Undertaking Commissioned
by the Ministry of the Environment

Feasibility Study on FY2014 Large-Scale JCM Project
for Realizing Low-Carbon Development in Asia
- Developing a Low Carbon Society Under Collaboration
  between Bandung City and Kawasaki City -

March 2015
Institute for Global Environmental Strategies
Japan Environmental Sanitation Center
Kawasaki City
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Outline of the undertaking

(1) Background and objectives of the undertaking

Being one of the signatories to the Joint Crediting Mechanism (JCM), Indonesia has pledged to reduce its greenhouse gas emissions by 26% (41% with international assistance) from the BAU level by 2020. While the use of JCM is expected to help contribute to achievement of the national target, it becomes increasingly important to develop a low-carbon urban plan at the city council level.

Being the capital city of West Java Province, Indonesia, and located 140 km southwest of Jakarta, Bandung is the third largest city in Indonesia, boasting a population of 2.5 million. In 2014, strategies for the next 5 years were adopted in the city assembly with involvement of citizen’s groups. Priority areas that Bandung announced include (1) conservation of environment, (2) development of infrastructure, (3) development of ICT, (4) improvement of family life, (5) dealing with social problems such as poverty and unemployment, (6) education and culture, (7) health, (8) administrative reform and governance, and (9) improvement in the economic environment such as in business and the tourism industry.

This undertaking will carry out a feasibility study in two areas (energy and waste) for the purpose of assisting development of a low-carbon city in Bandung, where environmental improvement is urgently required as a result of rapid urbanization; in addition, it is also expected that the results of this study will be incorporated into the planning by the Bandung government for development of low-carbon societies. Further, another objective of this undertaking was to help with comprehensive implementation of these as well as to contribute to wider promotion of Japanese technologies and knowledge and promotion of the strategic environmental cooperation of Japan.

Furthermore, since 2006, Bandung City and Kawasaki City have been building a partnership for about 10 years through such activities as “UNEP-IETC Eco-town Project” organized by UNEP-IETC, and Asia Pacific Eco-Business Forum held by Kawasaki City. On the basis of this trust and the collaborative relationship that has been cultivated in such a manner, we, together with other joint undertakers, gave support to development of a low-carbon society in Bandung.

(2) Commissioned undertaker

Representative of the study
Institute for Global Environmental Strategies (IGES)
Address: 2108-11 Kamiyamaguchi, Hayama-machi, Miura-gun, Kanagawa
Tel: 046-855-3700 (Reception)

Joint undertaker
Japan Environmental Sanitation Center
Address: 10-6 Yotsuyakami-cho, Kawasaki-ku, Kawasaki City, Kanagawa
Tel: 044-280-0035

Joint undertaker
Kawasaki Environment Research Institute, Environment Bureau, Kawasaki City
Address: 3-25-13 Tono-machi, Kawasaki-ku, Kawasaki City, Kanagawa
Tel: 044-276-8994

Sub-contractor
NTT FACILITIES, INC.
Address: 9F SAITAMA-MEDIAWAVE Building, 9 Shintoshin, Chuo-ku, Saitama City, Saitama
Tel: 048-602-5811
Sub-contractor
Hitachi Zosen Corporation
Address: Ninety Bldg., 5-3-28, Nishikujo, Konohana-ku, Osaka
Tel: 06-6468-9656

Sub-contractor
Institut Teknologi Bandung
Address: Jalan Ganesha no. 10, Bandung, 40132 INDONESIA
Tel: +62-22-2502350

Details of the undertaking

A general office to promote transformation of Bandung into a low-carbon city was established, and the following undertaking was carried out.

(1) Feasibility study

To assess the possibility of future technology transfer and assist in project development, a feasibility study was carried out to identify the issues, challenges, etc. in the following two areas:

1) Feasibility of energy saving technologies
   (a) Building facilities for energy saving (renewal of chiller; renewal of lighting)
   (b) Energy-saving street lamp (use of LED)

2) Feasibility of waste treatment that uses methane fermentation energy technology
1. Indonesian policy

1.1 Energy

The Indonesian economy has been enjoying a relatively high growth rate of around 6% since 2010 and is on a steady upwards trend toward the future. As a result of this, the consumption of primary energy has drastically increased by 44% between 2002 and 2012. One of the main factors for this, according to a study by the Asian Development Bank, is the transport sector, where oil consumption has been increasing by 4.7-5.9% every year. The bank anticipates that, unless fuel subsidy is reduced, this trend will continue, causing oil consumption to double by 2035 (compared to 2010); and, keeping pace with economic growth, the consumption of coal and electricity will increase by a factor of five to seven times (compared to 2012) in the future.

Although the country is relatively rich in energy resources, it is planning and promoting introduction of new energies, including coal and atomic energy and substitution by renewable energy, to reduce its dependency on oil for domestic demand as well as in consideration of environmental impact. As a Presidential Decree was issued in 2006 to formulate the “National Energy Policy (KEN – Kebijakan Energi Nasional)” in which the target, as a part of long-term energy strategy, is to reduce the use of fossil fuel such as oil, coal, and natural gas to 83% of total consumption and to increase the use of new or renewable energy to 17% or more by 2020. In addition, as an action plan for the strategy, the National Energy Master Plan (RUEN) toward 2050 was formulated in 2014. It is anticipated that there will be further formulation of energy plans at the provincial and municipal government levels in the future.

1.2 Waste management

In terms of waste management in Indonesia in general, 130,000 tons of waste are generated daily, and 74% of it is illegally dumped or left uncollected. Although the government was not very keen in dealing with waste for a long time, after the collapse of a rubbish dump at Leuwigajah final disposal site in Bandung in February 2005, where 141 people were killed, the concept of solid waste management was stipulated in 2007. After this, not only management of solid waste, but also other related legal systems such as measures concerning treatment of hazardous waste, waste recycling, health and sanitation, and import of waste have been put into place one after another.

Solid waste in Indonesia is usually collected and stored temporarily at an intermediate waste disposal yard (TPS) before finally deposited in landfills at the final disposal site (TPA) managed by the regional municipal government. Although there are 537 TPAs throughout Indonesia, as few of them are operated in an appropriate manner, it is necessary to curtail contamination of soil and water. In addition, as it is feared that there will be discharge of bad odor or untreated wastewater and/or ignition/fire caused by methane gas due to budget shortage of the regional municipal government, in 2008, “Solid Waste Management Law No. 18/2008” declared a ban of landfilling of solid waste (open dumping) in five years; further, a Presidential Decree in 2012, “Domestic Solid Waste Management and Solid Waste,” stipulated step-by-step introduction of sanitary landfill at waste disposal sites (improving operation and management by compacting the waste and covering the surface with soil every day). Although sanitary landfilling at the final disposal site (TPA) was managed by the city government, as a temporary measure, the obligation is being mitigated so that compaction of the waste and covering of the surface with soil can be done once every seven days (controlled landfill).

Moreover, as the volume of waste has increased and its constitution have changed, with much more plastic waste, the central government has been trying to implement 3R policy from 2007 with an eye to reducing the amount of landfill and recycling of resources, but it cannot be denied that the system needs further improvement. In addition, the tipping fee collected from residents and the budget of the local government are too small to cover the cost, which is another reason for this, as those regulations that are concerned with cleaning process, waste management, and fee structure of waste management carried out by respective local governments are very loose even though such operations had been transferred to the local governments or relevant organizations after 1999 thanks to localization policies in Indonesia.
Indonesia, among other Southeast/East Asian countries, produces a large amount of waste, making it the fourth-ranked country after China, Korea, and Japan. The composition of waste is food 63%, paper 11%, and plastics 10%; therefore, it is assumed that 3R initiative to promote effective use of waste would be beneficial in addition to the measures mentioned above. As a part of such effort, a target is to generate LP gas at the final disposal site in 240 cities throughout Indonesia by the end of 2014; and, the governmental budget for public awareness activities for 3R initiative has been increased by US$50,000,000 in the last 10 years.

Bandung City has also been struggling with waste management. As of 2012, while 85% of waste is treated by the government; the remaining 15% is treated by the residents themselves or dumped in rivers or along roadsides. Currently most of the publicly managed waste is disposed of by landfill; however, as the capacity of three landfill sites owned by the Bandung City has already been used up, city wastes are now transported to and disposed of at another landfill site managed by the West Java provincial government. As it is anticipated that this site will also be used up by 2015, in order to improve the situation, the Bandung city government and other associated organizations have set up rubbish bins to encourage waste reduction; i.e., 3R activities; as a result, about 7% or 135 tons of the city waste is being managed by the 3R program. In addition, there are 70 rubbish banks that have been set up in the city, and it is expected that these could be one of the useful measures to reduce household waste in the future. According to the Bandung City mid-term plan, waste power generation and treatment by 3R will constitute 35% and 30%, respectively, of total rubbish treatment by 2018.

### Figure 1.1: Bandung City Mid-term Plan 2014-2018 (waste area)

<table>
<thead>
<tr>
<th>Index</th>
<th>Composition</th>
<th>At the beginning</th>
<th>2014 target</th>
<th>2015 target</th>
<th>2016 target</th>
<th>2017 target</th>
<th>2018 target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of waste treated by the municipal government</td>
<td>% (a)</td>
<td>76</td>
<td>77</td>
<td>82</td>
<td>88</td>
<td>89</td>
<td>90</td>
</tr>
<tr>
<td>1) Disposal by landfill</td>
<td>% (b)</td>
<td>69</td>
<td>69</td>
<td>68</td>
<td>58</td>
<td>34</td>
<td>25</td>
</tr>
<tr>
<td>2) Waste reduction</td>
<td>% (c = a-b)</td>
<td>7</td>
<td>8</td>
<td>14</td>
<td>30</td>
<td>55</td>
<td>65</td>
</tr>
<tr>
<td>2)-a Waste reduction by 3R treatment</td>
<td>% (d)</td>
<td>7</td>
<td>7</td>
<td>10</td>
<td>15</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>2)-b Waste reduction by waste power generation</td>
<td>% (e = c-d)</td>
<td>0.1</td>
<td>1</td>
<td>4</td>
<td>15</td>
<td>30</td>
<td>35</td>
</tr>
</tbody>
</table>

2. Regional action plan of West Java Province for greenhouse gas emissions reduction

For Bandung to try to become a low-carbon city, first of all, it is necessary to understand the climate change measures promoted by the Indonesian government. As one of the major emitters of greenhouse gas in the world, Indonesia has been promoting climate change measures in a positive fashion. In September 2009, then-President Yudhoyono announced a target to “reduce the greenhouse gas emission by 26% (41% with international assistance) from the BAU level by 2020. To achieve this reduction target, a Presidential Decree “National Action Plan for Reducing Greenhouse Gas Emissions (RAN-GRK)” was formulated in September 2011; and, various stakeholders such as central government agencies, local governments, and private business operators are obliged to reduce their emission between 2010 and 2020.

As part of this initiative, each provincial government is working on formulation of an Action Plan for Reducing Greenhouse Gas Emissions (RAD-GRK); and West Java Province, where Bandung is located, has already completed the formulation of action plan. See the Figure below, which summarizes the policies and strategies in support of RAN-GRK in both the “energy” and “waste” areas.
**Figure 2.1: Province of West Java, Action Plan for Reducing Greenhouse Gas Emissions (RAD-GRK)**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Policy of West Java</th>
<th>Strategies of West Java</th>
</tr>
</thead>
</table>
| **Energy** | 1. Promote energy-saving  
2. Use clean fuel  
3. Strengthen the use of renewable energy | 1. Reduce final energy consumption by application of energy-saving technologies and reduction of non-renewable energy  
2. Recommend use of small to medium scale renewable energy |
| **Waste** | 1. Strengthen the domestic management of solid waste and wastewater treatment | 1. Strengthen organizational framework and legal system in the region  
2. Strengthen management of wastewater treatment in the urban area  
3. Reduce the volume of waste by 3R  
4. Improve the waste treatment processes at the final disposal facilities  
5. Improve, construct, and renovate the final disposal facilities  
6. Use the energy generated from the waste |


With respect to the greenhouse gas emissions reduction target for the West Java provincial government, CO₂ and CH₄ associated with waste constitute the greatest part; for example, 479.78 million ton of CO₂ is the target to be achieved in relation to landfill, incineration, etc. After that, with respect to reduction target associated with agriculture, it is 12.89 million ton of CO₂ from fertilizer etc. as well as CH₄ associated with livestock manure. In terms of CO₂ emission from general households in association with energy, LP gas, kerosene, and charcoal are major sources, amounting to 3.18 million ton of CO₂. In relation to the provincial government, the main component is the greenhouse gases associated with diesel oil, kerosene, and coal used in the manufacturing process of cement, limestone, steel, iron, and nonmetal products.
Figure 2.2: Greenhouse Gas Emissions Reduction Target of West Java Province

<table>
<thead>
<tr>
<th>Area/Activities</th>
<th>Reduction target (million t-CO₂)</th>
<th>Organization in charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Agriculture: 12.89 million t-CO₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Development of organic rice farming using System Rice Identification Method</td>
<td>12.54 (2010-2020)</td>
<td>DIPERTA¹</td>
</tr>
<tr>
<td>• Increase rice production and productivity in 19 regencies and 7 cities</td>
<td>0.0067 (2010-2020)</td>
<td>DIPERTA</td>
</tr>
<tr>
<td>• Development of BATAMAS</td>
<td>0.34 (2013-2020)</td>
<td>DISNAK²</td>
</tr>
<tr>
<td>• Distribution and application of feed technology</td>
<td>0.006 (2013-2020)</td>
<td>DISNAK</td>
</tr>
<tr>
<td>II. Forest: 0.34 million t-CO₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Rehabilitation of Degraded Forest Lands</td>
<td>0.34 (2013-2020)</td>
<td>DISHUT³</td>
</tr>
<tr>
<td>III. Energy: 3.18 million t-CO₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Energy saving program of West Java Province</td>
<td>3.18 (2013-2020)</td>
<td>DESDM⁴</td>
</tr>
<tr>
<td>IV. Transport area: 1.1 million tons of CO₂ Eq</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Mandatory biofuel by 15% in 2025 for the type of premium fuel and diesel oil</td>
<td>1.1 (2013-2020)</td>
<td>DESDM DISHUB³</td>
</tr>
<tr>
<td>V. Industry: 7.2 million tons of CO₂ Eq</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Obligation on utilizing alternative energy with substitution Target by 25% in 2025</td>
<td>7.2 (2013-2020)</td>
<td>DESDM DISPERINDAG⁶</td>
</tr>
<tr>
<td>VI. Waste: 479.78 million tons of CO₂ Eq</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Waste reduction (3R program)</td>
<td>42.71 (2013-2020)</td>
<td>DISKIMRUM⁷</td>
</tr>
<tr>
<td>• Construction of integrated waste disposal</td>
<td>0.00009 (2013-2020)</td>
<td>DISKIMRUM</td>
</tr>
<tr>
<td>• Operations of semi-aerobic landfill and sanitary landfill, as well as procurement of hoard land</td>
<td>139.74 (2015-2020)</td>
<td>DISKIMRUM</td>
</tr>
<tr>
<td>• Recovery of Methane gas in Sumur Batu Final Disposal (CDM – Project)</td>
<td>103.67 (2010-2020)</td>
<td>DISKIMRUM</td>
</tr>
<tr>
<td>• Conversion of Pit-Latrines to Septic-Tank</td>
<td>193.66 (2014-2018)</td>
<td>DISKIMRUM</td>
</tr>
</tbody>
</table>

