduction at household disposal level, collection/transportation, intermediate treatment, and final disposal and promote proper treatment of wastes from a comprehensive perspective.</td>
<td>PPWMD</td>
<td>Medium to long term</td>
<td></td>
</tr>
<tr>
<td>2. Improvement of collection/transportation</td>
<td>In order to perform management appropriate for collection of waste suppliers and transportation suppliers, delegation of authority is promoted to the ward, area without collecting and transporting waste is dissolved. The service to the metropolitan citizens is improved by these actions.</td>
<td>PPWMD</td>
<td>short-term</td>
<td>Waste Collection Rate</td>
</tr>
<tr>
<td>3. Implementation of model project for household garbage sorting/reduction</td>
<td>In order to promote sorting/reduction at the household disposal level, proper sorting of household garbage and popularization of raw garbage composting will be performed in a model district.</td>
<td></td>
<td>short-term</td>
<td>Same as above</td>
</tr>
</tbody>
</table>

※ Establishment of mechanism for employing waste pickers who make a living collecting valuable materials at composting centers or garbage banks. Such a system may lead to supporting the economic independence and preventing health hazards of waste pickers.

PPWMD: Phnom Penh Waste Management Division
Waste/Specific Measures (Draft)

<table>
<thead>
<tr>
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<th>Timing of implementation</th>
<th>Evaluation index</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Establishment of &quot;Garbage bank&quot;</td>
<td>In order to promote community-level separation and recovery of valuable materials such as PET bottles, cans, bottles, metals, plastics, etc. generated from households and other sources, a &quot;Garbage bank&quot; will be established.</td>
<td>PPWMD Private Company</td>
<td>short-term</td>
<td>Waste Recycle Rate</td>
</tr>
<tr>
<td>5. Introduction of waste power generation as intermediate treatment</td>
<td>For handing the increasing quantities of municipal garbage, there are limits to using landfill disposal alone, and in order to promote volume reduction through intermediate treatment, waste power generation projects will be introduced. There are methods for generating power using steam generated through waste incineration in a stoker furnace or utilizing methane gas generated by separating out raw garbage only, so investigations will be conducted for introduction of the most suitable facilities taking into consideration regional characteristics.</td>
<td>PPWMD</td>
<td>mid-long term</td>
<td>Disposal amount of Waste Amount of GHG reduction</td>
</tr>
<tr>
<td>6. Proper treatment at final disposal site</td>
<td>At the current Dangkor final disposal site, constant monitoring and proper treatment is performed to prevent environmental contamination from leached water, etc. Furthermore, in constructing the next disposal site, it will be changed to a sanitary landfill with the aim of reducing environmental impact.</td>
<td>PPWMD</td>
<td>mid-long term</td>
<td>Disposal amount of Waste Amount of GHG reduction</td>
</tr>
</tbody>
</table>

PPWMD: Phnom Penh Waste Management Division; MOE: Ministry of the Environment

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Waste/Specific Measures (Draft)

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<thead>
<tr>
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<th>Description</th>
<th>Implementing entity</th>
<th>Timing of implementation</th>
<th>Evaluation index</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Recycling of electrical and electronic waste (E-waste)</td>
<td>The country is urged to prepare laws regarding electrical and electronic waste (E-waste) to shift from informal sector handling to proper treatment and recycling of E-waste will be performed by businesses approved by the country</td>
<td>PPWMD Private Company</td>
<td>mid-long term</td>
<td>Waste Recycle Rate</td>
</tr>
<tr>
<td>8. Recycling of industrial waste</td>
<td>Together with utilizing industrial waste by converting it to fuel for cement plants, production of roadbed material from construction waste or fuel from sludge will also be performed to facilitate industrial cycles.</td>
<td>PPWMD Private Company</td>
<td>mid-long term</td>
<td>Waste Recycle Rate</td>
</tr>
<tr>
<td>9. Proper treatment of industrial wastes</td>
<td>In order to properly treat hazardous waste such as mercury-containing fluorescent lamps, businesses that can perform proper treatment of hazardous wastes will be nurtured.</td>
<td>MOE</td>
<td>mid-long term</td>
<td>Disposal amount of Waste Amount of GHG reduction</td>
</tr>
</tbody>
</table>

PPWMD: Phnom Penh Waste Management Division; MOE: Ministry of the Environment

---

Pilot Project in Waste Field (1)

Municipal waste reduction and recycling (Step 1)

- **Generation sources**
- **Municipal garbage**
- **Collection/ Disposal**
  - Formal sectors: CINTRI Co.
  - Informal sectors: Self-Help Groups, etc.
- **Disposal**
  - 2,000 t/day
- **Valuable substances**

Environmental organizations
- CDEP (Cambodian Education and Waste Management Organization)
- CSARO (Community Sanitation & Recycling Organization)

This project is intended to promote waste recycling and reduction in a model district under governmental guidance with the cooperation of residents and resident organizations. Therefore, the model district will be gradually expanded throughout the city.
1. In the model district, composting of household waste will be popularized through suitable sorting of municipal waste.
2. Distribution of household-generated compost shall also be an objective, and compost centers targeting markets, etc., which produce regular quantities of raw garbage will be constructed.
3. In local communities, garbage banks will be constructed to promote the sorting and collection of valuable substances such as plastic, cans, bottles, metals, etc., generated by households, etc.
Pilot Project in waste field (2)

Introduction of waste power generation for municipal waste (Step 2)

Project site (Dankao landfill: 30 ha)

- Location: Khan Dankao, Phnom Penh, Cambodia
- Raw garbage (Amount generated in the region: 2,000 t/day)
- Sun drying
- Sieve sorting
- Methane gas
- Electricity sales (66,831 MWh)
- External RDF
- Incinerator
- SH drying
- Infinite ash
- Final disposal landfill

- Final disposal site (operating)

- Gas reduction amount: 31,099 t CO2
- RDF (Supplementary fuel)
- Grid

The amount of generated waste has increased to nearly 2.5 times the 800 t amount at the time that the disposal landfill opened in 2009, and since this trend is expected to continue in the future, reducing the amount of generated waste together with reducing the amount of waste transported to the disposal landfill has become an urgent issue.

Because of this, focus has also been placed on a waste power generation project (with introduction of a 500 t incinerator as the first step) for intermediate waste processing to promote optimization of waste management with an integrated approach.

Energy / Current status and tasks

- Occurrence of power outages
  - Although the frequency of power outages in the city has decreased, in some regions power outages still occur frequently.
  - Although the frequency of the power outages in the PPSEZ has decreased to about once per month for about 10 minutes, problems are occurring in some factories. Tenant companies are strongly demanding the complete elimination of power outages.
  - In regions outside the PPSEZ where Japanese companies are operating, power outages occur frequently.

- Voltage instability
  - Problems with factory equipment are occurring due to the effects of power outages and voltage instability caused by insufficient supply capacity.

- High electric bill
  - Many businesses expanding into Phnom Penh metropolitan area view high electric bill as a problem.

Utilization of renewable energy

Although the government has plans to utilize renewable energy in order to secure diversified power sources, the efforts are from now on.

Tasks and Specific Measures by Field

< Energy Field >

Energy / Current status and tasks
Energy: Introduction of efforts in Kitakyushu

Collaborative environmental urban planning in Yahata-Higashida district

Next-generation urban planning will be promoted with both advanced urban infrastructure and environmental harmony enabled by redeveloping an immense former factory site.

Introduction of efforts in Kitakyushu

Energy:

Introduction of Energy Saving System in the Whole Region

Intensive introduction of system for two-way communication and control with the center, and corresponding HEMS and BEMS

Future generation gas station (1) for rapid charger for EV, with solar power generation and hydrogen station

Smart house (20 households) Smart office (5) Smart store (4) Smart school (4)

Regional energy saving station

Two-way communication and control

Smart factory (4) Smart streetlights (30) Smart rental bicycle station (3)

Introduction of Energy-saving System with all block functions

■ Kitakyushu

Collaborative urban planning—Livio

Low carbon traffic system

Active introduction of photovoltaic power generation

Saving Energy

Peak Integration

Whole Region

Minimization of energy use in the entire community

Roles and Form

- Expanding educational activities
- Improvement of energy use by the whole community
- Standardization of demand beyond the differences among buildings, businesses, etc.

Next-generation energy planning for a next-generation traffic system

Minimization of the impact of unstable new energy on core electric power

Maximization of the impact of stable new energy on core electric power

Roles and Form

- New energy for the system can be introduced into urban design
- Civilian use of factory energy

Total mobility managing system

Civilian use of factory energy

Higher evaluation by Stanford University and others as high-accuracy academically valuable data

Energy: Introduction of efforts in Kitakyushu

Introduction of Energy-saving System with all block functions

Roles and Form

- Expanding educational activities
- Improvement of energy use by the whole community
- Standardization of demand beyond the differences among buildings, businesses, etc.

Next-generation energy planning for a next-generation traffic system

Minimization of the impact of unstable new energy on core electric power

Maximization of the impact of stable new energy on core electric power

Roles and Form

- New energy for the system can be introduced into urban design
- Civilian use of factory energy

Total mobility managing system

Civilian use of factory energy

Higher evaluation by Stanford University and others as high-accuracy academically valuable data
Introduction of efforts in Kitakyushu

ESCO (Energy Service Companies)
ESCO companies comprehensively offer all points necessary to improve energy savings, including technology, equipment, human resources, and funding.

ESCO projects at The University of Kitakyushu

ESCO companies guarantee energy-saving effects (cost reductions, etc.)