The mitigation actions to reduce the greenhouse gas emissions of the West Java Province RAD-GRK to achieve the targets mentioned above are categorized into three, energy, transport, and waste management. Here we focus on the energy area and the waste area. In this regional plan, the energy demand in West Java Province in 2030 is projected using LEAP software; and, according to the projection, the demand for energy will increase in the future due to the rate of population increase, increase of GDP growth rate, and increase of electrification rate. According to the plan, measures to deal with this include introduction of alternative energy and raising awareness of energy savings. On the other hand, waste reduction is mentioned as one of the mitigation actions in relation to the waste area, where it is recommended that organic waste should be composted and effectively used as fertilizer and non-organic waste should be recycled through the 3R program. In addition, the plan indicates other measures such as waste collection, improvement of transport infrastructure, acquisition of land for landfill, and measures to deal with methane gas generated by open dumping. The list of concrete action plans in both areas is shown as follows:

¹ Department of Agriculture and Food
² Department of Livestock Service
³ Department of Forestry
⁴ Department of Energy and Mineral Resources
⁵ Department of Transportation
⁶ Department of Industry and Trade
⁷ Department of Settlement and Housing
**Figure 2.3: Province of West Java, Action Plan for Reducing Greenhouse Gas Emissions (RAD-GRK) - List of Action Plans in Energy Area**

<table>
<thead>
<tr>
<th>No</th>
<th>Action Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Major programs</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Convert kerosene for household use to LPG</td>
</tr>
<tr>
<td>2</td>
<td>Promote energy efficiency improvement for the household sector</td>
</tr>
<tr>
<td>3</td>
<td>Convert kerosene for commercial use to LPG</td>
</tr>
<tr>
<td>4</td>
<td>Promote energy efficiency improvement for the commercial sector</td>
</tr>
<tr>
<td><strong>B. Secondary programs</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Supporting activities</td>
</tr>
<tr>
<td>2</td>
<td>Development and management of the use of coal</td>
</tr>
<tr>
<td>3</td>
<td>Make the coal inspection in West Java Province simpler</td>
</tr>
<tr>
<td>4</td>
<td>Develop the use of gas in West Java</td>
</tr>
<tr>
<td>5</td>
<td>Increase awareness activities concerning energy conservation and energy savings</td>
</tr>
<tr>
<td>6</td>
<td>Promote self-supporting distributed renewable energy power generation in the remote villages of West Java Province</td>
</tr>
<tr>
<td>7</td>
<td>Monitor the method of fuel &amp; lubricant use and their quality</td>
</tr>
<tr>
<td>8</td>
<td>Create a database of geothermal reserves in West Java Province</td>
</tr>
<tr>
<td>9</td>
<td>Make the development of petroleum oil, gas, and geothermal WKP easier</td>
</tr>
<tr>
<td>10</td>
<td>Put in place environmentally friendly engineering in West Java Province in relation to geothermal energy, petroleum oil, and gas</td>
</tr>
<tr>
<td>11</td>
<td>Develop, monitor, and control the use of plant-derived electricity</td>
</tr>
</tbody>
</table>
### Figure 2.4: West Java Province Action Plan for Reducing Greenhouse Gas Emissions (RAD-GRK) - List of Action Plans in Waste Area

<table>
<thead>
<tr>
<th>No</th>
<th>Action Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Major programs</td>
</tr>
<tr>
<td>1</td>
<td>Program to reduce the waste as much as possible on the basis of 3R principles</td>
</tr>
<tr>
<td>2</td>
<td>Improvement on intermediate disposal facilities (TPST)</td>
</tr>
<tr>
<td>3</td>
<td>Acquisition of land and establishment of sanitary facilities for landfill</td>
</tr>
<tr>
<td>4</td>
<td>Introduction of methane recovery technology by CDM project</td>
</tr>
<tr>
<td>5</td>
<td>Transition from LATRIN to septic tank</td>
</tr>
<tr>
<td>B.</td>
<td>Supporting program</td>
</tr>
<tr>
<td>1</td>
<td>Prepare the master plan in relation to waste</td>
</tr>
<tr>
<td>2</td>
<td>FS (Feasibility study) on coordination of landfill sites</td>
</tr>
<tr>
<td>3</td>
<td>Coordination of landfill sites</td>
</tr>
<tr>
<td>4</td>
<td>Program to achieve Green Indonesia</td>
</tr>
<tr>
<td>5</td>
<td>C. Improvement of waste-related facilities</td>
</tr>
<tr>
<td>6</td>
<td>Improvement or construction of landfill site in 10 cities/areas</td>
</tr>
<tr>
<td>7</td>
<td>Wastewater management plan</td>
</tr>
<tr>
<td>8</td>
<td>Prepare the master plan in relation to wastewater</td>
</tr>
<tr>
<td>9</td>
<td>Feasibility study on shared septic tanks</td>
</tr>
<tr>
<td>10</td>
<td>Development plan for shared septic tanks</td>
</tr>
</tbody>
</table>

### 3. Regional action plan of Bandung City for greenhouse gas emissions reduction

The followings are excerpts from the West Java Province Action Plan that are related to Bandung City. With respect to Bandung City, 56 areas out of 151, approximately a third of the City, would be affected by climate change. It has been pointed out that there are such particular problems as (1) waste left uncollected/untreated, (2) increase of slum population, (3) access to energy has not been developed sufficiently; there are not many parklands/green spaces, and (4) there are no organizations or agencies to deal with climate change issues.

Among other action plans for Bandung City, the following is the list of energy-related action plans which are related to this feasibility study:
Figure 3.1: Bandung City, Action Plan for Reducing Greenhouse Gas Emissions (RAD-GRK) - List of Action Plans in Energy Area

<table>
<thead>
<tr>
<th>No.</th>
<th>Reduction actions</th>
<th>Source of funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Socialization of fuel savings</td>
<td>APBN, APBD</td>
</tr>
<tr>
<td>2</td>
<td>Socialization of biogas energy utilization in households</td>
<td>APBN, APBD, Foreign Aid</td>
</tr>
<tr>
<td>3</td>
<td>Biodigester installation program from organic waste, animal and human feces in the household</td>
<td>APBN, APBD, Foreign Aid</td>
</tr>
<tr>
<td>4</td>
<td>Socialization of biofuels to the public following the provision of fuels</td>
<td>APBN, APBD</td>
</tr>
<tr>
<td>5</td>
<td>Development of biofuels from local resources, such as paddy straw or organic waste rice fields</td>
<td>APBN, APBD, Foreign Aid</td>
</tr>
<tr>
<td>6</td>
<td>Utilization of biofuels</td>
<td>APBN, APBD</td>
</tr>
<tr>
<td>7</td>
<td>Socialization of energy savings in residential area and industries</td>
<td>APBN, APBD</td>
</tr>
<tr>
<td>8</td>
<td>Utilization of energy-efficient appliances</td>
<td>APBN, APBD</td>
</tr>
<tr>
<td>9</td>
<td>Implementation of smart technology with sensing-technology in electricity use</td>
<td>APBN, APBD, Foreign Aid</td>
</tr>
<tr>
<td>10</td>
<td>Implementation of eco-building concept in the offices</td>
<td>APBN, APBD, Foreign Aid</td>
</tr>
<tr>
<td>11</td>
<td>Installation of solar cells in residencies and industries</td>
<td>APBN, APBD, Foreign Aid, Private</td>
</tr>
<tr>
<td>12</td>
<td>Construction of micro-PLTSA or waste incinerator</td>
<td>APBN, APBD, Foreign Aid, Private</td>
</tr>
<tr>
<td>13</td>
<td>Utilization of wind energy (wind turbine)</td>
<td>APBN, APBD, Foreign Aid, Private</td>
</tr>
<tr>
<td></td>
<td>Non-technical RAD-PI</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Development of information system that provides energy data from each region to RAD PI</td>
<td>APBN, APBD</td>
</tr>
<tr>
<td>15</td>
<td>Socialization of RAD-PI to all districts</td>
<td>APBN, APBD</td>
</tr>
<tr>
<td>16</td>
<td>Development of information system of RAD Bandung City</td>
<td>APBN, APBD</td>
</tr>
<tr>
<td>17</td>
<td>Integration of RAD into educational curriculum from primary to high school level</td>
<td>APBN, APBD</td>
</tr>
</tbody>
</table>
4. Energy

4.1 Energy conservation plans in Indonesia

As energy conservation becomes an issue in the demand sectors as well as in the use of new and renewable energy in the supply sectors for the voracious energy consumption that is expected to continue in the future, the “National Energy Conservation Master Plan (Rencana Induk Konservasi Energi Nasional: RIKEN)” was enacted in 2005 in Indonesia as a long-term energy conservation strategy, and it was stipulated that the energy intensity shall be reduced by an annual average of 1% until 2025. In order to achieve the goal, a number of energy conservation-related policies have been established, such as the introduction of energy-conservation guidelines in government buildings, the implementation of energy audits in industrial and commercial facilities, and the introduction of energy evaluation labels to electrical appliances.

In addition, the Government Decree “Government Regulation No. 70/2009 on Energy Conservation” was enacted in October 2009, which required the energy supplying side, the demanding side, and the energy-related service providers, etc. to save energy. In order to change the awareness of large consumers (with annual consumption of 6,000 TOE or more of petroleum oil equivalent) in particular, incentives have been introduced for those consumers who have contributed to energy saving, such as reduction of or exemption from local taxes and provision of government subsidies for the cost of energy audits. On the other hand, for those who have not contributed, the fact that they did not comply may be published and a fine may be imposed.

In addition, under the initiative of then President Susilo Bambang Yudhoyono, the Presidential Decree “Presidential Instruction No. 13/2011 on Energy and Water Conservation” was stipulated in 2011 in order to promote energy-savings and water-savings, and cross-agency task force organizations and training institutions are being established to set the goal of a 20% power consumption cut and to lead the policy making to achieve it. A task force was established with the Ministry of Economic Affairs as the Chair, and it has been decided that it will give specific activity instructions to the provincial and municipal governments in the future. In addition, in order to achieve the goal, the establishment of a new organization to monitor energy savings is also required.
Figure 4.1: Indonesia’s main energy conservation-related policies

<table>
<thead>
<tr>
<th>Fiscal year</th>
<th>Regulation</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>Presidential Decree No. 9</td>
<td>Energy conservation in Government and public buildings and official vehicles</td>
</tr>
<tr>
<td>1991</td>
<td>Presidential Decree No. 43</td>
<td>Instruct that the energy conservation-related policies and programs be arranged by cross-related agencies. In particular, investment, energy conservation-related programs, and energy-related price setting are taken up.</td>
</tr>
<tr>
<td>2004</td>
<td>Ministerial Decree No. 0002</td>
<td>Promotion of renewable energy and energy conservation (“Green Energy Policy”)</td>
</tr>
<tr>
<td>2006</td>
<td>Presidential Decree No. 5</td>
<td>“National Energy Policy”</td>
</tr>
<tr>
<td>2007</td>
<td>Act No. 30/2007</td>
<td>Energy</td>
</tr>
<tr>
<td>2008</td>
<td>Presidential Decree No. 2</td>
<td>The Government shall report on the energy-saving and water-saving efforts at least every two years</td>
</tr>
<tr>
<td>2009</td>
<td>Government Decree No. 70</td>
<td>Energy conservation</td>
</tr>
<tr>
<td>2010</td>
<td>Ministerial Decree No. 13</td>
<td>Mandated that energy management personnel be assigned for industrial construction</td>
</tr>
<tr>
<td>2010</td>
<td>Ministerial Decree No. 14</td>
<td>Set the standards for building management personnel</td>
</tr>
<tr>
<td>2011</td>
<td>Presidential Decree No. 13</td>
<td>Energy-savings and water-savings</td>
</tr>
<tr>
<td>2011</td>
<td>Presidential Decree No. 61</td>
<td>Presidential Decree on the action plan for reducing greenhouse gas emissions and greenhouse gas inventory management</td>
</tr>
<tr>
<td>2012-2013</td>
<td>The Ministry of Energy and Mineral Resources’ energy savings and water savings-related Ministerial Decree</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• MEMR No. 13/2012 about electricity saving</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• MEMR No. 14/2012 about energy management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• MEMR No. 01/2013 about fuel consumption reduction</td>
<td></td>
</tr>
</tbody>
</table>

4.1.1 Province of West Java

In response to the central government policy, the Province of West Java, to which the City of Bandung belongs, has been promoting energy conservation and has set a goal to reduce energy consumption by 20% since the Ministry of Energy and Mineral Resources in 2012 stipulated the Ministerial Decree “MEMR No. 13/2012.” To start with, energy conservation activities in government buildings were to be undertaken, mandating as many as 30 activities.

1. Introduction of energy-efficient air conditioning equipment
2. Use of hydrocarbon coolants
3. Install the compressors for air conditioning equipment while avoiding direct sunlight
4. Turn off unused air conditioning
5. Install indoor thermometers
6. The room temperature and indoor humidity settings shall conform to the Indonesian National Standard (SNI)
1. Central air conditioning
2. Close the air-conditioned rooms where possible
3. Check on a regular basis
4. Use window glass that cuts solar heat as much as possible and at the same time keeps solar light indoors
5. Reduce temperature rise by arranging plants and a pool around the building
6. Replace incandescent lamps with energy-saving type lamps
7. Refrain from using decorative lighting
8. Use an electrical ballast for fluorescent lamps
9. Set the maximum power usage in accordance with the Indonesian National Standard (SNI)
10. Use high-reflectance ballast housings to disperse the light
11. Install lighting switches in every room to allow individual control
12. Install automatic photocell-controlled switches or switches with a timer for the lighting in gardens, on terrace structures, and in corridors
13. Be sure to turn off unused lights
14. Pull the curtain during the day to take the natural light in
15. Clean the lamps and ballasts
16. Set elevators to stop at every two floors
17. Install motion sensors to escalators
18. Set a PC to shut itself down when the user is away for more than 30 minutes
19. Set printers to be turned off when not in use
20. Set copying machines to the standby mode to reduce power consumption
21. Use audio equipment only when necessary
22. Turn on water heaters immediately before use and turn off immediately after use
23. Increase the power factor by using a capacitor bank
24. Decentralize energy supply sources

4.2 Energy conservation plans and related laws and regulations of the City of Bandung

The power supply rate in Bandung is higher than the national average, at 90% in 2013. However, the distribution networks are still inadequate and the costs for operation and maintenance are high. In addition, the supply and demand are not well balanced, causing excessive supply in specific areas but short supply in other areas. According to the energy and power-related regulations set forth by the City in 2012, “PERDA Kota Bandung No. 18 2012” (see attached English translation), the city government shall have the responsibility for general energy-related policies, including energy conservation. Through the advancement of energy source identification in the city, the decentralization of energy supply bases is promoted.

In recent years, Bandung has been recognized as an eco-city alongside Solo and Denpasar; it has been selected by the Government of Indonesia as a deployment site for the pilot project of street lamp energy savings, and LED street lamps with built-in smart meters are installed within the city. The city is constantly cooperating with the Ministry of Energy and Mineral Resources in its data collection and analysis. In addition, by using the subsidies from the Ministry, audits are conducted in four buildings (City Hall, hospital, government research facility, and shopping malls) to find out if there are ways to improve the energy use method, and specific energy conservation measures are taken based on the consultant recommendations.

In order to cope with the above-mentioned initiatives and the contribution requests toward energy conservation goals of the Province of West Java, the City of Bandung is making efforts to improve power-saving awareness of the government. In 2013, a roadmap to improve power-saving and water-saving awareness was established through the support from local NGOs; the Green Committee was established in the government in which the representatives of each Department participate; and training of government staff and measurement of power consumption in municipal office buildings that are scattered in the city are carried out. Thus, preparation for the full-fledged activities is underway. Steady efforts to draw attention of the 72 government-related public corporations are likely to continue in the future.
4.3 Review of energy conservation technologies introduced in the City of Bandung

In this section, the technologies introduced in order to promote energy conservation in the City of Bandung are described. As a target of introducing energy conservation technology, the use of LEDs for street lamps and the buildings has been reviewed.

Walk-through survey
A walk-through survey was conducted for the following facilities cited as candidates by the Bandung city government in order to grasp the actual conditions of the street lamps in the city and to select the buildings to implement energy conservation diagnosis when reviewing the latest technologies that contribute to installation of LED street lamps and to energy conservation in buildings in Bandung.

Walk-through survey implemented facilities:
1. LED street lamps
2. PTNBR-BATAN (nuclear research facility)
3. Borromeus Hospital (hospital)
4. Bandung Indah Plaza (shopping mall)
5. Trans Studio Mall (shopping mall)
6. Bio Farma (pharmaceutical company)

The energy-saving potential and feasibility were taken into account for the locations that were subjects of building energy conservation review, and the following conditions were reviewed as the basic policies for facility selection.

Conditions
1) Have an air-cooled or water-cooled chiller.
2) The chiller’s refrigeration capacity is approximately 1,000 kW (300 US refrigeration tons) or more.
3) Annual electricity usage of 6,000,000 kWh/year or more (approximately 1,500 kL of crude oil equivalent or more).
4) Ten or more years have passed since the chiller, etc. equipment was installed (15 years or more recommended).
5) In the case of the multiple packaged air conditioning unit system, the total shall satisfy 2) as well as 3) and 4).
6) An ammeter shall be installed in the system that supplies electricity to the chiller.
7) The conditions 1) to 3) shall be satisfied in one building.
8) Monthly electricity usage data have been kept for the last three years or more.
9) The power system diagram is kept, and can be shared before the on-site survey.
10) You have a good interest in energy conservation and shall cooperate in our surveys and proposals.

At the same time, surveys were carried out by installing a monitoring system in order to collect power usage data in facilities that were subjects of energy conservation diagnosis. The workability, etc. was taken into account by considering the conditions of the local facility, and the appropriate measurement method was selected from the following to carry out the surveys.

![Figure 4.0-2: Measurement methods](image)

**Walk-through survey results**

1. **LED street lamps**
   - **At the pole top is the smart box, and at the bottom is the junction with the PLN.**
   - **The hearing**
     - a) By using the GPS function, the local times for sunset and sunrise are calculated from each installation location’s longitude and latitude information to automatically change the timer settings for appropriate lighting control.
     - b) The LED street lamps’ outputs are dimmed to 40% to 60% between 10:00 p.m. and 3:00 a.m. to reduce energy consumption. Such output control had not been possible with the existing sodium lamps, etc.
   - **Sixteen LED street lamps surveyed this time are installed in the vicinity.**
Survey findings

- Review for renewal is possible from each type of street lamp specification and the existing power consumption data.
- The introduction of LED street lamps and smart meters in Bandung still remains experimental and is of limited scale.
- Based on the information about Kawasaki City’s street lamp renewal records, renewing from the existing lighting to LED lamps is considered.

PTNBR-BATAN (nuclear research facility)

The hearing

a) This building is the subject of the Building Energy Management and Saving (BEMS) Program of the Ministry of Energy and Mineral Resources (ESDM). Unlike BEMS in Japan, BEMS here means the maintenance and operational activities related to energy in buildings.

b) Since the introduction of power monitoring in FY2012, measurement of consumed electric energy in every building and on every site zone has been carried out.

c) Copper-iron fluorescent lamp ballasts are being replaced by electronic ballasts.

d) The power usage by the device cooling pumps is also large.

e) In recent years, the average power capacity has been 107 kW at normal times.

f) The energy conservation benchmark index is 4.17 kWh/m²-month (50.04 kWh/m²-year).
g) The power usage is 120 to 150 kVA at normal times and peaks at approximately 460 kVA. It peaks when the reactor device operates.

h) The reactor device with a large power capacity repeats the operational cycle consisting of 72 hours of operation followed by two weeks of suspension. Currently, it is not operating, due to disaster prevention work.

![Photo 6: Copper-iron ballast (below) and electronic ballast (above)](image1)

![Photo 7: In-house energy conservation awareness raising activity panel](image2)

![Photo 8: Packaged air conditioning unit (wall-mounted)](image3)

![Photo 9: Power-receiving transformer (630 kVA)](image4)

**Survey findings**
- As a whole, this is a building with low annual energy consumption (see f).
- Although the reactor device that affects the demand is installed, it is not a subject of renewal, in view of the operating time and the limited operating hours with respect to the annual energy usage (see h), as well as its status as a research device.
- Obsolescence and deterioration of the air-conditioning equipment due to aging can be taken into consideration and a reduced CO₂ emission effect can be expected by renewing to high-efficiency equipment, however, the project is considered to be less feasible because the total potential is considered to be low.

**Monitoring**
- Since a monitoring system was once introduced in the past and energy saving potential is also low, it has been determined that this facility is not an appropriate subject for monitoring.

**Borromeus Hospital (hospital)**

**The hearing**
- This hospital mainly has four buildings (the Maria Building, the Yosef Building, the Carolus Building, and the Irine Building).
- Currently, LPG is used as the fuel for the boilers. It is planned to be switched to city gas in the future.
- The manual switch for the outdoor lighting has been replaced by a timer type to reduce waste of energy.
- For instance, the pump system used to have four units in constant operation, but the number of units in operation is now being controlled for energy conservation.
c) Basically, the multiple packaged air conditioning unit system is employed, which does not have a large chiller. (Some seem to have a chiller for refrigeration)

f) In 2012, the fuel for the boilers was switched from gas oil to LPG.

g) In 2013, the water rate soared, causing a significant impact on payment.

h) Basically, every building is supposed to have the power measurement data.

i) The Yosef Building is considered to be the largest power consumer.

j) Water from the well is processed by the water treatment facility.

k) The annual electricity usage has been 5,392,640 kWh (2013 records), which approximately corresponds to 176 kWh/m²-year.

**Survey findings**

- As a whole, the building consumes a relatively small amount of energy as a hospital building, and since the multiple packaged air conditioning unit system is employed, if we take into account the peculiarities of the hospital and the complexities involved in the construction, etc. when renewing the air-conditioning facilities, it is difficult to make it a subject.
- Sufficient walk-through time in the hospital could not be secured and the possibility of lighting renewal, etc. could not be confirmed, but LED lighting may be feasible.

**Monitoring**

- The overall power usage is small, but among the buildings the Yosef Building, which is the largest power consumer, is considered to be the candidate for monitoring.
- The power usage in the Yosef Building can be measured using the ammeters on Panels No. 7 and No. 14 shown below. (Method 2)
- Only the officials are allowed to enter the room, and security is considered to be assured.
- Since there is an outlet in the room and the panel space is large enough, the installation is relatively simple.
- There is no Wi-Fi environment, so a separate mobile line is required.

![Photo 10: Packaged air conditioning unit (wall-mounted)](image1)

![Photo 11: Incoming transfer room (in the Yosef Building)](image2)

Figure 4.0-3: Plan view of the power room
Bandung Indah Plaza (shopping mall)

- **The hearing**

  a) The building has three basement floors and four floors above ground, and major tenants are Hypermart, Matahari Department Store, and a Food Court.

  b) Power is drawn from the PLN using the dual system.

  c) The air-cooled chiller was installed in 1990 and it should now be renewed, but currently the new water-cooled chiller introduced in 2011 is in regular use. Seemingly, the air-cooled chiller has not been used since the water-cooled chiller was introduced.

  d) In addition to the power-receiving point, a watt-hour meter is also installed only on the water-cooled chiller.

  e) The underground part of the building is a parking lot, and most of the fluorescent lamps are illuminated constantly.

  f) The lighting for the parking lot uses two types of lamps together – TL type 36-W fluorescent lamps along with 36-W lamps.

  g) The lighting for public passages inside the stores mostly uses compact fluorescent lamps (13 W), whose number totals approximately 3,200. Metal halide lamps are installed on the stairwell part, but currently they are not lit.

  h) In the backyard, only the necessary locations are lit and other locations are unlit.
Photos 16: Parking lot lighting
   (one-lamp unit)

Photos 17: Parking lot lighting
   (two-lamp unit)

Photo 18: TL type fluorescent lamp
   (36 W)

Photos 19: Parking lot passage

Photos 20: Store passage lighting
   (Compact fluorescent lamps)

Photos 21: Store passage lighting
   (Stairwell part)

Photos 22: Store passage lighting
   (Compact fluorescent lamps)

Photos 23: Store passage lighting
   (Stairwell part)
Survey findings

- Initially it was considered to be effective to renew the aged and deteriorated air-cooled chiller for CO₂ emission reduction potential, but the air-cooled chiller is currently not in use, so making it a subject of renewal is not considered to be cost effective.
- With regard to the parking lot lighting, since no natural light comes in and artificial lighting is constantly needed, replacing the fluorescent lamps with high-efficiency equipment such as LED lighting is considered to be effective in reducing CO₂ emissions.
- When promoting LED lighting for the parking lot, an even greater energy conservation effect can be expected if the one-lamp units are used instead of the two-lamp units, although it depends on the light conditions.
- In the store passages, replacing the compact fluorescent lamps with LED bulbs is simple, so it is considered that this inexpensive investment will allow energy conservation. In addition, in the high-ceiling portions such as the stairwells, it is desirable to use LED lamps as much as possible by taking advantage of the long life characteristics of LED lighting.
Monitoring
- This building uses a large amount of energy. In order to grasp the power usage by the various systems as a whole as well as its breakdown, etc., the master mains for System A and B, lighting master mains, and the water-cooled chiller are considered to be candidates for monitoring. The existing ammeter installed in each allows electric current detection. (Method 2)
- Only the officials are allowed to enter the room, and security is likely to be assured.
- The workability of the master mains for System B and the chiller is relatively favorable in terms of both measuring instrument installation spaces and wiring routes, but precautions are required in the construction of the master mains for System A and the lighting master mains, due to the hot-line proximity of the wiring routes.

![Diagram](image1)

Figure 4.0-4: Plan view of the power room (on the 1st basement floor)

![Diagram](image2)

Figure 4.0-5: Plan view of the power room (on the 2nd basement floor)
The hearing

a) Four large facilities exist on the premises; namely, two hotels (The Trans Luxury Hotel and Ibis Bandung Trans Studio), a mall (Trans Studio Mall), and a theme park (Trans Studio Bandung).

b) The total power receiving capacity from the PLN is 14,710 kVA. The four facilities are receiving power separately.

c) The average electricity usage is 4,000,000 kWh per month.

d) In the Mall, the air-cooled chillers seemingly consume 50 to 60% of the total power. In addition, there are 23 escalators and four elevators. Eighty percent of the lighting is TL5 fluorescent lamps.

e) The power usage is roughly grasped by visual inspection and by keeping records for each use every month.
Photo 36: Chiller 2C System breaker (top)

Photo 37: Transformer No. 3 distribution board

Photo 38: Water-cooled chiller

Photo 39: Cooling towers

Photo 40: Water-cooled chiller distribution board

Photo 41: Water-cooled chiller multimeter

Photo 42: Air-cooled chillers (Mall System 1)

Photo 43: Air-cooled chiller (Mall System 1)
Photo 44: Air-cooled chillers (Mall System 2)

Photo 45: Air-cooled chiller distribution boards (Mall System 2)

Photo 46: Breaker in the air-cooled chiller distribution board

Photo 47: Meter wiring on the back of Air-cooled chiller distribution board

Photos 48: Store passage lighting (indirect illumination)

Photos 49: Store passage lighting (indirect illumination)

Photo 50: Stairwell top light

Photo 51: Stairwell top light bottom
Survey findings

- The water-cooled chillers are relatively new, but with regard to the air-cooled chillers the end of the service life is approaching, so now is the time to consider renewal. Since they consume most of the power available in the Mall, the CO₂ emission reduction potential obtained by the renewal is considered to be high.
- As for the lighting in the Mall, the owner side cannot replace the lighting in the rented stores but the lighting on the passages can be renewed by the intention of the owner side. Since the lighting is on during the long opening hours of the Mall and the lighting is installed in the form of indirect illumination and more lighting fixtures are installed compared to other parts of the Mall, the CO₂ emission reduction potential obtained by using LED lighting on the passages is considered to be high.

Monitoring

- It is possible to measure the power consumption in each zone of the air-cooled chillers System 1 and 2 and of the water-cooled chillers.
- Since there are multiple installation locations for the chillers and power consumption measurement requires multiple systems for each use, it has been determined to be inappropriate, due to the difficulties involved in the measurement.
Bio Farma (pharmaceutical company)

The hearing

a) It is manufacturing pharmaceutical and other products in several buildings. There are 43 facilities on the premises.
b) The main building was completed in 1920 and is the oldest on the premises.
c) The building built with the assistance from JICA was completed in 1990. The building has three air-cooled chillers for air conditioning.
d) The site has two power-receiving systems; namely, PLN-1 (3,465 kVA) and PLN-2 (3,465 kVA).
e) The power usage in 2013 was 27,745 MWh/year, and 86% of it was consumed in the production facilities.
f) The breakdown of the annual electric power sources is 74% PLN and 26% Genset. Genset is in regular use (with a cycle of 72-hour continuous operation) as the power source for facilities that cannot tolerate power outages, including some frozen and cold storage facilities.
g) There are three 14-t/h boilers on the premises to supply hot water to each of the autoclave curing, heating, and pure steam generation facilities.
h) The R & D facility has three chillers.
i) Both state-owned and private IT providers are used. There are several VLANs on the premises.
j) Major efforts for energy conservation in the office building are as follows.
   1) Timer control of the AHU
   2) Introduction of chiller inverters has saved 26%
   3) Adoption of laminar air flow has saved 30%
   4) Reduced air conditioner use has saved 9,870 kWh/month
   5) Replacing the TL type fluorescent lamps with LED lighting has saved 701.28 kWh/month
   6) Introduction of solar panels and motion sensors has saved 6,380 kWh/month in lighting
   7) Introduction of solar panels for the parking lot lighting has saved 1,716 kWh/month
   8) Introduction of solar and LED street lamps has saved 2,160 kWh/month
   9) Introduction of outlets with a timer for drinking water machines has saved 1,177.05 kWh/month
  10) Use of solar panel power for recycling pumps has saved 480 kWh/month
k) Investments in energy conservation are as follows.
   In 2010 2,503 MIDR
   In 2011 2,855 MIDR
   In 2012 1,757 MIDR
   In 2013 3,830 MIDR
l) The cost for generating with Genset is approximately 4,000 IDR/kWh and the cost for purchasing power from the PLN is approximately 1,000 IDR/kWh.
m) When installing the monitoring devices, receive the request from the city government and then consider whether or not to give permission. Until then, installation is not permitted.
Survey findings

- As a whole, the annual energy consumption of the building is large, and the production facilities and equipment consume most of it (86%). The building facilities use the remaining 14%. Of the remainder, the major power consuming facility is considered to be air conditioning.
- The building was completed in 1992, and the air-cooled chillers have not been renewed since then. Twenty-two years have passed since they were installed, so the deterioration and reduced efficiency of the equipment cannot be denied.
- Energy conservation efforts have been carried out up until today and the awareness of energy conservation is high, and positive discussions can be expected regarding the introduction of energy-saving equipment.