Example of ESCO projects by businesses in Kitakyushu

Steel Memorial Yawata Hospital

ESCO projects by businesses

Murasakigawa My Town, My River Project

ESCO projects

Steel Memorial Yawata Hospital

ESCO projects

Murasakigawa Bashaku District Redevelopment

ESCO projects

Murasakigawa My Town, My River Project

ESCO projects

Environmental Symbiosis Urban Redevelopment (Riverwalk Kitakyushu)

Heat Island Measures for Downtown Kokura

View of Murasakigawa area

Riverwalk Kitakyushu

<table>
<thead>
<tr>
<th>Item</th>
<th>Major Heat Island Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promote use of unused energy</td>
<td>Heat pumps using river water (Riverwalk)</td>
</tr>
<tr>
<td>Promote greening on buildings</td>
<td>Roof top gardens (Riverwalk, etc.)</td>
</tr>
<tr>
<td>Promote greening in public space</td>
<td>Katsuyama Park improvement project</td>
</tr>
<tr>
<td>Promote measures for water use</td>
<td>Carry out a “water sprinkling campaign” using reclaimed sewage water</td>
</tr>
<tr>
<td>Promote creation of water and greenery network</td>
<td>My Town, My River Project Project to create avenues lined with flowers and greenery</td>
</tr>
<tr>
<td>Promote the use of an Urban Planning System</td>
<td>Use of porous asphalt pavement in Downtown Kokura</td>
</tr>
</tbody>
</table>

Energy saving effect of heat supply facility of Riverwalk Kitakyushu - 13.1%
**Energy/Specific Measures (Draft)**

<table>
<thead>
<tr>
<th>Classification</th>
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<th>Implementing entity</th>
<th>Timing of implementation</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1. Energy conservation projects and projects for the introduction of renewable energy targeting offices and commercial facilities</td>
<td>Increase the efficiency of energy utilization through implementation of energy conservation diagnosis and introduction of energy-saving equipment. In addition, the introduction of renewable energy such as solar power generation, etc.</td>
<td>Private Company</td>
<td>short-term</td>
<td>Amount of Energy reduction and GHG reduction</td>
</tr>
<tr>
<td>2. Energy conservation projects and projects for the introduction of renewable energy targeting public facilities</td>
<td>Carrying out the above projects at water treatment plants, schools, etc.</td>
<td>PPWSA</td>
<td>short-term</td>
<td>Same as above</td>
</tr>
<tr>
<td>3. Waste heat recovery power generation projects targeting factories</td>
<td>Waste heat power generation projects targeting cement factories, etc.</td>
<td>Private Company</td>
<td>short-term</td>
<td>Same as above</td>
</tr>
</tbody>
</table>

**Project Outline**

**Introduction of solar large power generation and high efficiency chiller for large shopping mall**

- **AEON mall Cambodia No.2**
- **International Consortium**

**Expected Effects**

- **Solar Power**: CO2 Reduction: 948.7[tCO2/year] High Efficiency Chiller: CO2 Reduction: 615.6[tCO2/year]

**Method for Raising Funds**

- Application of JCM scheme: Solar Power System; Subsidy rate 40%; High Efficiency Chiller System; Subsidy rate 50%

**Supporting MRV + PDD**

**EPC for Centrifugal Chiller**

**Solar PV System**

<table>
<thead>
<tr>
<th>Role</th>
<th>Co Participant Aeonmall (Cambodia) Co., Ltd.</th>
<th>AEON Mall Co., Ltd.</th>
<th>NTT Data Institute of Management Consulting, Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Consortium Agreement</strong></td>
<td><strong>Project Administration</strong></td>
<td><strong>Consulting, Inc.</strong></td>
</tr>
<tr>
<td></td>
<td>Implementation of Project</td>
<td>MBV for GHG emission reduction</td>
<td>Preparation of PDD, Registration of Project, etc.</td>
</tr>
<tr>
<td></td>
<td>Monitoring of GHG emission reduction, etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PPWSA**: Phnom Penh Water Supply Authority, **EDC**: Electricite du Cambodge


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**Energy/Specific Measures (Draft)**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>4. Mega-solar power generation projects</td>
<td>Mega-solar projects and solar heat utilization projects to take advantage of the sunlight conditions with which the country is blessed</td>
<td>Private Company</td>
<td>mid-long term</td>
<td>Same as above</td>
</tr>
<tr>
<td>5. Introduction of fixed purchase price system for renewable energy</td>
<td>Introduction of fixed-price purchasing system for the purpose of power supply diversification and popularization of renewable energy such as solar power generation, biomass power generation, etc.</td>
<td>EDC</td>
<td>mid-long term</td>
<td>Establishment of the system</td>
</tr>
</tbody>
</table>

**Pilot project in energy field(1)**

**Introducing solar large power generation and high efficiency chiller for large shopping mall**

- **AEON mall Cambodia No.2**

**Business Structure**

**International Consortium**

- **Representative Company**: AEON Mall Co., Ltd.
- **Co Participant AEONMALL (CAMBODIA)CO., LTD.**
- **NTT Data Institute of Management Consulting, Inc.**
- **EPC for Centrifugal Chiller**
- **Solar PV System**

**Expected Effects**

**Solar Power**: CO2 Reduction: 948.7[tCO2/year] High Efficiency Chiller: CO2 Reduction: 615.6[tCO2/year]
Pilot project in energy field (2)
Introduction of promotion of shift to low-carbon society through energy-saving measures, etc. targeting large hospitals

Assumed project (Khmer Soviet Friendship Hospital)

**Project overview (assumed)**
- With the Khmer-Soviet Friendship Hospital, which would be counted among facilities with large energy consumptions, as the assumed target, the feasibility of a JCM subsidized project is being investigated.
- Installation of solar panels on the hospital roof space (approx. 1,800 m²) is assumed.

**Expected effects (assumed)**
Based on rough estimation, the following effects are expected:
- Yearly Power Generation: approximately 250,000 kWh/year
- Yearly Electricity Cost Reduction: approximately 47,500 USD
- Yearly CO₂ Emission Reduction: approximately 160 tCO₂/year

**Funding procurement methods (assumed)**
- Based on rough estimation, initial cost is approximately 300,000 USD.
- It is assumed that around 30~40% of the initial cost is subsidized by JCM equipment subsidy project.
- As results of hearing with hospital, financing by themselves may be difficult.
- As one of the solution of initial cost, we started discussion with local bank using ESCO or lease scheme.
- After power generation is started, monthly lease fee which is commensurate with cost reduction by power generation will be paid by hospital to the bank

*Note that these figure are based on rough estimation. Detail design with PV panel manufacturer and EPC company are needed for actual project.

Pilot project in energy field (3)
Introduction of waste heat recovery power generation system for cement plant

Assumed project (CHIP MONG INSEE CEMENT CORPORATION)

**Project overview (assumed)**
- We conduct feasibility study of a JCM subsidized project for cement plant which have high potential for the CO2 reduction by using waste heat recovery power generation system.
- CHIP MONG INSEE CEMENT is a joint venture company of Chip Mong Group (CMG): 60% and Siam City Cement Company (SCCC): 40%.
- The plant will start production in mid Q4/2017.
- Around mid 2018, tendering exercise for suppliers of waste heat recovery (WHR) system will be stated.
- Commissioning of WHR system is expected in Q1 to Q2 of 2020.

**Expected effects (assumed)**
- Power generation of around 8MW of electrical power is expected.
- Yearly CO₂ Emission Reduction of around 30,000 tCO₂/year is expected.

**Funding procurement methods (assumed)**
- Initial cost of equipment would be financed by the cement company.
- It is assumed that 50% of the initial cost, as maximum, is subsidized by JCM equipment subsidy project.

Transportation/Current status and tasks

**Public Transportation**
- PPHC (Phnom Penh Public Transport Authority) and DPWT (Department of Public Works and Transport) have taken over the management of city buses with 3 routes currently being operated. However, private passenger cars, motorcycles or Remorque are still main players as travel modes due to the limited bus route network and bus fleet. Hence the mobility of citizens is still low. Especially, mobility-impaired people like ladies and the senior citizens.
- There are several ferry transport services in Mekong River on the east side of the city. However, access to the passenger jetties is chiefly by motorcycles, which is rather inefficient. An efficient, reliable and comfortable mode of transfer is very necessary. For this reason, public transport system should provide direct linkages to these ferry jetties.
- Currently, access to Phnom Penh International Airport is via the relatively low capacity travel modes of passenger cars, taxis and para-transits. In view of the future rapid growth of passengers, it is very necessary to begin preparing a public transport system that can provide efficient access to the airport with large travel capacity.

*Fig. Share of Phnom Penh International Airport Access Modes*
**Transportation/Current status and tasks**

**[Road Development]**
- Traffic conditions on roads in the city center deteriorate very rapidly such that, roads face serious space constraint while traffic demand increases exponentially.
- The continuity of several primary and secondary roads in the city is disrupted due mainly to geographical reasons such as presence of rivers and built-up areas.
- Road density in the suburban areas is low (City center: 12.2 km/sq. km and suburban area: 1.6 km/sq. km). Most of the existing secondary roads in these areas are not paved, making travels on such roads very difficult during the rainy season. Furthermore, widths of these roads are too narrow for the safe passage of two opposing vehicles.

**Traffic Management**
- While problems at many major intersections have been improved through the "Phnom Penh Urban Transportation Improvement Project", etc., there are still intersections (Chamkar Morn, Neang Kong Heang, Chrouy Changvar) where problems continue to exist.
- All signals in the city are isolated signals operating independently without coordination with neighboring signals. This type of signal operation becomes inefficient.
- There are a lot of drivers who don't obey traffic rules.
- In the Central Business District (CBD), there is currently a shortage of 12,000 parking spaces for motorcycles and another 6,000 spaces for cars.
- Pedestrian Walking Environment is very poor because sidewalks are often taken over by illegally parked vehicles or cafes as their outdoor terraces, or for the display of merchandise by shops or as planter areas due mainly to geographical reasons such as the presence of rivers and heavily built-up areas of the city. Freight trucks have to mix with the general urban traffic. As a result, its service and safety level are adversely affected.
- There are still some roads with narrow widths among the freight transport routes. Large and heavy trucks are thus forced to travel at very low speed.
- There is also no sufficient space for loading and unloading of freights by the trucks. Trucks are forced to do so by the road sides, causing severe interference to the traffic flows and creating hazardous situations for other road users.