Monitoring

- Each building has monitoring devices installed to some extent.
- In order to monitor each use, measuring each of the transformer system No. for the lighting, air conditioning, and chillers as well as of the transformer system No. for the production lines allows us to distinguish between the production facilities systems and building facilities systems. In addition, it is considered to be satisfactory if a monitoring device can be installed on the air-cooled chiller distribution board, which is the major power consuming equipment.

As a result of the walk-through survey, Trans Studio Mall and Bandung Indah Plaza have been selected as study subjects since CO₂ emission reduction potential is expected through the introduction of energy conservation equipment. The introduced technologies and the verification results of the effects are described in Section 5.3.2.
4.3.1 Case study 1 LED lighting

In Indonesia, the installation guidelines for street lamps are provided by the national standardization institution (hereafter the BSN), and the City of Bandung has also been installing street lamps in accordance with the guidelines. Based on the guidelines and the planning of Bandung, the introduction of LED lighting that contributes to the reduction of greenhouse gas emissions has been studied.

Guidelines
The guidelines for street lamp installation are classified into those for highways, local distribution roads, regional roads, bridges and tunnels, intersections, etc. in the Street Lighting Specifications in Urban Areas, which specifies the arrangement and functions of the lamps as well as their types and dimensions, etc.

1) Types of street lamps

Table 4.3.1-1: Types of street lamps

<table>
<thead>
<tr>
<th>Types of street lamps</th>
<th>Average efficiency (lm/W)</th>
<th>Design life (h)</th>
<th>Power consumption (W)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low pressure fluorescent lamps</td>
<td>60-70</td>
<td>8,000-10,000</td>
<td>18-20; 36-40</td>
<td>- Local distribution roads and regional roads</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Very high efficiency but short service life</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Used in some areas</td>
</tr>
<tr>
<td>High pressure mercury lamps</td>
<td>50-55</td>
<td>16,000-24,000</td>
<td>125; 250; 400; 700</td>
<td>- Local distribution roads, regional roads, and intersections</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Low efficiency but long service life</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Used in some areas</td>
</tr>
<tr>
<td>Low pressure sodium lamps</td>
<td>100-200</td>
<td>8,000-10,000</td>
<td>90; 180</td>
<td>- Local distribution roads, junctions, railroad crossings, tunnels, and resting places</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Very high efficiency and long service life</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Larger lamp sizes, light control is difficult, and very poor color</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Use is recommended for high efficiency</td>
</tr>
<tr>
<td>High pressure sodium lamps</td>
<td>110</td>
<td>12,000-20,000</td>
<td>150; 250; 400</td>
<td>- Expressways, highways, local distribution roads, junctions, and interchanges</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- High efficiency and very long service life</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Use is recommended for high efficiency</td>
</tr>
</tbody>
</table>
2) Provision related to installation
Street lamps are provided in accordance with the lamp height, road width, and illuminance level type. (See below for a schematic drawing of lighting arrangement)

In addition, the distances between the lamps are defined by classifying the types of lighting fixtures into two in accordance with Table 9 (a road lighting manual for developing countries). Lighting fixtures Type A are a kind of low pressure sodium lighting, which has the property of being capable of irradiating a broad area for superior visibility.

On the other hand, lighting fixtures Type B are a kind of mercury lighting or high pressure sodium lighting, and have high efficiency and high color rendering properties.

A survey has been conducted regarding the LED lighting that conforms to this provision.

H = Height of the lamppost
L = Road width including the median strip
E = Street lamp spacing
I = Illuminating angle

Figure 4.3.1-1: Street lamp arrangement image
## Table 4.3.1-2: Lighting fixtures Type A

<table>
<thead>
<tr>
<th>Type</th>
<th>H (m)</th>
<th>L (m)</th>
<th>Illuminance level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>35 W SOX*1</td>
<td>4</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>55 W SOX</td>
<td>6</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>90 W SOX</td>
<td>8</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>90 W SOX</td>
<td>8</td>
<td>36</td>
<td>35</td>
</tr>
<tr>
<td>135 W SOX</td>
<td>10</td>
<td>46</td>
<td>45</td>
</tr>
<tr>
<td>135 W SOX</td>
<td>10</td>
<td>25</td>
<td>24</td>
</tr>
<tr>
<td>180 W SOX</td>
<td>10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>180 W SOX</td>
<td>10</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*1: Low pressure sodium lamp

## Table 4.3.1-3: Lighting fixtures Type B

<table>
<thead>
<tr>
<th>Type</th>
<th>H (m)</th>
<th>L (m)</th>
<th>Illuminance level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>50 W SON*2</td>
<td>4</td>
<td>31</td>
<td>30</td>
</tr>
<tr>
<td>80 W MBF/U*3</td>
<td>5</td>
<td>33</td>
<td>32</td>
</tr>
<tr>
<td>70 W SON</td>
<td>6</td>
<td>48</td>
<td>47</td>
</tr>
<tr>
<td>125 W MBF/U</td>
<td>6</td>
<td>34</td>
<td>33</td>
</tr>
<tr>
<td>100 W SON</td>
<td>6</td>
<td>48</td>
<td>47</td>
</tr>
<tr>
<td>150 W SON</td>
<td>8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>250 W MBF/U</td>
<td>6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>250 W SON</td>
<td>10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>400 W MBF/U</td>
<td>10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>400 W SON</td>
<td>12</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*2: High pressure sodium lamp
*3: Mercury lamp

---

### Current state of street lighting in Bandung

In Bandung, street lamps are managed in an integrated fashion by the government-organized management corporation (PJU) with regard to the renewal of the existing equipment as well as policy making for and implementation of new installation. Currently, the existing street lamps are mainly mercury lamps and sodium lamps, and approximately 21,000 of them are installed. Street lamps are selected in principle by bid, and not only the domestic products but also a large number of overseas manufacturers’ products such as Philips have been adopted (the manufacturers are responsible for a two-year warranty for mercury lamps and sodium lamps, and a three-year warranty for LED lamps).

So far, only about 200 LED street lamps have been introduced and the process is still in the experimental phase, but it is planned to successively renew the existing street lamps to LED lighting in FY2015 through 2020.
As for the operation of street lamps, ambient light sensors determine the operating hours, which are approximately 11 hours/day. With respect to the LED lighting for demonstration purposes, the GPS calculates the latitude and longitude and the control is being performed in accordance with the sunset and sunrise time.

Electricity rates for street lamps in Bandung
According to the July 2013 records, Rp 1,726,944,502 was billed for the electricity in Bandung. The power usage according to the power consumption meter reading is stated on the invoice for most of the roads, in which the measured rates seem to be adopted. New installation of street lamps is also planned for the future, and increased efficiency through the use of the ICT is required in the meter reading business. Thus, smart meters are considered to come into wide use as an ICT tool.

Equipment renewal to LED street lighting
The introduction of LED products in the field of street lighting is currently in progress. The traditional mercury lamps and sodium lamps are being replaced by LED lamps also in Japan.

Since LED street lamps have characteristics of high light-emitting and illuminating efficiency, their power consumption is significantly reduced compared to the existing street lamps. In addition, since they have a long service life, advantages from the maintenance and operational point of view can also be obtained. Thus, a large cost reduction effect can be expected through the introduction of optimal LED street lamps to the existing street lamp-installed environment.

In Bandung, as the existing street lamps such as sodium lamps and mercury lamps are renewed to LED lighting, the indices for the equipment renewal have been set based on the capacity of the existing equipment as shown on the right.

As can be seen from this Table, the power consumption required by LED lamps for renewal is broadly classified into 60-70 W, 80-100 W, and 100-120 W. Renewal has been reviewed with regard to LED street lamps that comply with the above specifications and guidelines as the equipment for renewal. The Table below shows the equipment specifications of LED street lamps investigated in this survey.

<table>
<thead>
<tr>
<th>Lamp type (Before renewal)</th>
<th>Power consumption (W)</th>
<th>Power consumption after renewing to LED (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium lamp (SON)</td>
<td>70</td>
<td>60-70</td>
</tr>
<tr>
<td>Sodium lamp (SON)</td>
<td>150</td>
<td>80-100</td>
</tr>
<tr>
<td>Sodium lamp (SON)</td>
<td>250</td>
<td>100-120</td>
</tr>
<tr>
<td>Mercury lamp (HPL)</td>
<td>250</td>
<td>80-100</td>
</tr>
<tr>
<td>Mercury lamp (HPL)</td>
<td>125</td>
<td>80-100</td>
</tr>
<tr>
<td>Mercury lamp (HPL)</td>
<td>70</td>
<td>60-70</td>
</tr>
<tr>
<td>Fluorescent lamp (LHE)</td>
<td>45</td>
<td>60-70</td>
</tr>
<tr>
<td>Fluorescent lamp (LHE)</td>
<td>85</td>
<td>60-70</td>
</tr>
</tbody>
</table>

The Table below shows the power usage reduction effects through the introduction of the most highly efficient LED street lamps (70 W and 100 W) shown in the Table above.
Table 4.3.1-6: Effects of renewing to LED lighting

<table>
<thead>
<tr>
<th>Lamp type</th>
<th>Power consumption (W)</th>
<th>Operating hours (h/day)</th>
<th>Number of operating days (days/year)</th>
<th>Power usage (kWh/year)</th>
<th>LED power consumption (W)</th>
<th>LED power usage (kWh/year)</th>
<th>Power usage reduction (kWh/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium lamps</td>
<td>70</td>
<td>11</td>
<td>365</td>
<td>281</td>
<td>70</td>
<td>281</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>11</td>
<td>365</td>
<td>602</td>
<td>100</td>
<td>402</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>250</td>
<td>11</td>
<td>365</td>
<td>1,004</td>
<td>100</td>
<td>402</td>
<td>602</td>
</tr>
<tr>
<td>Mercury lamps</td>
<td>70</td>
<td>11</td>
<td>365</td>
<td>281</td>
<td>70</td>
<td>281</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>125</td>
<td>11</td>
<td>365</td>
<td>502</td>
<td>100</td>
<td>402</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>250</td>
<td>11</td>
<td>365</td>
<td>1,004</td>
<td>100</td>
<td>402</td>
<td>602</td>
</tr>
</tbody>
</table>

A sufficient effect can be expected for the existing high power-consuming 250-W class equipment by renewing to LED lighting through a 60% reduction in power consumption.

There is no power usage reduction effect in LED lighting with regard to 70-W sodium lamps or mercury lamps, but the goods and maintenance cost reduction effects, etc. can be expected through the prolonged service life of the products.

4.3.2 Case study 2  Energy conservation in buildings (Bandung Indah Plaza)

Based on the walk-through survey results, Bandung Indah Plaza was selected as a subject facility for energy conservation diagnosis, in view that the CO₂ emission reduction effect can be expected through the use of LED lighting in the parking and store common areas.

In addition, since this facility has a separate power system for each use and the power usage in the lighting equipment to be renewed is measurable, monitoring will be carried out, and energy conservation diagnosis with even higher accuracy will be implemented through data analysis. The master mains for the lighting and the master mains for the water-cooled chillers for comparison have been selected as the measurement objects.

■ Introduction of monitoring system

Remoni®, the energy monitoring service of NTT FACILITIES INC., has been introduced as the monitoring system for data collection.

This is a cloud-based ASP service in which the power consumption data are collected on a regular basis using the measuring unit (hereafter GMU) and sensor installed at the measurement locations and the data are sent to the servers held by the company via the Internet.

The outline of Remoni® service is shown below.
Here, because data analysis is intended, only data collection was carried out without releasing the measured data to the building owner, etc.

In addition, based on the above-mentioned walk-through survey results, the method of measuring the secondary current of the existing ammeters was adopted.

The list of the instruments used here, the installation locations, and the wiring connection diagram are shown below.

### Table 4.3.2-1: Measuring instrument components list

<table>
<thead>
<tr>
<th>Component</th>
<th>Part number</th>
<th>Manufacturer</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring unit (GMU)</td>
<td>MC310B</td>
<td>Contec</td>
<td>Data collection and data transmission to the servers</td>
</tr>
<tr>
<td>Watt-hour meter (WHM)</td>
<td>TWPM</td>
<td>Takemoto Denki</td>
<td>Addition of power usage</td>
</tr>
</tbody>
</table>

### Table 4.3.2-2: Instrument specifications (measuring unit)

<table>
<thead>
<tr>
<th>Item</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS</td>
<td>Linux kernel 2.6.37</td>
</tr>
<tr>
<td>CPU</td>
<td>T.I. ARM Cortex-A8: AM3517 600MHz</td>
</tr>
<tr>
<td>Memory</td>
<td>On-board 256MB DDR2 SDRAM</td>
</tr>
<tr>
<td>ROM</td>
<td>On-Board 256MB NAND Flash for OS</td>
</tr>
<tr>
<td>LAN</td>
<td>10BASE-T/100BASE-TX×1</td>
</tr>
<tr>
<td>Input voltage range</td>
<td>12-24 VDC ± 10%</td>
</tr>
<tr>
<td>Power consumption</td>
<td>15 W max.</td>
</tr>
<tr>
<td>Ambient operating temperature</td>
<td>0-50°C</td>
</tr>
<tr>
<td>Ambient operating humidity</td>
<td>10-90% RH (without condensation)</td>
</tr>
<tr>
<td>External dimensions</td>
<td>172.6 (W) × 138.0 (D) × 27.0 (H) (not including protrusions)</td>
</tr>
<tr>
<td>Weight</td>
<td>650 g</td>
</tr>
</tbody>
</table>

All the energy data are managed by the cloud servers. Can be viewed from anywhere using a web browser. Energy-saving support by the rich “visualization” and “digitization” tools.
Table 4.3.2-3: Instrument specifications (measuring unit)

<table>
<thead>
<tr>
<th>Item</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>AC 220 V (maximum voltage AC 300 V)</td>
</tr>
<tr>
<td>Power consumption</td>
<td>0.1 VA or below/phase</td>
</tr>
<tr>
<td>Ambient operating temperature</td>
<td>-10-55°C</td>
</tr>
<tr>
<td>Ambient operating humidity</td>
<td>30-85% RH (without condensation)</td>
</tr>
<tr>
<td>External dimensions</td>
<td>72 (W) × 50 (D) × 112 (H)</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 200 g</td>
</tr>
</tbody>
</table>

Figure 4.3.2-2: Instrument installation locations

Figure 4.3.2-3: Wiring connection diagram
Power consumption measurement has been conducted in the power room on the 1st basement floor, and a GMU and watt-hour meter have been installed in the spare space on the chiller panel. The CT wiring has been laid under the floor from the watt-hour meter installed on the panel, and the CT has been connected to the input of the watt-hour meter and the ammeter. With regard to the power supply for the instruments (the multi plug) and the Internet connection environment (including the LAN cable), the existing facilities on the chiller panel (provided by the owner side) have been used.

Photo 1: Before installation of the unit
Photo 2: After installation of the unit

Photo 3: Before installation of CT (for chillers)
Photo 4: After installation of CT (for chillers)

Photo 5: Before installation of CT (for lighting)
Photo 6: After installation of CT (for lighting)
After installation of the unit, current value comparison tests were carried out for each current input (R, S, and T).