**Freight Transport**
- The road surface along the trucking routes is badly damaged because of poor maintenance and management. As a result, trucks travel at low speed and safety level is not satisfactory.
- Freight transport facilities are located in the heavily built-up areas of the city. Freight trucks have to mix with the general urban traffic. As a result, its service and safety level are adversely affected.
- There are still some roads with narrow widths among the freight transport routes. Large and heavy trucks are thus forced to travel at very low speed.
- There is also no sufficient space for loading and unloading of freights by the trucks. Trucks are forced to do so by the roadsides, causing severe interference to the traffic flows and creating hazardous situations for other road users.

**Transportation Improvement Project**
- All signals in the city are isolated signals operating independently without coordination with neighboring signals. This type of signal operation becomes inefficient.
- There are a lot of drivers who don't obey traffic rules.
- In the Central Business District (CBD), there is currently a shortage of 12,000 parking spaces for motorcycles and another 6,000 spaces for cars.
- Pedestrian Walking Environment is very poor because sidewalks are often taken over by illegally parked vehicles or cafes as their outdoor terraces, or for the display of merchandise by shops or as planter areas due mainly to geographical reasons such as the presence of rivers and heavily built-up areas of the city. Freight trucks have to mix with the general urban traffic. As a result, its service and safety level are adversely affected.
- There are still some roads with narrow widths among the freight transport routes. Large and heavy trucks are thus forced to travel at very low speed.
- There is also no sufficient space for loading and unloading of freights by the trucks. Trucks are forced to do so by the roadsides, causing severe interference to the traffic flows and creating hazardous situations for other road users.

**Environmental and Social Considerations etc.**
- The rapid urbanization of suburban areas has caused a rapid decline of green areas. Meanwhile, in the city center, nature parks and green lungs are also decreasing, while emission of greenhouse gases such as the exhaust gases from vehicles is on the increase.
- Traffic volumes in the city are increasing year after year causing a serious deterioration of the air quality and elevated levels of vibration in the urban areas. There are still many factories located within the urban areas, and exhaust and other particulates emitted by vehicles coming in and out of these factories are also a major concern.
- There are areas in the suburbs still without water supply simply because there are no roads leading to these areas. Since development of water distributing pipe is closely related, it is necessary to coordinate with road development plans adequately.
- In suburban area that fee of collection waste can not be collected, waste is not collected sufficiently and illegal dumping to the sidewalk and drainage is found. Therefore, countermeasures against illegal dumping should be considered with road environment improvements integrally.
Super "No Car" campaigns

Promoting the use of public transportation

Eco-Drive

Gentle acceleration:
Saves ~9,860 yen (Reduces CO2 94 kg)

Driving with little acceleration/deceleration:
Saves ~3,460 yen (Reduces CO2 68 kg)

Stop accelerating early:
Saves ~2,130 yen (Reduces CO2 42 kg)

Idling stop
Saves ~2,040 yen (Reduces CO2 40 kg)

Short drives
Car sharing

Eco-cycling

Public transportation is convenient and can reduce CO2 emissions.

Economical and safe driving that anyone can do.

Improved fuel economy
• Reduced costs (economic benefit)
• Reduced CO2 (environmental effects)
• Reduced traffic accidents

Introduction of Urban Monorail: Japan's first urban monorail

Successful case of public transit-oriented development (TOD) leading to urban development along railways ~OECD Report~

- Reduced traveling time: Traveling time from Tokuriki, Shi area in Kokura Minami district to Kokura city centre has been reduced by approximately 30 minutes.
- Car traffic reduction/Traffic congestion moderation: After monorail has been introduced, car traffic in national highway of 322 has been reduced by 14,920 cars per day.
- Promotion of development along railway line: Promotion of site location for residential and commercial complex along monorail line/ Population growth/ Growth of employment population and merchandise sales etc.

- Transit Oriented Development or TOD is defined as a mixed-use residential or commercial area designed to maximize access to public transport, and often incorporates features to encourage transit ridership. A well planned TOD would turn a rail or bus station from a transport hub into an activity hub so that people could easily access the development by means of convenient public transport, in particular, railways or metros, for longer distance and by walking/cycling, if walkways and cycle network are provided.
Specific measures are in accordance with Comprehensive Urban Transport Plan in Phnom Penh Capital City (PPUTMP)

<table>
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<tr>
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<tbody>
<tr>
<td></td>
<td>1) Development of bus transportation • Position bus transportation as a short-term basic public transit system for Phnom Penh and enhance the route network • For the long term, develop a loop public transportation system and reorganize bus routes as feeder lines to the loop system • Create good urban areas through urban development centered on public transportation nodes, such as transit-oriented development, etc. • Develop car and bicycle parking lots at public transportation nodes to enable smooth transfers between public transportation facilities and cars, paratransit, bicycles, etc.</td>
<td>DPWT PPUD</td>
<td>short-term</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2) Development of railway systems • Develop a loop public transportation system and reorganize bus routes as feeder lines to the loop system.</td>
<td>DPWT PPUD</td>
<td>mid-long term</td>
<td>Number and Ratio of Public Transportation utilization</td>
</tr>
<tr>
<td></td>
<td>3) Development of transportation hubs</td>
<td>DPWT PPUD</td>
<td>mid-long term</td>
<td></td>
</tr>
</tbody>
</table>

DPWT: Department of Public Works and Transport, PPUD: Phnom Penh Urbanization Division

Comprehensive Urban Transport Plan in Phnom Penh

Inter-Regional Road & Ring Road

Legend
- Rehabilitation/Widening (Arterial Road)
- New Construction (Arterial Road)
- Rehabilitation/Widening (Collector Road)
- New Construction (Collector Road)
- Existing Road (Arterial Road)
- Existing Road (Collector Road)
- Proposed Grade Separation
- Flyover Completed / Under Construction

Source: JICA, PPUTMP Project Team December 2014
Specific measures are in accordance with Comprehensive Urban Transport Plan in Phnom Penh Capital City (PPUTMP)

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<tbody>
<tr>
<td>4. Introduction of traffic management facilities</td>
<td>1) Development of a traffic control system: Optimal control of traffic signals at intersections in the metropolitan area from the traffic control center to promote alleviation of traffic congestion. 2) Changing narrow streets to one-way streets (to ensure smooth passage) • Promote a change to one-way traffic in order to alleviate traffic congestion on narrow streets and reduce traffic accidents.</td>
<td>DPWT, JICA</td>
<td>short-term (2015 ~)</td>
<td>Travel Speed in main Road</td>
</tr>
<tr>
<td>5. Development of comfortable pedestrian space</td>
<td>• Promote the development of parking lots and restrictions on illegal parking to create spaces where pedestrians can walk in peace.</td>
<td>DPWT, PPUD</td>
<td>short-term</td>
<td>Illegal parking number in sidewalk</td>
</tr>
<tr>
<td>6. Mobility management</td>
<td>• In addition to hard measures, implement soft measures such as thorough driver education at time of license renewal, traffic manner PR, etc. to make the citizens themselves give more consideration to traffic congestion and environmental/health problems and promote a shift from the current overdependence on automobiles to the wise use of public transportation, bicycles, etc.</td>
<td>Police</td>
<td>short-term</td>
<td>The number of times carried out driver education</td>
</tr>
</tbody>
</table>

DPWT: Department of Public Works and Transport, PPUD: Phnom Penh Urbanization Division

DPWT: Department of Public Works and Transport, PPUD: Phnom Penh Urbanization Division
PPWSA: Phnom Penh Water Supply Authority, PPWMD: Phnom Penh Waste Management Division, MOE: Ministry of the Environment
You get profits with a fare of 2 dollars*

- Eco car attract tourists
- Inexpensive electric tricycle with Japanese quality
- Reduction of initial cost burden with subsidy from Japanese government (JCM Project)

* When you operate six times with a fare of 2 dollars a day
* We do not consider management of solar charging stations.
2. Project implementation structure

It is assumed that an international consortium of the representative businesses (Japanese companies) and the taxi company (Phnom Penh) will be formed and will operate the project.

- **International consortium**
  - Implementation of subsidized project (Equipment introduction, operation, etc.)
  - Monitoring of GHG reductions, etc.

**Co-Participants**
- **Taxi Company** (Phnom Penh)
  - Supervision of entire subsidized project (Equipment procurement, installation, commissioning, accounting management, etc.)
  - Implementation of subsidized project (Equipment introduction, operation, etc.)
  - Monitoring of GHG reductions, etc.

- **Representative business (Japanese Electric tricycle maker)**

**JCM equipment subsidies**
- Support based on the inter-city collaboration (Provision of locations for charging stands, etc.)

**Support based on inter-city collaboration**
- Transfer of CO₂ credits

---

3. Investigation results (Terra motors, Distributor, Remorque association)

(1) Electric tricycle cost and specifications (Terra Motors Y6)

<table>
<thead>
<tr>
<th>Item</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling price</td>
<td>2,200 USD (Vehicle: 1,200 USD; Batteries (5 pcs.): 1,000 USD)</td>
</tr>
<tr>
<td>Batteries</td>
<td>Equipped with 5 lead-acid batteries (Voltage: 60V; Capacity: 140Ah)</td>
</tr>
<tr>
<td>Travel distance</td>
<td>Capacity to travel around 100 km on a single charge (Charging time: 8 to 12 hours)</td>
</tr>
<tr>
<td>Maintenance cost</td>
<td>About 1,000 USD/year (Maintenance cost + Electrical charges = 200 USD/year + Replace of battery = 1,000 USD/year, Charging times in 4 days, Mileage = 40 km/day x 300 days)</td>
</tr>
<tr>
<td>Specifications</td>
<td>Overall length: 2,950 mm, Overall width: 1,090 mm, Overall height: 1,800 mm, Vehicle weight: 278 kg, Maximum travel distance: 100 km, Rated output: 1 kw, Maximum speed: 40 km/h, Practical climbing capability: 10°</td>
</tr>
</tbody>
</table>

(2) Local Gasoline Remorque (Result of interview with the Remorque association)

<table>
<thead>
<tr>
<th>Item</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase price</td>
<td>1,000 to 2,000 USD (Basket: 600 to 800 USD, Bike: 300 to 1,000 USD)</td>
</tr>
<tr>
<td>Travel distance</td>
<td>50 km to 75 km/day (There are also drivers who travel 100 km)</td>
</tr>
<tr>
<td>Driver revenue and expenses</td>
<td>Around 1,800 USD/year (Expenses including gasoline and maintenance are around 150 USD/month; Profit is 150 USD/month)</td>
</tr>
<tr>
<td>Other</td>
<td>Development of charging stations is important. Showing the performance (including travel distance) and safety of Electric tricycle is important.</td>
</tr>
</tbody>
</table>

---

4. Test Ride

5. Outline of Solar charging stands

(The Number of Electric tricycle charged: 20 vehicles /day)
5. Case study of introduction of electric three-wheeled vehicles (1): Philippines

In the Philippines, there are more than 3.5 million three-wheeled taxis (tricycles) driving around, and air pollution due to exhaust gas is worsening. The Philippine Government is introducing electric three-wheeled vehicles (E-Trikes) with the intention of improving the living environment and increasing driver income.

In January 2016, Uzushio Electric Co., Ltd. of Japan received orders for 3,000 units from the E-Trike Project of the ADB (Asia Development Bank) and DOE (Philippine Department of Energy).

→ Electric three-wheeled vehicles are more expensive than gasoline vehicles, so it may be difficult to spread their use only through the power of private companies. It is important that vehicles with high environmental impact be regulated through strong governmental leadership to switch to low-pollution vehicles such as electric vehicles, etc.

5. Case study of introduction of electric three-wheeled vehicles (2): Bangladesh

In 2015, Terra Motors Corp. of Japan established a joint venture with the local top motorcycle maker in Bangladesh, and began manufacturing and sales of electric three-wheeled vehicles. With relatively inexpensive pricing and good performance to match local needs, its sales have steadily increased, and a cumulative total of 10,450 units (17 months from the start of sales) have been sold.

<Current situation in Bangladesh>
- As the population increases, the increasing number of gasoline motorcycles and CNG tricycles is a cause of air pollution.
- Although there is widespread use of Chinese-made electric three-wheeled vehicles in the region, they break down easily. In addition, since the price of natural gas is increasing, there is a demand for high-quality electric three-wheeled vehicles.

**Waterworks / Current status and tasks**

**Waterworks water supply penetration rate; Non-revenue water rate**
- The major part of Phnom Penh is supplied with water by the Phnom Penh Water Supply Authority. In the area under the jurisdiction of the Phnom Penh Water Supply Authority, the waterworks water supply penetration rate has reached approximately 85% (as of May 2018).
- In addition, the waterworks water supply quality meets the WHO standards and it is possible to drink water directly from the tap, and the non-revenue water rate and fee collection rate are outstandingly excellent compared to cities of other ASEAN countries (Non-revenue water rate: 5.94%. Fee collection rate: 99.9%; 2009 data).

**Current status of private water supply sector in the suburbs**
- In the suburbs of Phnom Penh such as farming villages, etc., water is supplied by the private water supply sector.
- However, in the private water supply sector, since there is no measuring equipment, water leakage, faulty water output, and wasteful power generation occurs. For proper operation and maintenance management, the development of the necessary measuring equipment is required.

**Increased demand volumes**
- The Phnom Penh Water Supply Authority owns four water purification plants, with a total waterworks water treatment capacity of 430,000 m³/day (as of September 2013). It has been forecast that the demand volume in 2025 will increase to approximately 7,100,000 m³/day. Securing water sources to meet the increased demand and preserving water quality is required.

**Introduction of energy-saving waterworks water supply equipment and renewable energy**
- It is desirable to promote the introduction of energy-saving waterworks water supply equipment and renewable energy such as solar power generation, etc., in order to reduce GHG.

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**Sewerage/rainwater drainage field: Problems**

**Household sewerage**
- Sewerage is discharged through city sewerage systems to treatment facilities (supported by the European Community) etc. that use marsh/stabilization pond methods. With population growth and urbanization, the amount of sewerage is increasing, and the water quality environment is severely degraded.
- It is necessary to promote development of sewerage and wastewater treatment plants, improvement of public hygiene, and environmental conservation.

**Industrial wastewater**
- It is presumed that many factories outside the PPSEZ do not have wastewater treatment facilities installed.
- It is necessary to promote the application of administrative guidance and penalties related to wastewater standards compliance.
- For almost all hospitals, the discharged wastewater causes progressive deterioration.
- It is desirable to promote the introduction of energy-saving waterworks water supply equipment and renewable energy such as solar power generation, etc., in order to reduce GHG.

**Increased demand volumes**
- The Phnom Penh Water Supply Authority owns four water purification plants, with a total waterworks water treatment capacity of 430,000 m³/day (as of September 2013). It has been forecast that the demand volume in 2025 will increase to approximately 7,100,000 m³/day. Securing water sources to meet the increased demand and preserving water quality is required.

**Introduction of energy-saving waterworks water supply equipment and renewable energy**
- It is desirable to promote the introduction of energy-saving waterworks water supply equipment and renewable energy such as solar power generation, etc., in order to reduce GHG.
Sewerage/rainwater drainage field: Problems

【Rainwater drainage】
• Phnom Penh city has the characteristics that rainwater is likely to collected and difficult to drain because it is in low-lying area.
• The obstruction of drainage is getting worse and the function of the drainage is dropping because of the civil war and the aging cleaning equipment.
• Furthermore, as a result of an increase in surface runoff due to the increased impermeable area, reduced marsh and lake area accompanying urbanization, various parts of the capital have been flooded even with daily rainfall of about 20 mm that occurs about 20 times during the rainy season.

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Waterworks/sewerage and rainwater drainage field: Introduction of efforts in Kitakyushu

■ Onga River water source water-treatment know-how (U-BCF)
Upward Biological Contact Filtration patented in Japan by Kitakyushu (Upward Biological Contact Filtration: U-BCF)

【Kitakyushu waterworks water sources】
Waterworks source water intake is at the most downstream point of the river which is affected by household wastewater.

Original development of a new water-treatment technology (U-BCF) over 11 years as a measure for Onga River as a water source
Patent Number 3831055 (Application: 1997; Registration: 2006)

【Upgrading of main water-treatment plants to U-BCF】
Honjo Water-Treatment Plant (2000 & 2010): 106,500m³/day
Anno Water-Treatment Plant (2003): 171,000m³/day

【Features】
Running cost = ¥3.6/m³
Compactness (economical construction cost)

Expansion within Vietnam and throughout various countries in Southeast Asia

Introduction of U-BCF from small-scale water-treatment plant in Hai Phong to main water-treatment plants (utilizing grant aid)

Main water-treatment plant
(An Duong water-treatment plant)

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Waterworks/sewerage and rainwater drainage field: Introduction of efforts in Kitakyushu

Overview of Kitakyushu sewerage system

- Feb. 1963 Establishment of Kitakyushu
  - Start of Kogasaki Treatment Center
  - Sewerage coverage ratio reaches 30% (20 km)
  - Total length of installed culverts reaches 4 km.
  - More than 600 billion yen invested in construction costs over approx. 40 years.

- July 1963
  - Start of Kogasaki Treatment Center
  - More than 600 billion yen invested in construction costs over approx. 40 years.

- March 1977
  - Sewerage coverage ratio reaches 50%
  - Total length of installed culverts reaches 4,000 km.

- March 2005
  - Sewerage coverage ratio reaches 99.8%

Main sewerage facilities

- Treatment centers: 5 locations
  - Kogasaki Treatment Center (KTC)
  - Hiagari Treatment Center
  - Kitaminato Treatment Center
  - Shimmaci Treatment Center
  - Sone Treatment Center

- 16,191 ha (including mixed flow district area of 3,422 ha)

Historical events

- Feb. 1963 Establishment of Kitakyushu
- Jul. 1963 Start of Kogasaki Treatment Center
- Aug. 1963 Start of Kogasaki Treatment Center
- Oct. 1963 Start of Kogasaki Treatment Center
- Dec. 1963 Start of Kogasaki Treatment Center
- Feb. 1964 Start of Kogasaki Treatment Center

- March 2005 Total length of installed culverts reaches 4,000 km.

Specific measures for waterworks/sewerage and rainwater drainage field (draft proposal)

Waterworks

1. Introduction of measuring equipment in the private sewerage sector (suburbs)
   - Introduce measuring equipment into the private sewerage sector to eliminate leakage and flood problems and reduce energy consumption.
   - Project classification: Medium-term
   - Project description: Implementation of new measuring equipment.