[Chillers]
- Measured value according to the input current tester of the panel watt-hour meter × Panel power ratio (measured value)
- Current value indicated on the newly installed watt-hour meter (newly installed watt-hour meter)
- Current value indicated on the existing panel watt-hour meter (panel watt-hour meter)

<table>
<thead>
<tr>
<th>Phase</th>
<th>Measured value</th>
<th>Newly installed watt-hour meter</th>
<th>Panel watt-hour meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>510 A</td>
<td>508 A</td>
<td>511 A</td>
</tr>
<tr>
<td>S</td>
<td>468 A</td>
<td>456 A</td>
<td>464 A</td>
</tr>
<tr>
<td>T</td>
<td>496 A</td>
<td>496 A</td>
<td>494 A</td>
</tr>
</tbody>
</table>

[Lighting]
- Measured value according to the input current tester of the panel watt-hour meter × Panel power ratio (measured value)
- Current value indicated on the newly installed watt-hour meter (newly installed watt-hour meter)
- Current value indicated on the existing panel ammeter (panel ammeter)

<table>
<thead>
<tr>
<th>Phase</th>
<th>Measured value</th>
<th>Newly installed watt-hour meter</th>
<th>Panel watt-hour meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>154 A</td>
<td>158 A</td>
<td>110 A</td>
</tr>
<tr>
<td>S</td>
<td>160 A</td>
<td>169 A</td>
<td>120 A</td>
</tr>
<tr>
<td>T</td>
<td>184 A</td>
<td>185 A</td>
<td>120 A</td>
</tr>
</tbody>
</table>

Although there were momentary current variations and slight errors in both the chillers and the lighting, it has been confirmed that the measured value and the indicated value of the newly installed watt-hour meter roughly approximate each other.

There were large gaps in the indicated values of the ammeter on the lighting master mains panel, but this is considered to be due to this instrument not having been calibrated, since it is currently not in use.
It has been confirmed that the measured data is stored on the servers via the Internet and can be viewed on the Remoni® site as shown in Figure 4.3.2-4. Using this system, power consumption measurement was carried out every 15 minutes, and data were collected for about three months between October 23 and January 30.

![Figure 4.3.2-4 Remoni® web screen](image)

**Data analysis**

By using the above-mentioned Remoni, power consumption measurement of the lighting and chiller systems was carried out during the period from October 23, 2014 to January 30, 2015. The weekly power consumption trends are shown below. Here, Japan Standard Time is used, and the local time in Indonesia is two hours behind the time shown.

The load change pattern is stable throughout the week, and the power consumption during the night is approximately 10 kWh due to the suspension of air conditioning and lighting use, so presumably there is no unnecessary power consumption. However, the graphs start on Thursdays, and on Wednesdays some chillers seem to be not in use even during the daytime; thus, it is suspected that a different operational pattern from the other days of the week is adopted. In addition, it can be seen that the numbers of operating chillers differ depending on the air conditioning load with multiple units being installed.

With regard to the power consumption due to lighting, the lamps seem to be continuously turned on during the facility’s opening hours. After evening, the power consumption gradually increases, since outdoor street lamps and lighting in the passages, etc. start to be turned on. It can be seen that the power consumption gradually decreases as each store is closed during nighttime hours.
Figure 4.3.2-5: Hourly total power consumption (chillers and lighting added) 10/23/2014-10/29/2014

Figure 4.3.2-6: Hourly total power consumption (chillers) 10/23/2014-10/29/2014

Figure 4.3.2-7: Hourly total power consumption (lighting) 10/23/2014-10/29/2014
Figure 4.3.2-8: Hourly total power consumption (chillers and lighting added) 10/30/2014-11/5/2014

Figure 4.3.2-9: Hourly total power consumption (chillers) 10/30/2014-11/5/2014

Figure 4.3.2-10: Hourly total power consumption (lighting) 10/30/2014-11/5/2014
Figure 4.3.2-11: Hourly total power consumption (chillers and lighting added) 11/6/2014-11/12/2014

Figure 4.3.2-12: Hourly total power consumption (chillers) 11/6/2014-11/12/2014

Figure 4.3.2-13: Hourly total power consumption (lighting) 11/6/2014-11/12/2014
Figure 4.3.2-14: Hourly total power consumption (chillers and lighting added) 11/13/2014-11/19/2014

Figure 4.3.2-15: Hourly total power consumption (chillers) 11/13/2014-11/19/2014

Figure 4.3.2-16: Hourly total power consumption (lighting) 11/13/2014-11/19/2014
Figure 4.3.2-17: Hourly total power consumption (chillers and lighting added) 11/20/2014-11/26/2014

Figure 4.3.2-18: Hourly total power consumption (chillers) 11/20/2014-11/26/2014

Figure 4.3.2-19: Hourly total power consumption (lighting) 11/20/2014-11/26/2014
Figure 4.3.2-20: Hourly total power consumption (chillers and lighting added) 12/11/2014-12/17/2014

Figure 4.3.2-21: Hourly total power consumption (chillers) 12/11/2014-12/17/2014

Figure 4.3.2-22: Hourly total power consumption (lighting) 12/11/2014-12/17/2014
Figure 4.3.2-23: Hourly total power consumption (chillers and lighting added) 12/18/2014-12/24/2014

Figure 4.3.2-24: Hourly total power consumption (chillers) 12/18/2014-12/24/2014

Figure 4.3.2-25: Hourly total power consumption (lighting) 12/18/2014-12/24/2014
Figure 4.3.2-26: Hourly total power consumption (chillers and lighting added) 12/25/2014-12/31/2014

Figure 4.3.2-27: Hourly total power consumption (chillers) 12/25/2014-12/31/2014

Figure 4.3.2-28: Hourly total power consumption (lighting) 12/25/2014-12/31/2014
Figure 4.3.2-29: Hourly total power consumption (chillers and lighting added) 1/1/2015-1/7/2015

Figure 4.3.2-30: Hourly total power consumption (chillers) 1/1/2015-1/7/2015

Figure 4.3.2-31: Hourly total power consumption (lighting) 1/1/2015-1/7/2015
Figure 4.3.2-32: Hourly total power consumption (chillers and lighting added) 1/8/2015-1/14/2015

Figure 4.3.2-33: Hourly total power consumption (chillers) 1/8/2015-1/14/2015

Figure 4.3.2-34: Hourly total power consumption (lighting) 1/8/2015-1/14/2015
Figure 4.3.2-35: Hourly total power consumption (chillers and lighting added) 1/15/2015-1/21/2015

Figure 4.3.2-36: Hourly total power consumption (chillers) 1/15/2015-1/21/2015

Figure 4.3.2-37: Hourly total power consumption (lighting) 1/15/2015-1/21/2015
Figure 4.3.2-38: Hourly total power consumption (chillers and lighting added) 1/22/2015-1/28/2015

Figure 4.3.2-39: Hourly total power consumption (chillers) 1/22/2015-1/28/2015

Figure 4.3.2-40: Hourly total power consumption (lighting) 1/22/2015-1/28/2015
The Figure below shows the amount of power consumption sorted in descending order during the measurement period.

The chillers are operating between 100 kW and 300 kW, and it can be seen that they are being operated according to the load by the control of the number of units, etc. in accordance with the internal load, external conditions, and other factors.

The lighting is operating approximately between 120 kW and 130 kW, and it can be seen that almost no on-off operation of the lighting is performed during the opening hours except for the nighttime lighting.

The power consumption is approximately 20 kW or less during nighttime hours, presumably because only the necessary illumination such as security lighting is lit.

Figure 4.3.2-41: Hourly total amount of power consumption sorted 10/23/2014-1/31/2015
Overview of energy-saving technologies

Conventional facilities mostly use fluorescent lamps to illuminate the building. In recent years, there is also an approach to renew to LED lighting while utilizing the existing equipment. In this case, the fluorescent lamp fixture body itself is not replaced, but modifying the existing equipment can cope with it. Therefore, this approach is less costly and at the same time can minimize the waste.

Figure 4.3.2-42 shows the procedure for renewing the existing fluorescent lighting to LED.

In Step 1, remove the existing ballast.

In Step 2, disconnect the wiring of the socket on one side so as not to energize it. Then, rewire the open wiring so that only one side can be energized.

Lastly, in Step 3, plug the power input side of the LED lamp into the energizable socket so that it can be lit.

Figure 4.3.2-42: Procedure for the renewal of lighting
The specifications of an LED lamp are listed below for the consideration of renewal.

<table>
<thead>
<tr>
<th>Model Name</th>
<th>DL-DTA1U</th>
<th>DL-DTA2U</th>
<th>DL-DTA3U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical feature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminous flux</td>
<td>1,600lm</td>
<td>1,650lm</td>
<td>1,600lm</td>
</tr>
<tr>
<td>CRI</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Color temperature</td>
<td>5,000K</td>
<td>5,000K</td>
<td>6,000K</td>
</tr>
<tr>
<td>View Angle</td>
<td>150°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric character</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated input voltage</td>
<td>AC 100V-277V, 50Hz/60Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>Built In</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>18.5W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic specification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency</td>
<td>86 lm/W</td>
<td>89 lm/W</td>
<td>86 lm/W</td>
</tr>
<tr>
<td>Lifetime</td>
<td>30,000h *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>G13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimension</td>
<td>φ27.0 x 1,198mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>210g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>-10 ~ 45°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IP Level</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4.3.2-43: LED lamp specifications

**Summary**

The power consumption monitoring allowed us to grasp the power consumption trends in the building lighting and the chillers.

The measurement of power consumption in each system is important for the implementation of energy conservation diagnosis as well as for the estimation and demonstration of greenhouse gas emission reduction effects.

The present introduction of the monitoring system to collect measured data via the Internet has allowed us to grasp the power consumption in the project. In the same way, installing monitoring equipment will enable us to carry out monitoring without causing problems at the site as well as to check the data, which is considered to be also effective in the verification of the MRV in the future.
With regard to this building, adoption of LED lighting fixtures in the indoor parking lot with relatively long hours of illumination is considered by replacing the lamps only through the modification of the existing fluorescent fixtures to renew them to LED lighting.

4.3.3 Case study 3 Energy conservation in buildings (Trans Studio Mall)

Based on the walk-through survey results, Trans Studio Mall was selected as a subject facility for energy conservation diagnosis, in view that a CO\textsubscript{2} emission reduction effect can be expected through the renewal of the air-cooled chillers to water-cooled chillers.

- **Overview of energy-saving technologies**
  With regard to performance of the heat source system, the water-cooled chiller generally has higher efficiency than the air-cooled chiller.

As can be seen from the Figure below, the two differ in configuration of the heat source equipment radiating part: the air-cooled chiller has the radiator within itself while the water-cooled chiller radiates heat via the cooling towers and cooling water pumps. The water-cooled chiller has more auxiliary machines in its equipment configuration, but it normally has higher efficiency as a whole system when the heat radiation characteristics are taken into consideration.

![Figure 4.3.3-1: Example configuration comparison between the water-cooled chiller and the air-cooled chiller](image-url)
Water-cooled chillers generally have a COP of 6 or higher, and some demonstrate a COP of 10 or higher, depending on the conditions. Air-cooled chillers generally have a COP of 3 or higher, but it is difficult to demonstrate COP that is comparable to the water-cooled chiller due to the equipment configuration.

In general, the service life of freezing machines is approximately 15 years, and if a period longer than this has passed since the machine was installed, cases of failure increase and the efficiency of radiation and heat exchange of the equipment is significantly reduced, causing deterioration in efficiency of the equipment. In addition, the specified cooling capacity can no longer be exhibited. In such a case, even if the equipment efficiency is low and the power consumption does not increase, in many cases the specified cooling capacity cannot be demonstrated, causing an increase in complaints about the air conditioning.

The status of the subject building
This subject building has a composite system comprising the air-cooled chillers (the 331TR × 8 units) and the water-cooled chillers (the 381TR chiller unit).

Presumably the water-cooled chillers were renewed relatively recently, but the air-cooled chillers have not been renewed ever since the completion of the building, and as can be seen in the photos, long-term deterioration is prominent.
Photo 1: Air-cooled chillers (Mall System 1)

Photo 2: Air-cooled chiller (Mall System 1)

Photo 3: Air-cooled chillers (Mall System 2)

Photo 4: Air-cooled chiller distribution boards (Mall System 2)

**Summary**

- Here, greenhouse gas emission reduction effects are discussed including the case study for renewal of the chillers in particular whose power consumption is considered to account for more than 50% of the whole building’s.
4.4 Amount of greenhouse gas emissions reduction at target facilities

The amount of greenhouse gas emissions reduction expected when Japanese technologies are introduced is calculated at respective target facilities.

We performed trial calculation to work out the amount of greenhouse gas emissions reduction expected when LED lighting is introduced in 4.4.1 and 4.4.2, and when chiller is introduced in 4.5.3.

4.4.1 LED street lamps

With respect to this facility, we looked at existing street lamps (sodium lamps and mercury lamps) which are subject to renewal. As stated in the preceding section, with respect to existing street lamps such as sodium lamps, mercury lamps in Bandung, they are considering changing them over to LED, which consumes less electricity; and, to help select an appropriate capacitance, indices of replacement equipment corresponding to the capacitance of existing facility has been established as shown in the table below:

<table>
<thead>
<tr>
<th>Lamp type (Before renewal)</th>
<th>Power consumption (W)</th>
<th>Power consumption after renewing to LED (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium lamp (SON)</td>
<td>70</td>
<td>60-70</td>
</tr>
<tr>
<td>Sodium lamp (SON)</td>
<td>150</td>
<td>80-100</td>
</tr>
<tr>
<td>Sodium lamp (SON)</td>
<td>250</td>
<td>100-120</td>
</tr>
<tr>
<td>Mercury lamp (HPL)</td>
<td>250</td>
<td>80-100</td>
</tr>
<tr>
<td>Mercury lamp (HPL)</td>
<td>125</td>
<td>80-100</td>
</tr>
<tr>
<td>Mercury lamp (HPL)</td>
<td>70</td>
<td>60-70</td>
</tr>
<tr>
<td>Fluorescent lamp (LHE)</td>
<td>45</td>
<td>60-70</td>
</tr>
<tr>
<td>Fluorescent lamp (LHE)</td>
<td>85</td>
<td>60-70</td>
</tr>
</tbody>
</table>

We studied at the greenhouse gas reduction when existing equipment is converted to LED, which would be the case when a 70-W or 100-W LED street lamp is compatible with existing sodium lamps and mercury lamps.