2. Securing water sources and water quality preservation
   - Secure water sources to cope with forecast major increases in demand volumes.
   - In conjunction with the above, preserve water quality of water sources.
   - Project classification: Medium-term
   - Project description: Implementation of new water treatment equipment.

3. Introduction of energy-saving wastewater equipment and renewable energy
   - Promote GHG reduction through the use of energy-saving models of wastewater equipment such as pumps, etc., and introduction of renewable energy such as solar power generation, etc.
   - Project classification: Medium-term
   - Project description: Implementation of new wastewater treatment equipment and renewable energy systems.

Sewerage/rainwater drainage

4. Surface maintenance of sewer and early construction of sewerage treatment plants based on sewerage treatment master plan which is currently being compiled
   - Project classification: Short-term
   - Project description: Implementation of new sewerage treatment plants.

5. Strengthening of administrative guidance and clarification and proper application of penalties and regulations
   - Project classification: Long-term

6. Urgent maintenance and improvement of rainwater drainage facilities
   - Project classification: Long-term
   - Project description: Implementation of new rainwater drainage facilities.

7. Distributed wastewater treatment system development project
   - Project classification: Long-term
   - Project description: Implementation of new distributed wastewater treatment systems.

Specific measures for waterworks/sewerage and rainwater drainage field: Introduction of efforts in Kitakyushu

As sewage coverage spread, the water quality of Murasaki River improved dramatically.

Source: Kitakyushu

Specific measures for waterworks/sewerage and rainwater drainage field (draft proposal)

Source: Kitakyushu

Example of improvements at final treatment plant

Example of improvements of industrial park wastewater treatment facilities (PPSEZ)

Source: Kitakyushu

Example of distributed wastewater treatment facility system (septic tank)

Source: Kitakyushu

Solar power system (existing Phnom Penh Water Supply Authority equipment)

Example of high-efficiency inverter-controlled motors

Examples of electromagnetic flow meters with excellent accuracy


http://www.aichitokei.co.jp/products/02_water/05

Example of distributed wastewater treatment facility system (septic tank)
1. Current situation of Phnom Penh metropolitan area

- Water environmental problems and flooding problems have manifested due to rapid urbanization.
- While maximizing existing facility capacity, facility maintenance and management to contribute to flood damage mitigation and educational activities to raise public awareness are necessary.

2. Project overview

- Objective: To raise citizen awareness and suitable, efficient maintenance and management of sewerage and drainage facilities for the "sustainable development of sewers" and "flood damage mitigation" of the Phnom Penh metropolitan area.
- Period: 2016 to 2019 (planned)
- Activities: Public awareness activities/environmental studies, local technical guidance, acceptance of trainees, holding of seminars
- Input:
  - Raise public awareness through awareness activities, flood hazard map creation, etc.
  - Creation of maintenance/management manuals, etc. and operation of sewerage/drainage facilities

3. Project schedule (1/2017 to 12/2019)

<table>
<thead>
<tr>
<th>Project content</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptance trainees</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Work consultations</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Workshop/seminars</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Project implementation structure

- Kitakyushu Environment Agency
- Asia Center for Low Carbon Society
- Yaskawa Electric Corp. (inverters)
- KWS (Data analysis)
- Uni-Elex Co., Ltd.

Demonstration test system diagram

- Water purification equipment
- Power reception
- Water supply tank
- Water pressure meter
- Water tower system
- Pump pressure system
- Water pressure meter
- Flow rate
- Pump
- Temporary electric power meter
- Temporary flow meter
- Existing waterworks meter
- Pump
- Uni-Elex Co., Ltd.
- Cambodia launch office
- Contractors
- Counterparts (CWA)
- Relevant ministries/agencies (MIH)
- Business partners within city (various kinds)

2. Project implementation structure
Pilot project in water/sewerage and rainwater drainage field (3)
Hospital wastewater treatment project

1. Project overview
   - In view of the fact that hospital wastewater is being discharged without even undergoing sterilization, with
     the exclusion of hospitals located in the Cheung Aek treatment district which will undergo off-site sewage
     treatment (construction of sewage treatment plants) under JICA’s sewage master plan, septic tanks
     packaging together various kinds of treatment equipment will be introduced to the other hospitals and
     proper treatment of hospital wastewater will be performed.
   - In the Tamok treatment district, wastewater treatment combining on- and off-site treatment was
     investigated under the current plan, but since the conclusion presumes on-site treatment, hospitals
     located in this area will also be subject to the above plan. There are 7 hospitals in the district, with a total
     bed count of approximately 940 beds.

Subject hospitals and bed counts

<table>
<thead>
<tr>
<th>No.</th>
<th>Hospital name</th>
<th>Beds</th>
<th>Type</th>
<th>Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cho Ray Phnom Penh Hospital</td>
<td>500</td>
<td>Large</td>
<td>Private</td>
</tr>
<tr>
<td>2</td>
<td>Sen Sok International University Hospital</td>
<td>250</td>
<td>Medium</td>
<td>MHD</td>
</tr>
<tr>
<td>3</td>
<td>Cambodia-China Friendship Sen Sok Referral Hospital</td>
<td>60</td>
<td>Medium</td>
<td>MHD</td>
</tr>
<tr>
<td>4</td>
<td>Meanchey Referral Hospital</td>
<td>42</td>
<td>Medium</td>
<td>MHD</td>
</tr>
<tr>
<td>5</td>
<td>Phnom Penh Referral Hospital</td>
<td>35</td>
<td>Medium</td>
<td>MHD</td>
</tr>
<tr>
<td>6</td>
<td>Phnom Penh Referral Hospital</td>
<td>19</td>
<td>Medium</td>
<td>MHD</td>
</tr>
<tr>
<td>7</td>
<td>Preah Prok Referral Hospital</td>
<td>13</td>
<td>Medium</td>
<td>MHD</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>936</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Project scheme (proposal)
   - Although the project scheme is not yet determined, grant aid from the Foreign Ministry of Japan and support from ADB,
     etc. is being considered.
   - Together with installation of the septic tank, cultivation of personnel capable of proper facility operation is essential.

3. Project implementation organization (proposal)
   - The estimated treatment water volume and septic tank scale are shown in the table at left.
   - Since the septic tank is a package system, installation is simple.
   - For large-scale septic tanks, sludge removal will be performed once per week. For medium-scale tanks, the frequency would,
     be once every two weeks.
   - Tank maintenance inspection needs to be performed once every two weeks, and it is necessary to cultivate personnel who will be
     capable of properly performing such maintenance and inspection in order to ensure stable septic tank operation.

Approximate septic tank scale for each hospital

<table>
<thead>
<tr>
<th>No.</th>
<th>Hospital name</th>
<th>Treatment water volume</th>
<th>Septic tank scale</th>
<th>annual electrical consumption (kWh/y)</th>
<th>annual operating expense (total) = approx. 3.8 M USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cho Ray Phnom Penh Hospital</td>
<td>22</td>
<td>109,800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Sen Sok International University Hospital</td>
<td>14</td>
<td>54,540</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Cambodia-China Friendship Sen Sok Referral Hospital</td>
<td>4.5</td>
<td>20,660</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Meanchey Referral Hospital</td>
<td>3.8</td>
<td>20,440</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Phnom Penh Referral Hospital</td>
<td>3.8</td>
<td>21,280</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Phnom Penh Referral Hospital</td>
<td>2.0</td>
<td>20,130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Preah Prok Referral Hospital</td>
<td>1.6</td>
<td>12,200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Preah Prok Referral Hospital</td>
<td>2.5</td>
<td>12,150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Preah Prok Referral Hospital</td>
<td>1.6</td>
<td>8,920</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tasks and Specific Measures by Field

< Environmental Conservation Field >
Environmental Conservation
Current status and tasks

**Air pollution**
- With the spread and increase of automobile and motorcycles, air pollution is progressing since appropriate inspections are not being carried out. At the current time, air pollution from factories is not progressing properly according to the usage of the bodies of water.
- Although environmental standard values were met in previous surveys, it is questionable whether appropriate monitoring is being performed.
- There is only one air pollution monitoring site, so the actual situation is not grasped (jurisdiction of the Ministry of the Environment).

**Noise/vibration**
- Although environmental standards for noise have been set, periodic monitoring is not being performed.
- At locations where traffic volume outside the city is larger than in the downtown area, environmental standards for noise are not being met. (JICA survey results)
- No environmental standards for vibration have been set, and the current situation is unclear.

Environmental Conservation
Current status and tasks

**Water pollution**
- Environmental standard values are not set properly according to the usage of the bodies of water.
- The sewerage from homes, etc. flows untreated into the small rivers and canals of the old city and water pollution is progressing severely.
- Periodic water quality surveys are not being conducted in the above bodies of water.
- The actual water pollution situation of ponds and wetlands is unclear.

Environmental Conservation
Current status and tasks

**Ecosystem**
- There are important wetlands which are the habitat of valuable bird species such as the Philippines pelican, Oriental darter, etc.
- There were instructions to clarify areas in each city district that should be protected from ecological and cultural points of view (September 2015)
- Systematic surveys of the ecosystem have not been carried out so the current situation is unclear.

**Others**
- Growth Promotion Plan (tentative name). There is no master plan for environmental conservation. They have not started working on establishment of a plan due to insufficient technology, personnel, and budget.
- Action plans have been established for the 14 ministries related to promotion of the Cambodia Climate Change Strategic Plan 2014-2023.
- The Climate Change office of the Ministry of the Environment which has jurisdiction over this plan has requested support by Kitakyushu City for the establishment of a Green
Environmental conservation field: Introduction of efforts in Kitakyushu

**Dokai Bay Cleanup**

**Dredging of Dokai Bay**

- Sediment with total mercury concentration of 30 mg/L or more: 350,000 m³

**Environment monitoring (Ocean region, rivers)**

- Monitoring of various items such as COD, BOD, etc. being performed.
  - Ocean regions: pH, COD, total nitrogen, total phosphorus, dissolved oxygen, amount of suspended matter, transparency, number of coliform bacteria groups, etc.
  - Rivers: pH, BOD, electrical conductivity, dissolved oxygen, amount of suspended matter, transparency, number of E. coli groups, etc.

**Total project cost:** 1.8 billion yen
**Burden ratio:**
- Operator: 71%
- Public: 29%

![Graph showing COD levels from 1968 to 2008](image)

Environmental conservation field: Introduction of efforts in Kitakyushu

**Change over time of Dokai Bay water quality (COD)**

- The water quality of Dokai Bay is improving as a result of various countermeasures.
- It has now become possible to confirm the presence of many types of marine products.

**Network for constant air pollution monitoring/measurement**

**On-site inspection based on the Air Pollution Control Law**

<table>
<thead>
<tr>
<th>Installation status of soot-generating facilities (as of March 31, 2010)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large-scale facilities</td>
<td>120</td>
</tr>
<tr>
<td>Medium-scale facilities</td>
<td>221</td>
</tr>
<tr>
<td>Small-scale facilities</td>
<td>1,230</td>
</tr>
<tr>
<td>Total</td>
<td>1,571</td>
</tr>
</tbody>
</table>

- Large-scale facilities: Exhaust gas volume ≥ 40,000 m³/h
- Medium-scale facilities: 10,000 m³/h < Exhaust gas volume < 40,000 m³/h
- Small-scale facilities: Exhaust gas volume < 10,000 m³/h

- On-site inspection plans are formulated every fiscal year.

- Companies develop pollution control equipment and energy-saving production processes.

**Trend of air pollution situation**

- (annual mean values from general ambient air measurement stations)

![Graph showing trend of air pollution](image)

Dokai Bay had been heavily polluted by wastewater from steel and chemical plants, etc. Because it had reached the condition where no living thing could survive, it was nicknamed the "Sea of Death".
Specific measures for environmental conservation field (draft proposal)

<table>
<thead>
<tr>
<th>Project classification</th>
<th>Project description</th>
<th>Project implementing entity</th>
<th>Implementation timing</th>
<th>Evaluation index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Development of air quality monitoring system and understanding of current situation based on such system</td>
<td>• Air-quality (including noise) monitoring system development project</td>
<td>Ministry of the Environment</td>
<td>Short-term</td>
<td>Environmental standard achievement ratio GHG reduction amount</td>
</tr>
<tr>
<td>2. Setting of environmental standards related to vibrations</td>
<td>• Investigation and setting of vibration environmental standards for various land applications and development of monitoring system.</td>
<td>Ministry of the Environment</td>
<td>Medium-long term</td>
<td>Environmental standard achievement ratio</td>
</tr>
<tr>
<td>3. Enhancement of the legal system for improvement of air pollution derived from exhaust gas</td>
<td>• Review and reliable implementation of automobile inspection system.</td>
<td>Ministry of the Environment</td>
<td>Short-term</td>
<td>Automotive inspection reception ratio Exhaust gas emission reduction ratio</td>
</tr>
<tr>
<td>4. Review of environmental standard and application methods conducive to organized water pollution improvement</td>
<td>• Review of laws to subordinate standard values and achieve type-based directive according to water region use conditions.</td>
<td>Ministry of the Environment</td>
<td>Medium-long term</td>
<td>Environmental standard achievement ratio</td>
</tr>
</tbody>
</table>

Pilot project in environmental conservation field

Project for development of air quality and noise monitoring system

1. Project outline
   * In order to understand the air quality and noise conditions in Phnom Penh, automatic monitoring equipment for air and noise will be introduced (around 3 units in fixed locations and 1 mobile unit). In addition, the monitoring data will be shared with the Cambodia Institute of Technology (CIT)’s monitoring station. The research on air pollution and the training of experts will also be supported.
   * In conjunction with this, in order to develop a specialist for environmental monitoring, training will be performed at Kitakyushu City.
   * For the funding of this project, the use of ODA grant aid will be investigated.

<Observation items>
Sulfur dioxide (SO2), Carbon monoxide (CO), Nitrogen oxides (NOx), Ozone (O3), Suspended particulates (TSP, PM2.5), Noise

<Abbreviated system composition>

Pilot project in environmental conservation field

Project for development of air quality and noise monitoring system

Reference: Air monitoring conditions in Kita Kyushu City

[Map showing air quality monitoring stations in Kita Kyushu City]
Pilot project for environmental conservation field
Project for development of air quality and noise monitoring system

◆ Example of equipment composition for fixed station

TSP measurement capability by changing sampling section

◇ Material source: Horiba Ltd.
(The same company has already delivered 10 stations to MONRE. Horiba specifications have effectively become Vietnam’s standards)

◆ Example of mobile station

The mobile station consists of a 2t-class truck equipped with monitoring equipment which can perform air monitoring at any desired location.

Since it is assumed that from the cost aspect it would be difficult to install fixed-location stations at all areas within the city, a mobile station will be introduced and efforts will be made to understand the actual conditions of air pollution and noise in the city.

◇ Example of equipment composition

◆ Example of exterior of fixed monitoring station

2. Results, etc.

◇ Facility development
- Understanding of actual conditions of air pollution and noise (status of achievement of environmental standards), accumulation of measurement data
- Confirmation of effects when countermeasures have been implemented
- Provision of information to citizens, etc. in case of emergencies
- Possibility to perform monitoring at any desired location using the mobile station etc.

◇ Human resource development
- Acquisition of technique regarding maintenance of equipment and the way to take advantage of the monitoring data. Training of experts in association with Cambodia Institute of Technology (CIT)

3. Implementation system, etc.

Cambodia: Ministry of the Environment (MOE), CIT
- Installation of automatic monitoring measurement equipment
- Establishment of central monitoring office
- Information network, Installation of public announcement lighted signboards
- Operation of facilities - Planning countermeasures
- Establishment of the system of training experts in association with CIT

Japan side (Kita Kyushu City, consultant, manufacturers)
- Investigation of monitoring methods
- System design, provision of equipment
- Acquisition of technique regarding maintenance of equipment and the way to take advantage of the monitoring data. Training of experts.

4. Funding procurement
- Investigation of utilization of ODA grant aid
- Taking advantage of the JICA Partnership Program for the human resource development
- Total project cost: Approx. 1.6 million USD (excluding the cost of human resource development)
- Fixed station (3 stations) and central monitoring station: Approx. 1.2 million USD
- Mobile station (1 station): Approx. 0.4 million USD

◇ Example of mobile station

◇ Example of composition of mobile station measuring equipment

◇ Material source: Horiba Ltd.
Tasks and Specific Measures by Field

< Green Production Field >

Green Production
Current status and tasks

[Industrial field]
- In Cambodia, secondary industry (manufacturing industry) occupies 27.1% of the GDP and 24.3% of employment, which is not a large ratio compared to other ASEAN countries, and this industry accounts for more than 60% of production value through sewn products and shoes. Because of this, the nurturing of industrial personnel with the aim of changing the industrial structure by diversifying industries, adding value, and promoting trade has become an important issue.

- The "Cambodia Industry Development Policy (2015 - 2025)" was announced in August 2015, with the main vision being the transformation and evolution of Cambodia’s industries from labor-intensive to technology-driven. As specific approaches for achieving this goal, development in the manufacturing sector and agricultural product processing sector would be promoted. For this purpose, the policy aims to promote integration into international and regional production chains, development of industrial parks and industrial clusters, etc. Furthermore, it specifies the following as priority industries: 1) New industries that produce creative, highly competitive products with high added value, 2) small- and medium-sized enterprises, 3) agricultural product processing industry, 4) supporting industries related to the supply chain, 5) industries that contribute to international production lines, etc.

Green Production
Current status and tasks

[Agricultural field]
- Rice production is the main agricultural products of Cambodia, and it has been increasing steadily. But yield is low compared to neighboring countries.

- In Cambodia’s farmland, productivity is low, and as a result the amount of chemical fertilizer usage has increased significantly in recent years. On the other hand, it is a dilemma that with the increased use of fertilizer, the fertility of the soil is conversely decreasing. Problems such as health damage due to misuse, overuse, etc. of agricultural chemicals and problems with food safety, etc. are occurring.

- Furthermore, in production activities, it is important to ensure the work environment and safety of workers as well as switch to environmentally friendly production activities such as effectively utilizing raw materials and energy and actively suppressing the environmental impact of exhaust gases, wastes, wastewater, etc.

- Agriculture is also prosperous in the suburbs and outskirts of the Phnom Penh capital, and it is necessary to increase the added value of agricultural products by cultivating organic vegetables and fruits. In addition, not only agricultural production but also strategies to increase added value through processing of such agricultural products are required.

Green Production
Current status and tasks

(Agricultural field)
- In order to achieve solid economic development, first it is important to make use of foreign direct investment as a driving force for changing the industrial structure, and for this purpose the investment environment for special economic zones and industrial parks should be improved to attract superior enterprises. As part of that process, it is necessary to nurture small- and medium-sized enterprises and personnel in the local area and work to further improve their technical capabilities.

- Furthermore, in production activities, it is important to ensure the work environment and safety of workers as well as switch to environmentally friendly production activities such as effectively utilizing raw materials and energy and actively suppressing the environmental impact of exhaust gases, wastes, wastewater, etc.

- Green Production
Current status and tasks

- In Cambodia, the primary industry (manufacturing industry) occupies 27.1% of the GDP and 24.3% of employment, which is not a large ratio compared to other ASEAN countries, and this industry accounts for more than 60% of production value through apparel and footwear. Because of this, the nurturing of industrial personnel with the aim of changing the industrial structure by diversifying industries, adding value, and promoting trade has become an important issue.