The following is the result of estimation of the case where only LED lamps are installed; i.e., poles, etc. are left as is and a monitoring system is introduced for each unit of 100 street lamps.
### Table 4.4.1-2: Estimation of amount of greenhouse gas emissions reduction

<table>
<thead>
<tr>
<th>Before conversion</th>
<th>Lamp type</th>
<th>Power consumption (W)</th>
<th>Quantity*</th>
<th>Operating hours (h/day)</th>
<th>Number of operating days (day/year)</th>
<th>Operation efficiency (-)</th>
<th>Amount of electricity used (kWh/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium lamp</td>
<td>150</td>
<td>2,087</td>
<td>11</td>
<td>365</td>
<td>1.00</td>
<td>1,256,896</td>
<td></td>
</tr>
<tr>
<td></td>
<td>250</td>
<td>863</td>
<td>11</td>
<td>365</td>
<td>1.00</td>
<td>866,236</td>
<td></td>
</tr>
<tr>
<td>Mercury lamp</td>
<td>250</td>
<td>1,112</td>
<td>11</td>
<td>365</td>
<td>1.00</td>
<td>1,116,170</td>
<td></td>
</tr>
<tr>
<td></td>
<td>125</td>
<td>2,346</td>
<td>11</td>
<td>365</td>
<td>1.00</td>
<td>1,177,399</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>After conversion</th>
<th>Lamp type</th>
<th>Power consumption (W)*</th>
<th>Quantity*</th>
<th>Operating hours (h/day)</th>
<th>Number of operating days (day/year)</th>
<th>Operation efficiency (-)</th>
<th>Amount of electricity used (kWh/year)</th>
<th>Investment in equipment (million yen)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LED</td>
<td>100</td>
<td>2,087</td>
<td>11</td>
<td>365</td>
<td>1.00</td>
<td>837,931</td>
<td>153</td>
</tr>
<tr>
<td></td>
<td>LED</td>
<td>100</td>
<td>863</td>
<td>11</td>
<td>365</td>
<td>1.00</td>
<td>346,495</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>LED</td>
<td>100</td>
<td>1,112</td>
<td>11</td>
<td>365</td>
<td>1.00</td>
<td>446,468</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>LED</td>
<td>100</td>
<td>2,346</td>
<td>11</td>
<td>365</td>
<td>1.00</td>
<td>941,919</td>
<td>172</td>
</tr>
</tbody>
</table>

*1: Estimated based on the total number of street lamps and the ratio of various types of lamps
*2: Chosen in accordance with the guideline

In the table above, as factors such as the extended service life of the product due to the LED conversion are not taken into account, 70-W sodium lamps and mercury lamps are considered to have no impact on greenhouse gas reduction; therefore, they are not subjects of renewal. According to the table, although the amount of greenhouse gas emissions reduction for individual equipment is small, in view that the power consumption of existing equipment subject to renewal is not very large, the potential reduction amount as a whole is significant, as the quantity is large.

However, as the amount of investment in equipment is large and subsidy is only applicable to installation of lamps, cost-effectiveness is not very good. Choosing high-efficiency equipment of lower price might be our future challenge.

#### 4.4.2 Bandung Indah Plaza

With respect to this facility, as the heat source for the air-conditioning has been changed over from air-cooled chiller to water-cooled chiller, we focused on the lighting facilities whose power consumption is considered to be high after the chiller.

Among other lighting facilities, as, in the tenant area, they tend to install the tenant’s own lighting facilities and, in the public area, lighting could impact the general image of the shopping mall, we thought it would be effective to renew the lighting facilities of the parking lot. The following is the result of examinations regarding the greenhouse gas emissions reduction when fluorescent lamps in the parking lot are converted to LED lighting.
Table 5.4.2-1: Estimation of energy-saving effects of LED conversion

- LED conversion of parking lot lighting -

<table>
<thead>
<tr>
<th>Place of installation</th>
<th>Lamp type</th>
<th>Quantity</th>
<th>Power consumption (W)</th>
<th>Operating hours (h/day)</th>
<th>Number of operating days (day/year)</th>
<th>Operation efficiency ((\times))</th>
<th>Amount of power consumption (kWh/year)</th>
<th>Amount of electricity reduction</th>
<th>Amount of CO(_2) emissions reduction</th>
<th>Cost effectiveness (Estimated based on a service life of 6 years)</th>
<th>Cost effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>&lt;Before conversion&gt;</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking lot</td>
<td>FL36W×2</td>
<td>113</td>
<td>80</td>
<td>14</td>
<td>365</td>
<td>1.00</td>
<td>46,194</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking lot</td>
<td>FL36W×1</td>
<td>371</td>
<td>40</td>
<td>14</td>
<td>365</td>
<td>1.00</td>
<td>75,832</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>&lt;After conversion&gt;</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking lot</td>
<td>LED18.5W×2</td>
<td>113</td>
<td>37</td>
<td>14</td>
<td>365</td>
<td>1.00</td>
<td>21,365</td>
<td>65,589</td>
<td>53.4</td>
<td>6,086</td>
<td>0.814 t-CO(_2)/MWh</td>
</tr>
<tr>
<td>Parking lot</td>
<td>LED18.5W×1</td>
<td>371</td>
<td>18.5</td>
<td>14</td>
<td>365</td>
<td>1.00</td>
<td>35,072</td>
<td>56,437</td>
<td></td>
<td>1,950,000</td>
<td></td>
</tr>
</tbody>
</table>

* 0.814 t-CO\(_2\)/MWh
4.4.3 Trans Studio Mall

With respect to this facility, as this is a shopping mall, it is considered that the heat source for air-conditioning of the whole building accounts for a large part of the power consumption. Further, as the heat source for air-conditioning has not been renewed since the foundation of the building, it is considered that conversion to a water-cooled chiller would be effective, because it was evident that the equipment was significantly outdated and aged/deteriorated. The following shows the result of examination regarding the greenhouse gas emissions reduction when the air-cooled chiller is converted to a water-cooled chiller.

Table 4.4.3-1: Estimation of energy-saving effects of chiller conversion

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Existing equipment</th>
<th>After renewal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Air-cooled chiller</td>
<td>Water-cooled centrifugal chillers</td>
</tr>
<tr>
<td>Chiller type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling capacity</td>
<td>kW</td>
<td>1,165</td>
<td>1,197</td>
</tr>
<tr>
<td>Quantity</td>
<td></td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Power consumption</td>
<td>kW</td>
<td>524</td>
<td>187</td>
</tr>
<tr>
<td>Efficiency</td>
<td>kW/TR</td>
<td>1.58</td>
<td>0.55</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power consumption of the existing chiller</td>
<td>8,262 MWh/year</td>
</tr>
<tr>
<td>Power consumption of the replaced chiller (including ancillary equipment)</td>
<td>4,423 MWh/year</td>
</tr>
<tr>
<td>Reduction of power consumption (reduction from the existing chiller)</td>
<td>3,839 MWh/year</td>
</tr>
<tr>
<td>Amount of CO_{2} emission reduction (as per JCM_ID_AM002 Ver1.0)</td>
<td>475 t-CO_{2}/year</td>
</tr>
<tr>
<td>Investment in equipment</td>
<td>314 (million yen)</td>
</tr>
<tr>
<td>Cost-effectiveness (estimated based on a service life of 15 years)</td>
<td>44,070 yen/t-CO_{2}</td>
</tr>
</tbody>
</table>
4.5 Potential greenhouse gas emissions reduction in the case of large-scale propagation

Under the assumption that similar schemes as adopted in this project are deployed horizontally across Indonesia, potential greenhouse gas emissions reduction was examined and is shown in each section below. With regard to the reference values in relation to MRV methodology, as they are being formulated currently, the amount of greenhouse gas emissions of existing equipment is used as a reference value in calculating the amount of greenhouse gas emissions reduction in the study of this section.

4.5.1 LED street lamps

Although street lamp lighting is managed by PJU at each city, as the guideline for the installation of street lamps is stipulated by the state government, it is thought that it is possible to deploy such a greenhouse gas reduction scheme as considered in this study all over Indonesia.

There are approximately 21,000 street lamps installed in Bandung city and the number of lamps installed per 1 km is 35; therefore, the total length of roads with street lamps in Bandung is approximately 600 km. As the total length of roads in all Indonesia is approximately 502,000 km (as of 2012; data from Indonesian Bureau of Statistics) and out of that 285,000 km are sealed roads, we can say that there are approximately 9.98 million street lamps installed all over Indonesia.

Assuming the way existing street lamps are installed across Indonesia is similar to that of Bandung City, if all street lamps are converted to LED, the expected reduction effect would be 712,975 (t-CO\textsubscript{2}/year).

4.5.2 Energy savings concerning buildings

With respect to energy savings concerning buildings, it was found that it is possible to reduce the energy-derived CO\textsubscript{2} emissions by converting fluorescent lighting to LED or conversion of air-conditioning chiller at commercial facilities. The table below shows the trend of power consumption for different sectors in Bandung City between 2005 and 2012. If we work out the amount of energy-derived CO\textsubscript{2} in the commerce sector based on the table below, it is thought that it is possible to deploy such greenhouse gas reduction scheme as considered in this study across Indonesia.

<table>
<thead>
<tr>
<th>Sector</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household</td>
<td>41,182</td>
<td>43,754</td>
<td>47,324</td>
<td>50,184</td>
<td>54,945</td>
<td>59,825</td>
<td>65,110</td>
<td>72,132</td>
</tr>
<tr>
<td>Commerce</td>
<td>15,980</td>
<td>18,415</td>
<td>20,608</td>
<td>22,926</td>
<td>24,825</td>
<td>27,157</td>
<td>28,309</td>
<td>30,989</td>
</tr>
<tr>
<td>Industry</td>
<td>42,453</td>
<td>43,615</td>
<td>45,802</td>
<td>47,969</td>
<td>46,204</td>
<td>50,985</td>
<td>54,725</td>
<td>60,176</td>
</tr>
<tr>
<td>Public</td>
<td>7,417</td>
<td>6,825</td>
<td>7,510</td>
<td>7,940</td>
<td>8,607</td>
<td>9,330</td>
<td>9,848</td>
<td>10,694</td>
</tr>
<tr>
<td>Total</td>
<td>107,032</td>
<td>112,609</td>
<td>112,246</td>
<td>129,019</td>
<td>134,581</td>
<td>147,297</td>
<td>157,992</td>
<td>173,991</td>
</tr>
</tbody>
</table>


Taking 2012 as a base and assuming the energy-derived CO\textsubscript{2} per unit in the commerce sector is 0.814 (t-CO\textsubscript{2}/MWh), the total emission would be 25,225,046 (t-CO\textsubscript{2}/year). Out of this, assuming that the electricity consumed by large-scale commercial facilities constitutes 20% of the total and 50% of that is used by the heat source for lighting and air-conditioning, if we improve its efficiency by 20%, the expected reduction effect would be 504,500 (t-CO\textsubscript{2}/year).
4.6 Examination of JCM methodology and PDD

4.6.1 LED street lamps

4.6.1.1 JCM methodology

With respect to methodology for LED lighting, we could refer to ID_PM004 which is currently being proposed; however, as eligibility requirements do not match, we will consider a new methodology. As for reference values, we will consider them in our future study.

(1) Eligibility requirements

Eligibility requirements are shown in the table below.

Table 4.6.1.1-1: Eligibility requirements for LED street lamp

<table>
<thead>
<tr>
<th>Number</th>
<th>Requirement (ID_PM004)</th>
<th>Proposed modification of requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirement 1</td>
<td>New installation or conversion of fluorescent lamp at a grocery shop (400 m² or less)</td>
<td>Outdoor street lamps &amp; road lighting</td>
</tr>
<tr>
<td>Requirement 2</td>
<td>Color temperature of LED: 5,000K - 6,500 K Length: 602.5 mm - 1,513.0 mm Efficiency: 120 lm/W or more</td>
<td>Color temperature of LED: 3,000 K - 6,000 K Length: 422 mm or more Efficiency: 120 lm/W or more</td>
</tr>
<tr>
<td>Requirement 3</td>
<td>If an existing fluorescent lamp contains mercury, it shall not be released to the environment.</td>
<td>Same as on the left</td>
</tr>
<tr>
<td>Requirement 4</td>
<td>Lux conforms to Indonesian National Standard (SNI 7391:2008)</td>
<td>E (lux)</td>
</tr>
<tr>
<td></td>
<td>Street type</td>
<td>E (lux)</td>
</tr>
<tr>
<td></td>
<td>Sidewalk</td>
<td>1-4</td>
</tr>
<tr>
<td></td>
<td>Local road</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Primary</td>
<td>2-5</td>
</tr>
<tr>
<td></td>
<td>secondary</td>
<td>2-5</td>
</tr>
<tr>
<td></td>
<td>Feeder road</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Primary</td>
<td>3-7</td>
</tr>
<tr>
<td></td>
<td>Secondary</td>
<td>3-7</td>
</tr>
<tr>
<td></td>
<td>Main road</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Primary</td>
<td>11-20</td>
</tr>
<tr>
<td></td>
<td>secondary</td>
<td>11-20</td>
</tr>
<tr>
<td></td>
<td>Main roads with access control, freeways</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tunnels, overpasses, highways</td>
<td>15-20</td>
</tr>
</tbody>
</table>

(2) Formula to calculate the emissions reduction

Emissions reduction is calculated using the formula below

\[ \text{ER}_p = \text{RE}_p - \text{PE}_p \]

\( \text{ER}_p \): Emissions reduction for the period ‘p’ (tCO₂/p)

\( \text{RE}_p \): Reference emission for the period ‘p’ (tCO₂/p)

\( \text{PE}_p \): Project emission for the period ’p’ (tCO₂/p)

(3) Formula to calculate the project emission

\[ \text{PE}_p = \text{EC}_{PJ,p} \times \text{EF}_{elec} \]

\( \text{PE}_p \): Project emission for the period ‘p’ (tCO₂/p)
EC<sub>PJ,p</sub>: Total power consumption of project lighting for the period ‘p’ (MWh/p)
EF<sub>elec</sub>: CO₂ emission factor of the power consumption (tCO₂/MWh)

(4) Formula to calculate the reference emission

\[ RE_p = EC_{PJ,p} \times (\eta_{PJ} \div \eta_{RE}) \times EF_{elec} \]

- \( RE_p \): Reference emission for the period ‘p’ (tCO₂/p)
- \( EC_{PJ,p} \): Total power consumption of the project lighting for the period ‘p’ (MWh/p)
- \( \eta_{PJ} \): Luminous efficiency of the project lighting (lm/W)
- \( \eta_{RE} \): Luminous efficiency of the reference lighting (lm/W)
- \( EF_{elec} \): CO₂ emission factor of the power consumption (tCO₂/MWh)

(5) Setting parameter values

- \( EF_{elec} \): The most recent CO₂ emission factor must be used.
- \( \eta_{PJ} \): With respect to the luminous efficiency of the project lighting, if multiple products are to be introduced, the lowest one shall be used.
- \( \eta_{RE} \): As LED street lamps are still at a trial stage, for luminous efficiency of the reference lighting, use the one for sodium lamp and mercury lamp equipment, which has proven track records. For the reference value, use the value of the most efficient product (110 lm/W).

Table 4.6.1.1-2: Efficiency of the existing products (sodium lamp/mercury lamp)

<table>
<thead>
<tr>
<th>Type</th>
<th>Model number</th>
<th>Electricity Consumption (W)</th>
<th>Efficiency (lm/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium lamp</td>
<td>LAMP SON I 70W/220V</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>LAMP SON T 150W/220V</td>
<td>150</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>LAMP SON T 250W/220V</td>
<td>250</td>
<td>110</td>
</tr>
<tr>
<td>Mercury lamp</td>
<td>LAMP HPL 80W/220V</td>
<td>80</td>
<td>44.5</td>
</tr>
<tr>
<td></td>
<td>LAMP HPL 125W/220V</td>
<td>125</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>LAMP HPL 250W/220V</td>
<td>250</td>
<td>51</td>
</tr>
</tbody>
</table>

4.6.1.2 PDD

As stated in section 5.3, we are considering energy-saving proposals. As we are going to submit these proposals to the Indonesian side and coordinate the content with them, we are planning to prepare the PDD plan after each energy-saving proposal is confirmed.

4.6.2 Energy savings inside the building

In this study, we propose two methods as energy-saving measures inside the building. One of them is use of LED lighting in the office or parking lot. The other is conversion of the existing chiller to a high-efficient water-cooled chiller. We will discuss the JCM methodology for each of them as follows:

4.6.2.1 JCM methodology

a) Use of LED for lighting equipment

With respect to methodology for LED lighting, we could refer to ID_PM004 which is currently being proposed; however, as eligibility requirements do not match, we will consider a new methodology. As for reference values, we will consider them in our future study.