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Green Production
Current status and tasks

(Agricultural field)
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- In Cambodia’s farmland, productivity is low, and as a result the amount of chemical fertilizer usage has increased significantly in recent years. On the other hand, it is a dilemma that with the increased use of fertilizer, the fertility of the soil is conversely decreasing. Problems such as health damage due to misuse, overuse, etc. of agricultural chemicals and problems with food safety, etc. are occurring.

- Furthermore, in production activities, it is important to ensure the work environment and safety of workers as well as switch to environmentally friendly production activities such as effectively utilizing raw materials and energy and actively suppressing the environmental impact of exhaust gases, wastes, wastewater, etc.
Green Production
Current status and tasks

Tourism field
- The tourism industry comprises 20% of Cambodia’s GDP. In 2014, 4.5 million foreign tourists visited Cambodia, making tourism one of the main industries. The main destination is Siem Reap with the ruins of Angkor Wat, but many foreign tourists are also seen in the Phnom Penh capital, which has an environment where tourists can enjoy not only Cambodian cuisine but also all kinds of dishes from various countries, and there is great potential for the tourism industry to become a main industry of Phnom Penh as well.
- From now on, it is also necessary to fully utilize suburban areas and investigate popularization of green tourism, etc. which focuses on the environment and food education.

Green Production Field: Introduction of efforts in Kitakyushu

Development of cleaner production (CP)

Cleaner production concept
- Low-pollution-type production technology that provides both economic benefits and environmental conservation
- Comprehensive evaluation and improvements
  - Raw material usage
  - Production processes
  - Maintenance management
  - Personal training (workplace activities)

In the case of iron and steel industry in Kitakyushu, SOX emissions were reduced from 27,575 t to 607 t in the period from 1970 to 1990. 75% of this reduction was the effect of cleaner production, and the remaining 25% was due to final disposal measures.

Outline
Of the products and services offered by the industrial and technology field, products (Eco Products) and services (Eco Services) that lead to a reduction in the environmental load will be selected as “Eco Premium,” and through their expansion and diffusion, will help to promote environmental consideration activities for all city industries.
- Eco Premium: Products, technology and industrial activities with the added value of a lowered environmental load

Past Achievements (FY 2004 - 2016)
- Selection: Eco Products – 163 (Field: Domestic, machinery and plants, engineering and construction, etc.)
- Eco Services – 40 (Field: Targeting consumers and business entities)
- PR Method: Introduction at Eco Town Center, Display at Eco Techno Exhibition and Eco Products Exhibition, Creation of pamphlets and booklets
### Green Production Field: Introduction of efforts in Kitakyushu

**Kitakyushu Eco Premium [Services + Products]**

1. Repair and maintenance service for household appliances from all makers
2. Rental apartment with photovoltaic power generation, the first in Japan (Received the FY 2005 New Energy Award from METI)
3. Refill service for printer ink
4. Community-based food waste recycle system
5. Thermal analysis service of heater appliances that leads to energy conservation
6. Hybrid city lamps generated by wind and solar energy
7. Automatic water-saving taps with self power generation function
8. Luminescence tube for ceramic metal halide lamps that are long-life and have very effective energy conservation features
9. Energy conserving high ceiling HID light system that enables a significant reduction in electricity use for lighting

### Specific measures for green production field (draft proposal)

<table>
<thead>
<tr>
<th>Project classification</th>
<th>Project description</th>
<th>Project implementing entity</th>
<th>Implementation timing</th>
<th>Evaluation index</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Sales of environmentally friendly products</td>
<td>In order to avoid the generation of useless garbage in cooking, shopping, and other activities in daily life, the use of excessive packaging, store-provided shopping bags, etc. will be reduced as much as possible.</td>
<td>Business operators (Citizens)</td>
<td>Short-term</td>
<td>Amount of energy consumption reduction GHG reduction amount</td>
</tr>
<tr>
<td>5. Development of green agriculture</td>
<td>Use organic fertilizers such as compost to reduce chemical fertilizers and promote the growing of rice with drastic reductions in the amount of agricultural chemicals used and it will be made a brand.</td>
<td>Ministry of Agriculture and Fisheries</td>
<td>Short-term</td>
<td>Amount of energy consumption reduction GHG reduction amount</td>
</tr>
<tr>
<td>6. Effective utilization of biomass emitted from agriculture and rearing of livestock</td>
<td>Promote power generation projects utilizing the husks of rice, Cambodia’s largest agricultural product. To promote resource recycling in agricultural areas, biomass power generation utilizing livestock manure and raw garbage will be promoted together with organic farming using the liquid fertilizer that is generated.</td>
<td>Ministry of Agriculture and Fisheries</td>
<td>Short-term</td>
<td>Amount of energy consumption reduction GHG reduction amount</td>
</tr>
</tbody>
</table>

Source: [NEDO](http://www.nedo.go.jp/hyoukabu/) - el.ksrp.or.jp/training/index.html

### Specific measures for green production field (draft proposal)

<table>
<thead>
<tr>
<th>Project classification</th>
<th>Project description</th>
<th>Project implementing entity</th>
<th>Implementation timing</th>
<th>Evaluation index</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Popularization of green tourism</td>
<td>To promote the tourism industry, one of Cambodia’s major industries, the popularization of green tourism focused on the environment and food education will be promoted.</td>
<td>Farmers Ministry of Agriculture and Fisheries</td>
<td>Short-term</td>
<td>Number of projects Number of participants</td>
</tr>
</tbody>
</table>

Source: [Ministry of Agriculture and Fisheries](http://ivyivy.org/act/cambodia/articles/201302chugai/index.html)
1. Project outline

- Introduce biomass power generation facilities that utilize rice hulls at rice milling plants to reduce consumption of fossil fuel (lighter fluid) and CO2 emission.
- For power generation method, direct combustion system in which rice husks are burned directly to make the steam which will rotate the turbine to generate power will be adapted.

**Power generation capacity and total project cost**

1) Power generation capacity: 2.0MW (Generating-end output: 2.4MW, Loss factor of plant-home use: 15%)  
2) Total project cost: Approx. 10.0 million USD

**CO2 reduction effect**

- Annual CO2 emission reduction amount: 4,441 tCO2  
- CO2 emission reductions during the statutory service life: 4,441tCO2/year ×10year = 44,410tCO2

**Assumed conditions**

- Annual days of operation: 336 days

**Cost-effectiveness**

- Cost-effectiveness of subsidy related to energy-derived CO2 emissions
  - Subsidy: 5 million USD / 44,410 tCO2 = 112 USD/tCO2

### Pilot project in green production field

**Introduction of power generation facilities utilizing agricultural biomass**

**Economic Advantage**

- **Total Annual profit**: About 1 million USD

  Benefits of reducing fuel consumption - Loss of benefit from sales of rice husk
  
  \[ \text{High Season} = \frac{9,000 \text{L/day} \times 15 \text{hour/day} \times 140 \text{day}}{0.6 \text{USD/L}} = 1,203,929 \text{USD} \]
  
  \[ \text{Low Season} = \frac{5,000 \text{L/day} \times 8.3 \text{hour/day} \times 196 \text{day}}{0.6 \text{USD/L}} = 1,120,392 \text{USD} \]
  
  \[ \text{Benefits of reducing fuel consumption} = 1,203,929 \text{USD} - 1,120,392 \text{USD} = 83,537 \text{USD} \]

- **Benefit of reducing fuel consumption**

  \[ \text{Benefit} = 1,344,000 \text{USD} - 223,608 \text{USD} = 1,120,392 \text{USD} \]
Pilot project in green production field
Introduction of power generation facilities utilizing agricultural biomass

2. Business Structure

- The representative company (Japanese company) and the co-participant (Cambodian company) will organize the international consortium to do the project.
- This project will be applied JCM subsidized project supported by MOE of Japan. (Maximum Subsidy: 50% of the initial equipment installation costs)

<<International Consortium>>

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Representative Company</td>
<td>Management of entire project (Procurement, installation and trial operation of equipment, etc.)</td>
</tr>
<tr>
<td>Co Participant (Rice Mill Company)</td>
<td>Implementation of project (Purchase and operation of equipment, etc.)</td>
</tr>
<tr>
<td></td>
<td>Monitoring of GHG emission reduction, etc.</td>
</tr>
<tr>
<td>EPC Company</td>
<td>Design, Manufacture, Transportation, Installation and Guidance of trial operation</td>
</tr>
<tr>
<td></td>
<td>Construction related of installation, etc.</td>
</tr>
<tr>
<td>O&amp;M Company</td>
<td>Operation Maintenance</td>
</tr>
</tbody>
</table>


![Green Production Field Pilot Project (2)
Development of green agriculture](Image)

1. Project overview

- In this project, model districts are set up in agricultural areas in the suburbs of Phnom Penh and organic vegetables are cultivated utilizing compost (organic fertilizer) produced in the waste field project.
- In addition, soil improvement will be performed using carbonized rice husk charcoal in order to increase the income of farmers and provide safe, worry-free vegetables.

![Verification methods of the Strategy Measures](Image)
To achieve the goals on schedule, constant monitoring of implementation of the measures is needed. It is also important to resolve any issues that may arise.

As method of verification, introduction of PDCA cycle is recommended. This PDCA cycle is a method to provide continuous improvement by repeatedly carrying out the four-phases of activity, namely Plan → Do → Check → Action.