(1) Eligibility requirements

Eligibility requirements are shown in the table below.
### Table 4.6.2.1-1: Eligibility requirements for LED lighting inside the building

<table>
<thead>
<tr>
<th>Number</th>
<th>Requirement (ID_PM004)</th>
<th>Proposed modification of requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirement 1</td>
<td>New installation or conversion of fluorescent lamp at a grocery shop (400 m² or less)</td>
<td>Indoor lighting &amp; indoor parking lot</td>
</tr>
</tbody>
</table>
| Requirement 2 | Color temperature of LED: 5,000 K - 6,500 K  
Length: 602.5 mm - 1,513.0 mm  
Efficiency: 120 lm/W or more | Color temperature of LED: 4,000 K - 6,000 K  
Length: 602.5 mm - 1,513.0 mm  
Efficiency: 120 lm/W or more |
| Requirement 3 | If an existing fluorescent lamp contains mercury, it shall not be released to the environment. | Same as on the left                                                      |
| Requirement 4 | —                                                                                     | LUX should conform to Indonesia National Standards (SNI 7391:2008)       |
| Requirement 5 | —                                                                                     | Renovate the electric wiring and utilize existing light fixtures         |

<table>
<thead>
<tr>
<th>Lighting for Indoor parking lot</th>
<th>Day time (lux)</th>
<th>Night time (lux)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sidewalks</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>Areas with moderate of high level of activity</td>
<td>110</td>
<td></td>
</tr>
</tbody>
</table>
(2) Formula to calculate the emissions reduction
Emissions reduction is calculated using the formula below.

\[ ER_{p} = RE_{p} - PE_{p} \]

- **ER**: Emissions reduction for the period ‘p’ \((t\text{CO}_2/p)\)
- **RE**: Reference emission for the period ‘p’ \((t\text{CO}_2/p)\)
- **PE**: Project emission for the period ‘p’ \((t\text{CO}_2/p)\)

(3) Formula to calculate the project emission

\[ PE_{p} = EC_{PL,p} \times EF_{elec} \]

- **PE**: Project emission for the period ‘p’ \((t\text{CO}_2/p)\)
- **EC**: Total power consumption of project lighting for the period ‘p’ \((\text{MWh}/p)\)
- **EF**: CO₂ emission factor of the power consumption \((t\text{CO}_2/\text{MWh})\)

(4) Formula to calculate the reference emission

\[ RE_{p} = EC_{PL,p} \times (\eta_{PJ} \div \eta_{RE}) \times EF_{elec} \]

- **RE**: Reference emission for the period ‘p’ \((t\text{CO}_2/p)\)
- **EC**: Total power consumption of the project lighting for the period ‘p’ \((\text{MWh}/p)\)
- **η**: Luminous efficiency of the lighting \((\text{lm}/\text{W})\)
- **EF**: CO₂ emission factor of the power consumption \((t\text{CO}_2/\text{MWh})\)

(5) Setting parameter values

**EF**
- The most recent CO₂ emission factor must be used.
- With respect to the luminous efficiency of the project lighting, if multiple products are to be introduced, the lowest one shall be used.
- For luminous efficiency of the reference lighting, use the one model of the equipment that has proven track records. For the reference value, use the value of the most efficient product \((84.2 \text{ lm/W})\).

*1: According to the additional information of JCM_ID_PM004, Manufacturer A’s No1 to No.3 considered for installament. The existing lighting fixture can be used by changing the electricity wiring. The most efficient model will with the figure 84.2 l/W will be used.

Table 4.6.2.1-2  Excerpts from JCM_ID_PM004 Additional Information

Manufacturer A

<table>
<thead>
<tr>
<th>No.</th>
<th>Category</th>
<th>Model Number</th>
<th>Type</th>
<th>Length (mm)</th>
<th>Color Temperature (K)</th>
<th>Luminous Flux (lm)</th>
<th>Rated Power Consumption (W)</th>
<th>Luminous Efficacy (lm/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MASTER LED tube G1</td>
<td>MASTER LED tube G1</td>
<td>T8</td>
<td>1212.9</td>
<td>6500</td>
<td>1600</td>
<td>19</td>
<td>64.2</td>
</tr>
<tr>
<td>2</td>
<td>MASTER LED tube G2</td>
<td>MASTER LED tube G2</td>
<td>T8</td>
<td>907.5</td>
<td>5500</td>
<td>1150</td>
<td>13</td>
<td>76.7</td>
</tr>
<tr>
<td>3</td>
<td>MASTER LED tube G3</td>
<td>MASTER LED tube G3</td>
<td>T8</td>
<td>602.5</td>
<td>5500</td>
<td>800</td>
<td>13</td>
<td>60.0</td>
</tr>
<tr>
<td>4</td>
<td>Essential LED tube</td>
<td>Essential LED tube</td>
<td>T8</td>
<td>1212.9</td>
<td>6500</td>
<td>1600</td>
<td>23</td>
<td>60.0</td>
</tr>
<tr>
<td>5</td>
<td>Essential LED tube</td>
<td>Essential LED tube</td>
<td>T8</td>
<td>602.5</td>
<td>6500</td>
<td>800</td>
<td>13</td>
<td>60.0</td>
</tr>
</tbody>
</table>

Source: Data quoted from manufacturer A website and compiled by the Study Team. (2014)
4.6.3 Conversion to high-efficiency chiller

4.6.3.1 JCM methodology

With respect to JCM methodology for conversion to a high-efficiency chiller, we could refer to ID_AM002 which is currently being proposed.

(1) Eligibility requirements

Eligibility requirements are shown in the table below.

Table 4.6.3.1-2: Eligibility requirements for chiller

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The project chiller is a centrifugal (turbo) chiller unit and its cooling capacity is 1250 USRT or less. 1 USRt = 3.52 kW</td>
</tr>
</tbody>
</table>
| 2 | * COP of the project chiller ‘i’ under standard temperature conditions must be 6.0 or more. 
   * COP<sub>pj,t,c,i</sub> is worked out by converting COP of the project chiller under project conditions to COP under standard conditions. 
   * COP<sub>pj,i</sub> is worked out on the basis of a quote from the manufacturer and factory test data. 
   (Formula to calculate COP<sub>pj,t,c,i</sub>)

\[
\text{COP}_{pj,t,c,i} = \text{COP}_{pj,i} \times \left( \frac{T_{\text{cooling-out},i} - T_{\text{chilled-out},i} + TD_{\text{chilled}} + TD_{\text{cooling}}}{37 - 7 + TD_{\text{chilled}} + TD_{\text{cooling}}} \right)
\]

- COP<sub>pj,t,c,i</sub>: COP of the project chiller ‘i’ calculated under standard temperature conditions (-)
- COP<sub>pj,i</sub>: COP of the project chiller ‘i’ calculated under project specific conditions (-)
- T<sub>cooling-out,i</sub>: Outlet temperature of the cooling water of the project chiller ‘i’ under project specific conditions (°C)
- T<sub>chilled-out,i</sub>: Outlet temperature of the chilled water of the project chiller ‘i’ under project specific conditions (°C)
- TD<sub>cooling</sub>: Difference between condensation temperature of the refrigerant and outlet temperature of the cooling water; the default value is 1.5 (°C)
- TD<sub>chilled</sub>: Difference between evaporation temperature of the refrigerant and outlet temperature of the chilled water; the default value is 1.5 (°C)

* Standard conditions to calculate COP<sub>pj,t,c,i</sub>
  * Chilled water temperature: At the exit 7 (°C) At the entrance 12 (°C)
  * Cooling water temperature: At the exit 37 (°C) At the entrance 32 (°C)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Periodical inspection at least four times a year must be planned.</td>
</tr>
<tr>
<td>4</td>
<td>Refrigerant whose ozone depletion potential is zero must be used for the project chiller.</td>
</tr>
<tr>
<td>5</td>
<td>For the project chiller, select equipment for which there will be no refrigerant leakage. When converting the existing chiller to the project chiller, care must be taken so that no refrigerant is released into the atmosphere from the existing chiller.</td>
</tr>
</tbody>
</table>
(2) Formula to calculate the amount of emissions reduction
The amount of emissions reduction is calculated using the formula below.

\[
RE_p = \sum \left( EC_{pj,i,p} \times \left( COP_{pj,tc,i} + COP_{RE,i} \right) \times EF_{elec} \right)
\]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Explanation on data</th>
<th>Information source</th>
</tr>
</thead>
<tbody>
<tr>
<td>(RE_p)</td>
<td>Emissions reduction for the period ‘p’ (tCO(_2)/p)</td>
<td>(Grid electricity) The most recent value available at the time of verification will be applied later during the monitoring period as a fixed value. As the data is an “emission factor for power interconnection system,” if that is not the case, it will be supplied by the National Committee on CDM, the Designated National Authority of Indonesia.</td>
</tr>
<tr>
<td>(EC_{pj,i,p})</td>
<td>Power consumption of project chiller ‘i’ for the period ‘p’ (MWh/p)</td>
<td>(Grid electricity) The most recent value available at the time of verification will be applied later during the monitoring period as a fixed value. As the data is an “emission factor for power interconnection system,” if that is not the case, it will be supplied by the National Committee on CDM, the Designated National Authority of Indonesia.</td>
</tr>
<tr>
<td>(COP_{pj,tc,i})</td>
<td>COP of the project chiller ‘i’ calculated under standard temperature conditions (-)</td>
<td>(Dedicated power supply) With regard to CDM, the small-scale methodology will be approved with AMS-I.A</td>
</tr>
<tr>
<td>(COP_{RE,i})</td>
<td>COP of the reference chiller ‘i’ calculated under standard temperature conditions (-)</td>
<td></td>
</tr>
<tr>
<td>(EF_{elec})</td>
<td>CO(_2) emission factor associated with the power consumption (tCO(_2)/MWh)</td>
<td>(Grid electricity) The most recent value available at the time of verification will be applied later during the monitoring period as a fixed value. As the data is an “emission factor for power interconnection system,” if that is not the case, it will be supplied by the National Committee on CDM, the Designated National Authority of Indonesia.</td>
</tr>
</tbody>
</table>

(3) Formula to calculate the amount of project emissions

\[
PE_p = \sum \left( EC_{pj,i,p} \times EF_{elec} \right)
\]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Explanation on data</th>
<th>Information source</th>
</tr>
</thead>
<tbody>
<tr>
<td>(PE_p)</td>
<td>Project emissions for the period ‘p’ (tCO(_2)/p)</td>
<td>(Grid electricity) The most recent value available at the time of verification will be applied later during the monitoring period as a fixed value. As the data is an “emission factor for power interconnection system,” if that is not the case, it will be supplied by the National Committee on CDM, the Designated National Authority of Indonesia.</td>
</tr>
<tr>
<td>(EC_{pj,i,p})</td>
<td>Power consumption of project chiller ‘i’ for the period ‘p’ (MWh/p)</td>
<td></td>
</tr>
<tr>
<td>(EF_{elec})</td>
<td>CO(_2) emission factor associated with the power consumption (tCO(_2)/MWh)</td>
<td></td>
</tr>
</tbody>
</table>

(4) Formula to calculate the amount of reference emissions

\[
ER_p = RE_p - PE_p
\]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Explanation on data</th>
<th>Information source</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ER_p)</td>
<td>Emissions for the period ‘p’ (tCO(_2)/p)</td>
<td>(Grid electricity) The most recent value available at the time of verification will be applied later during the monitoring period as a fixed value. As the data is an “emission factor for power interconnection system,” if that is not the case, it will be supplied by the National Committee on CDM, the Designated National Authority of Indonesia.</td>
</tr>
<tr>
<td>(RE_p)</td>
<td>Reference emissions for the period ‘p’ (tCO(_2)/p)</td>
<td></td>
</tr>
<tr>
<td>(PE_p)</td>
<td>Project emissions for the period ‘p’ (tCO(_2)/p)</td>
<td></td>
</tr>
</tbody>
</table>

(5) Setting parameter values

<table>
<thead>
<tr>
<th>Parameter (EF_{elec})</th>
<th>Explanation on data</th>
<th>Information source</th>
</tr>
</thead>
<tbody>
<tr>
<td>(EF_{elec})</td>
<td>This is the CO(_2) emission factor associated with consumption of electricity. When the project chiller consumes either grid electricity or dedicated power supply, apply the respective CO(<em>2) emission factor. When the project chiller consumes both grid electricity and dedicated power supply, apply CO(<em>2) emission factor in accordance with the ratio of consumption. The ratio of dedicated power supply is calculated by dividing the dedicated power supply generated at the project site by total power consumption. Total power consumption during the monitoring period is the sum of the input electricity from grid ((EI</em>{grid,p})) and dedicated power supply ((EG</em>{gen,p})). (<em>): The amount of electric power of dedicated power supply is calculated from meter reading or on the basis of operating hours during the monitoring period and rated capacity of the generator ((RC)). (\text{(CO}_2\text{ emission factor)}) Grid power: Specify the most recent value available from the information source in this table at the time of verification. Dedicated power supply: 0.8 (tCO(_2)/MWh) (</em>): The most recent value at the time verification is approved should</td>
<td>(Grid electricity) The most recent value available at the time of verification will be applied later during the monitoring period as a fixed value. As the data is an “emission factor for power interconnection system,” if that is not the case, it will be supplied by the National Committee on CDM, the Designated National Authority of Indonesia. (Dedicated power supply) With regard to CDM, the small-scale methodology will be approved with AMS-I.A</td>
</tr>
</tbody>
</table>
Choose the COP of the reference chiller ‘i’ from the default COP values listed in the table below in accordance with the cooling capacity of the project chiller ‘i’.

<table>
<thead>
<tr>
<th>Cooling capacity (USRt)</th>
<th>x&lt;300</th>
<th>300≤ x&lt;450</th>
<th>450≤ x&lt;500</th>
<th>500≤ x&lt;700</th>
<th>700≤ x&lt;1250</th>
</tr>
</thead>
<tbody>
<tr>
<td>COP_{RE,i}</td>
<td>4.92</td>
<td>5.33</td>
<td>5.59</td>
<td>5.85</td>
<td>5.94</td>
</tr>
</tbody>
</table>

Specifications of the project chiller ‘i’ are based on the quotation from the manufacturer and factory test data. The default COP value is worked out on the basis of the result of survey on COP of a refrigeration unit of a manufacturer having a high market share. COP_{RE,i} should be revised every three years as necessary by JC or participants of the project in accordance with the survey result.

Specifications of the project chiller ‘i’ is based on the quotation from the manufacturer and factory test data.

Specifications of the project chiller ‘i’ are based on the quotation from the manufacturer and factory test data.

Specifications of the project chiller ‘i’ are based on the quotation from the manufacturer and factory test data.

Specifications of the dedicated power supply generator.

### 4.6.4 PDD

As stated in section 5.3, we are considering energy-saving proposals. As we are going to submit these proposals to the Indonesian side and coordinate the content with them, we are planning to prepare the PDD plan after confirming each energy-saving proposal.
4.7 Funding plan and PDD

4.7.1 Initial investment cost

a) LED Street lamp

The PJU of Bandung City is planning to renew and newly install street lamps in order to promote LED lighting; and, in FY2015, they set aside a portion of their budget roughly equivalent to 900 renewals and 1,000 new installations.

In principle, introduction of LED street lamps is implemented within the budget set aside for the year; however, the project period is expected to be shortened by trying to reduce the budget expenditure and complete the conversion plan earlier with the use of the equipment subsidies of up to 50% shown below.

b) Energy-savings for the building

One of the barriers against introduction of energy-saving facilities is a funding plan. In particular, as considerable funds are required for the initial investment, it is anticipated that there will be significant impact by the local economic situation, financial circumstances of the local businesses, etc.