**Plan (Plan)**
- Specific planning of the project
- Setting the evaluation indicators and monitoring method which can confirm progress
- Rate of waste separation and recycle in urban areas
- Operation rate of facility operation
- Reduction amount of GHG
- Obligation to report regarding the amount of waste generated recycled to business operators (every month)

**Do (Execute)**
- Implementation of the project
- Monitoring and recording of evaluation indicators
- Evaluation indicators must be recorded

**Check (Evaluation)**
- Confirmation of the project achievement
- Extraction of the project problem
- The achievement status of the project is not satisfied with the goal
- Identification of the cause → Consideration of improvement measures
- Objective analysis of the problem by the evaluation indicators, etc., is needed.

**Action (Handling)**
- Specification of improvement measures
- Identification of points which can confirm the effectiveness of the improvement measures
- Reflection in the next planning
- Objective analysis and accurate reflection in the next plan are important.

---

Order and Fund Procurement Methods

- Ways of utilizing private financing and know-how
  The administration, etc. can utilize private funds and know-how to reduce the burden of initial costs, and PPP/PFI or ESCO businesses, etc. are available as ways to improve infrastructure facilities and save energy in existing facilities.

- Ways to use administrative policies to encourage voluntary efforts by private companies
  It is extremely important for the government to instruct companies periodically to comply with environmental standards. At the same time, it is also desirable to introduce economic means such as environmental surcharges, etc. to provide economic motivation for companies to reduce emissions of pollutants.
  It is also important to introduce a tourism tax along with environmental surcharges in order to secure resources to provide subsidies and low-interest loans to companies which introduce pollution prevention facilities.
  Furthermore, it is possible to encourage voluntary efforts by companies through utilizing an environmental labeling system or existing certification systems (ISO 14001, etc.) and introducing a mechanism in which governmental and public agencies procure products and services from companies which are engaging in environmentally friendly activities.
PPP / PFI (1/3)

(1) Overview
- The scheme in which public agencies and private organizations cooperate to provide public services is called PPP (Public · Private · Partnership), and PFI (Private Finance Initiative) is a typical PPP method. PFI is a way of thinking in which public services are provided through private initiatives utilizing private funds and know-how for the design, construction, maintenance and operation of public construction projects, etc., for the purpose of providing efficient and effective public services.

(2) Results
- It is expected to provide high-quality public services while reducing costs.
- New public-private partnerships are formed based on the appropriate division of roles between public and private sectors.
- Invigoration of the economy is expected through the creation of opportunities for private businesses.

Case 1: Kitakyushu City: Renovation and maintenance of deteriorated Shiei Junior High School (pool, gymnasium, dojo) 
Source: http://www.k7.cao.go.jp/pfi141010_100_hikatsu.pdf

Case 2: Kitakyushu City: Maintenance and management of library and halls, Maintenance of open spaces and green areas

PPP / PFI (2/3)

(3) Typical PFI scheme

ESCO project

- In an ESCO project, the basic concept is to cover all costs (construction costs, interest fees, expenses of ESCO project operators) through reductions in lighting, heating, and water charges achieved through energy-saving renovations. Because of this, the emphasis is placed on project profitability so that customers (local governments, factory owners, etc.) do not suffer losses due to the implementation of the ESCO project and there are no new financial expenditures required of customers. In addition, after the end of the contract term, all of the reductions in lighting, heating, and water charges benefit the customers.
- When utilizing funding procurement by ESCO project operators, from the initial year of the project, there will be no cost burdens that exceed conventional lighting, heating, and water costs, and at the same time it can promote energy conservation and achieve reductions in greenhouse gas emissions.

Business for maintenance and operation of municipal sewage biomass energy utilization facility in Kurobe

<table>
<thead>
<tr>
<th>Order issuer</th>
<th>Kurobe (Toyama Prefecture)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility outline</td>
<td>Facility scale: 2,050 m²</td>
</tr>
<tr>
<td>Business description</td>
<td>Development, maintenance, and management of facilities to generate biogas from sewage sludge, etc. and coffee grounds for use by sludge drying facilities and on-site power utilization</td>
</tr>
<tr>
<td>Business period</td>
<td>17 years (maintenance and management period: 15 years)</td>
</tr>
<tr>
<td>VFM</td>
<td>Approx. 4.1% (when selected as a designated project)</td>
</tr>
<tr>
<td>Contract amount</td>
<td>Approx. 3.6 billion yen</td>
</tr>
<tr>
<td>Implementation policy announcement</td>
<td>January 31, 2008</td>
</tr>
</tbody>
</table>

- Methane generation facility utilizing sewage sludge, etc. and local biomass (coffee grounds).
- Utilizes approx. 1 million m³ of biogas produced annually as energy for sludge drying fuel and electricity generation.
- Dry materials derived from sewage sludge is registered and sold as fertilizer. In addition, efforts are being made to utilize it as fuel for power plants, etc.
- The generated power is used as power for the facilities and supplies 50 to 80% of the total power used.
- As a contribution to the community, a footbath that utilizes biogas was installed as a facilities amenity. Concentrated sludge volume of sewage sludge, etc.: 25,810 m³/year
- Amount of local biomass accepted: 2,800 m³/year


Sources:
Environmental surcharges (1/2)

(1) Overview
- Environmental surcharges impose financial burdens on companies according to the amount and quality of environmental pollutant emissions, and are intended to give companies economic motivation toward reducing emissions.
- For factory wastewater, environmental surcharges will be higher as the discharge amount increases or the quality of discharged water worsens.
- The collected surcharges will be used as subsidies or low-interest loans for the introduction of pollution-prevention facilities.

(2) Examples

<table>
<thead>
<tr>
<th>Country</th>
<th>Taxes / Surcharges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>Sewage fees and forest/water source replenishment taxes (both by local governments)</td>
</tr>
<tr>
<td>China</td>
<td>Emission surcharges, automobile fuel taxes</td>
</tr>
<tr>
<td>Korea</td>
<td>Overall water quality excess charges, overall air emissions excess charges, traffic environmental taxes</td>
</tr>
<tr>
<td>Vietnam</td>
<td>Environmental taxes</td>
</tr>
</tbody>
</table>

Environmental surcharges (2/2)

Table: Vietnam - Taxable items and tax amounts in environmental tax laws (Examples)

<table>
<thead>
<tr>
<th>Taxable Item</th>
<th>Tax amount (VND/unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fossil fuels (L)</td>
<td>1,000–6,000</td>
</tr>
<tr>
<td>1.1 Automobile-use gasoline (L)</td>
<td>1,000–6,000</td>
</tr>
<tr>
<td>1.2 Aviation fuel (L)</td>
<td>1,000–6,000</td>
</tr>
<tr>
<td>1.3 Light oil (L)</td>
<td>500–2,000</td>
</tr>
<tr>
<td>1.4 Kerosene (L)</td>
<td>300–2,000</td>
</tr>
<tr>
<td>1.5 Fuel oil for cooking (L)</td>
<td>300–2,000</td>
</tr>
<tr>
<td>1.6 Lubricating oils (L)</td>
<td>300–2,000</td>
</tr>
<tr>
<td>1.7 Coal (kg)</td>
<td>6–30</td>
</tr>
<tr>
<td>1.8 Natural gas, coal gas (m³)</td>
<td>35–100</td>
</tr>
<tr>
<td>2. HCFC solutions (kg)</td>
<td>1,000–3,000</td>
</tr>
<tr>
<td>3. Plastics (kg)</td>
<td>500–2,000</td>
</tr>
<tr>
<td>4. Agricultural chemicals (kg)</td>
<td>500–5,000</td>
</tr>
<tr>
<td>5. Bleach detergents (kg)</td>
<td>400–2,000</td>
</tr>
<tr>
<td>6. Inorganic acid solutes (L)</td>
<td>600–3,000</td>
</tr>
<tr>
<td>7. Industrial paints (kg)</td>
<td>500–2,000</td>
</tr>
</tbody>
</table>

Sight-seeing Tax

The preservation of natural environment is an important element for sightseeing in Phnom Penh city. We'd like to propose that Sight-seeing tax is introduced and used for the environment conservation business in the whole Capital.

Introduction of environmental labeling system and utilization of existing certification systems

(1) Environmental labeling system
- Environmental labels are labels given to products or services with low environmental impact, and are expected to raise environmental consciousness while helping consumers to choose products with low environmental impact.
- Although there are many types of environmental labels, the ones whose acquisition have the largest impact on a company's business are those defined in ISO 14024. This type of label has a system in which a third-party organization conducts an examination and determines whether or not to give certification based on whether or not the criteria for specific environmental labels are satisfied.
- Environmental labels not only provide company appeal but can also beneficially promote trading, funding procurement, and recruitment.
- The introduction of environmental labels is progressing in Europe, America, and Asian countries, and systems are being introduced in Indonesia and the Philippines with the support of JICA.
(2) Existing public certification systems

- Public certification systems for environmentally friendly activities include environmental management certifications such as ISO 14001, EMAS (EU Eco-Management and Audit Scheme), etc.
- Both are international standards that check the voluntary efforts of businesses toward environmental management from objective standpoints.

(3) Preferential policies for companies which have acquired environmental labels and public certification

- Governments preferentially procure products and services from businesses who have acquired environmental labels and public certification (Green Public Procurement (GPP)). In addition, they introduce companies inside and outside of the country and support increased profitability of companies.

Green public procurement is being performed in Asia in Japan, Indonesia, Thailand, the Philippines, Vietnam, Malaysia, China, Korea, etc.

Expansion of green markets

Source: http://gpn.jp/about/index.html

Introduction of environmental labeling system and utilization of existing certification systems

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- In addition, they introduce companies inside and outside of the country and support increased profitability of companies.
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Purchasing of green products/services

Evaluation of company efforts

In a sustainable society

Schedule

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<th>Contents of Discussion(Draft)</th>
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<td>May 12, 2016</td>
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