Here, we would like to discuss a couple of measures in relation to financing. However, loans from ordinary financial institutions will not be mentioned in the discussion, as such matters are specific issues; in particular, issues for the local businesses.
(1) Joint Crediting Mechanism (JCM) Based Project Facility Subsidy Scheme

JCM facility subsidy scheme is a program to let a developing country carry out energy-derived CO₂ emissions reduction using superb low-carbon technologies, etc., followed by measurement, report, and verification (MRV). We will provide a facility subsidy up to 50% of the initial investment to the undertaker (international consortium) aiming to record the emission reductions achieved through this program as Japan’s emission reductions by way of JCM.

For the owner of the facilities, there will be benefits such as they can introduce the most advanced energy-saving facilities at a low cost and, at the same time, reduce their energy costs. Japan, on the other hand, can not only enhance its presence in the host country, but also improve its CO₂ emissions reduction performance; therefore, this mechanism brings about a Win-Win situation for both countries.

Figure 4.7.1-1: Outline of JCM Based Project Facility Subsidy Scheme
(2) ADB contribution

Collaboration regarding JCM Japanese Fund is being sought through relationship/cooperation between the Ministry of the Environment and the Asian Development Bank (ADB). Here we would like to outline the ADB contribution as one of the means of the funding scheme based on what was reported by the media in FY2014.

a) Outline of JCM Japanese Fund
This is to reduce the additional cost required for introduction of advanced low-carbon technologies with the fund contributed to the Asian Development Bank Trust Fund so that such technologies that have not been introduced in the ADB project due to high start-up costs could be deployed in the project.

With this fund, we would like not only to make the developmental assistance by the ADB an instrument to ‘leapfrog’ to a low-carbon society, but also to obtain credits through JCM.

The briefing material provided by the Ministry of the Environment is shown as follows:

Figure 4.7.1-2: The outline of ADB contribution
b) Areas of cooperation
- Climate change mitigation and adaptation
- Conservation and sustainable use of biodiversity
- Chemical management
- Air quality management
- Waste water management
- Solid waste management
- Environmentally sustainable cities
- Other areas of environmental protection and improvement as may be confirmed by both participants

c) Forms of Cooperation
Cooperation in relation to the Japan Fund for the JCM, support for knowledge networks and environment related institutions (the Asia Pacific Adaptation Network, Clean Air Asia, Asian Environmental Compliance and Enforcement Network, etc.), support for knowledge exchange and activities relating to capacity and human resource development (Asia Leadership Program, etc.), and mutual participation in events on environment and sustainable development.

(3) Fund for promotion of low-carbon technologies by JICA

There is a fund to facilitate the diffusion of Japan’s leading low carbon technologies which, although initial cost is high, are highly effective in reducing CO₂ emissions by establishing and operating a fund to support those projects, among other projects, etc. supported by our government agencies such as JICA, which are highly effective in reducing GHG emissions.

Here we would like to outline the fund for promotion of low-carbon technologies by JICA as one of the means of funding scheme based on what was reported by the media in FY2014.
4.7.2 Maintenance costs

a) LED street lamps

As we are just replacing street lamps this time, it is thought that LED conversion of the street lamps would have no impact on maintenance costs. The following describes our basic stance:

- If conventional periodic inspection, equipment cleaning, etc. are carried out, unless frequency of the inspection or cleaning is changed, the maintenance costs would be the same as before.
- The maintenance costs are considered to be less because LEDs have longer service life and thus the globe replacement frequency will be reduced.

b) Energy savings of the building

Introduction of energy-saving facilities would not have significant impact on the building maintenance costs. That is because it is basically replacement of existing equipment.

The following describes our basic stance with respect to LED conversion of fluorescent lights and conversion of chillers for air-conditioning proposed this time:

“LED conversion of fluorescent lights”

- If conventional periodic inspection, equipment cleaning, etc. are carried out, unless frequency of the inspection or cleaning is changed, the maintenance costs should be the same as before.
- The maintenance costs are considered to be less because LEDs have longer service life and thus the globe replacement frequency will be reduced.
- By the same token, if the number of pieces of equipment was reduced by thinning of the equipment, the maintenance costs should be reduced.

“Conversion of chillers for air-conditioning”

- Depends on the type of existing chiller; if the existing chiller is a water-cooled one, we think it is possible to carry out maintenance work without any particular change.
- If the existing chiller is an air-cooled one, the maintenance cost would probably increase as the equipment composition is different and equipment maintenance time usually increases. However, as it depends on what sort of maintenance work they do, it is difficult to generalize.

4.8 Policy proposal toward introduction of energy-saving technologies

Aiming to achieve stabilization of power supply, the Bandung City government put forward a number of initiatives in 2013 including “waste power generation” and “improvement on transmission network and underground power cables.” They anticipate funding will come from the governmental budget and private sector as follows:

- Improvement of East Bandung underground cable (target period: 2016-2030; budget scale: 200 billion IDR)
- Installation of new power transmission network (target period: 2015-2030; budget scale: 800 billion IDR)
- Installation of new power distribution grid (target period: 2013-2015; budget scale: 400 billion IDR)
- Improvement on overhead power transmission lines (target period: 2014-2021; budget scale: 250 billion IDR)

Although improvement of infrastructure has been promoted, it is an effective policy, in the long run, to enhance awareness of the need to save electric power. For that, one of the ideas for the Bandung City government to consider is establishment of guidelines, monetary incentives (tax reduction, tax exemption, etc.) and non-monetary incentives (award system) for conversion of existing facilities to highly energy-efficient facilities.
4.9 Action plan from the next fiscal year

4.9.1 LED street lamp

To proceed with this project, establishment of an international consortium is required; however, as PJU is a municipal government agency, it cannot participate in an international consortium.

At this stage, our concept is to have a framework like the one detailed in the figure below; however, we will clarify a concrete implementation framework in our future study.

![Figure 4.9.1-1: Proposed implementation framework (LED street lamps)](image)

In addition, as there are constraints depending on, for example, the amount of money and other conditions for the proposal to the city government, the project could be subject to bidding, the way of dealing with the bidding system could be an issue to be considered before implementation.

As, in consideration of these issues, we are going to give a proposal to the Indonesian side and try to coordinate the content with them, we are planning to prepare the action plan after all the above-mentioned matters are settled.

4.9.2 Energy savings of the building

To proceed with this project, establishment of an international consortium is required; therefore, basically we are planning to enter the company targeted for the introduction of energy-saving facilities as a local company.

At this stage, our concept is to have a framework like the one detailed in the figure below; however, we will clarify a concrete implementation framework in our future study.
Proposed implementation framework

Figure 4.9.1-2: Proposed implementation framework (energy savings of the building)

Schedule

<table>
<thead>
<tr>
<th>(Month)</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction of energy-saving facilities for the building</td>
<td>Public offer of facility subsidy</td>
<td>Approval</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order construction work</td>
<td>Production and procurement of equipment</td>
<td>Preparation for local construction work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Installation of equipment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Implementation of construction work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trial operation and adjustment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Final inspection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start monitoring</td>
</tr>
</tbody>
</table>
5. Waste

5.1 Laws and plans concerning waste in Indonesia

5.1.1 Waste Management Law (No. 18/2008)

The Waste Management Law is a comprehensive law that covers general matters concerning waste management.

Although the Law does not specify any concrete sorting method, sorting itself should be carried out by households and workplaces, which discharge waste.

In addition, because the Law is the first to regulate open dumping, which requires improvements in the structure and maintenance of final disposal sites, local governments are required to reduce waste more than before.

(Reference) Contents of the related parts of the Waste Management Law

Sorted discharge:
  (Article 13)
  * The administrator of each district (such as a residential district) and each facility (such as a public facility) shall establish waste sorting facilities.
  (Article 22)
  * Waste shall be sorted according to the nature, quantity, and characteristics of waste.

Regulation of final disposal sites:
  (Article 44)
  * Local governments shall draw up a plan to close open-dumping final disposal sites within one year after this Law comes into force.
  * Local governments shall close open-dumping final disposal sites within five years after this Law comes into force.

5.1.2 Household waste - Control Order (Presidential Order No. 81/2012)

This is a presidential order enacted based on the Waste Management Law. As matters deeply related to the establishment of biodigesters, the parts concerning “sorted discharge” and “regulation of final disposal sites” can be summarized as follows:

Sorted discharge of waste:
  (Article 17) Waste shall be sorted according to the following five natures at a minimum:
  1) Waste which contains a toxic substance
  2) Organically decomposable waste
  3) Reusable waste
  4) Recyclable waste
  5) Other types of waste

Final disposal sites:
  (Article 22)
  * There are three forms of final disposal: “controlled landfill,” “sanitary landfill,” and “environmentally friendly technology.” They are carried out by local governments.
  (Article 24)
  * The management of final disposal sites shall satisfy the technical requirements specified by the minister who has jurisdiction over the management.
5.1.3 Law and plan related to the installation of urban waste facilities

(1) AMDAL (environment impact assessment system)
- Provisions about AMDAL are included in the Environment Management Law (Law No. 32/2009). (Chapter 5, Part 2, Section 5)
- The types and sizes of businesses and activities that require AMDAL have been specified in the Minister of Environment Order (No. 17/2001). This biodigester is exempted from AMDAL.
- Under the Law, however, if a business or an activity is exempted from AMDAL, permission for business operations shall be gained after preparations for UKL (environmental management plan) and UPL (environmental monitoring plan). (Section 6 of the Law)

(2) Urban space plan
When installing the biodigester, it is necessary to “hear opinions from the Committee on the Urban Space Plan in Bandung beforehand to judge whether the installation is in accordance with the plan.”

Waste management plan in Bandung and relevant laws
(1) Medium- and long-term waste plans in Bandung
Bandung drew up a long-term plan (2005-2025) and a five-year medium-term plan (the latest is the 2014-2018 plan). These plans include waste plans, which have fixed goals for three items: “3R,” “conversion of waste into energy (W to E),” and “sanitary landfill.” (See the table below.)

With regard to “conversion of waste into energy,” the medium-term plan has set a target (35% in 2018), which is higher than the target in the long-term plan (30% in 2025). This shows that the medium-term plan has placed special importance on making biogas from waste.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3R</td>
<td>40%</td>
<td>30%</td>
</tr>
<tr>
<td>W to E</td>
<td>30%</td>
<td>35%</td>
</tr>
<tr>
<td>Sanitary landfill</td>
<td>20%</td>
<td>25%</td>
</tr>
</tbody>
</table>

(2) Background to the establishment of the waste plans
- The waste plans set high targets for “the ratio of W to E” and “the 3R ratio.”
- The background to this is that, since the collapse of the Leuwigajah waste disposal site in 2005, waste disposal sites have been scarce and a reduction in the final disposal volume has become an impending issue.

(3) Waste disposal charges
Each household has to pay two types of waste disposal charges: a “charge paid to the local community” and a “charge paid to the city cleaning authority (PDK).” The former is a charge for transportation from each household to the temporary disposal station (TPS), while the latter is a charge for transportation from the temporary disposal station (TPS) to the final disposal site (the Sarimukti disposal site managed by West Java Province) and dumping at the final disposal site.

Charges paid to PDK are specified as follows:

(Waste disposal charges to be paid to PDK)
- Discharging enterprises pay waste charges to PDK as provided in the regulation by Bandung City (Notification No. 316/2013).
- Under the regulation, discharge sources are divided into six types. Further, household waste is subdivided into six classes. Waste from public transportation is subdivided into five classes. (See the table below.)
- Household waste charges are classified according to site area, electricity usage, and floor area.
### Procedures from waste discharge to final disposal in Bandung

The amount of urban waste generated in Bandung has been estimated to be about 1,500 tons/day (1994). The amount can be broken down according to generation source as follows. Organic waste has been estimated to about 52% of the total amount of waste.

### Breakdown by generation source

<table>
<thead>
<tr>
<th>NO</th>
<th>Classification by generation source</th>
<th>Weight (tons/day)</th>
<th>Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Households</td>
<td>983</td>
<td>65.6</td>
</tr>
<tr>
<td>2</td>
<td>Markets</td>
<td>282</td>
<td>18.8</td>
</tr>
<tr>
<td>3</td>
<td>Roads</td>
<td>83</td>
<td>5.6</td>
</tr>
<tr>
<td>4</td>
<td>Commercial districts</td>
<td>90</td>
<td>6.0</td>
</tr>
<tr>
<td>5</td>
<td>Offices</td>
<td>42</td>
<td>2.8</td>
</tr>
<tr>
<td>6</td>
<td>Manufacturers</td>
<td>20</td>
<td>1.4</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
<td>1,500</td>
<td>100</td>
</tr>
</tbody>
</table>

### City cleaning authority (PDK) budget

In principle, PDK is managed by a self-supporting accounting system and covers the maintenance expenses for waste storage, transportation, and disposal with disposal charges collected from discharging enterprises. However, because disposal charges are collected insufficiently, a large portion of the maintenance expenses are covered from the city’s general account.

### Management of septic tank sludge

- Bandung has a final sewage disposal plant (Bojongsoang disposal plant), which has been designed to dispose of human sewage for 400,000 people (about 15% of the city’s total population). The sewage disposal plant began to operate in 1992 and covers a little more than 60% of the population subject to the service.
- On the other hand, most of the city residents are using septic tanks. The number of septic tanks has reached about 200,000. Although sludge deposited in them must be pulled out regularly, this has not been carried out sufficiently. As a result, filthy water from the tanks has worsened the water environment.
- To cope with this, the water utility company (PDAM) has been encouraging the residents to pull sludge out from the septic tanks regularly (once every two years). However, this has not been carried out sufficiently. The charge for purring out sludge is 75,000 RP/m³ (for transportation) within the sewage area or 10,000 RP (for cleaning) plus 75,000 RP/m³ (for transportation) out of the sewage area.
5.2 Feasibility study on the biodigester to be introduced in Bandung

The purpose of this feasibility study is to study the feasibility of “the project to reduce greenhouse gas through the disposal of organic waste by the biodigester and by the use of the byproducts (biogas and liquid fertilizer) gained during the process of disposal.”

(1) Basic concept of the feasibility study
The biodigester can be roughly divided into three processes (collection of waste, operation of the biodigester, and the use of the byproducts). (See the table below.)

To manage and operate the biodigester continuously, it is necessary to carry out the procedures from “the sorted discharge of waste” to “the use of the byproducts” according to the plan. This especially requires coordination and cooperation among the parties engaged in these activities.

Therefore, the feasibility study aimed to carry out and manage the project stably and to reduce greenhouse gas efficiently, taking into consideration the three processes that constitute the whole biodigester. For this purpose, the feasibility study focused on the following three points:

1) Securing organizations and human resources to carry out each of the three processes that constitute the biodigester
2) Ensuring the stability of the management of the biodigester project
3) Considering a study to estimate greenhouse gas reduction and establish the MRV method through the operation of biodigesters

(2) Significance of establishment of facilities
Although the direct purpose of the establishment of biodigester facilities is “acquisition of credit through the reduction of greenhouse gas,” the establishment also contributes to the promotion of the following policies of the Indonesia Government and the Bandung City Government:

1) Promotion of renewable energy
2) Purification of the urban river
3) Improvement of management of public or communal toilets
4) Management of parks
5) Urban greening by organic fertilizers
Main items covered by the feasibility study
The feasibility study covered the following items on the assumption that the study is based on the scale of the biodigester facilities (around 15 tons/day) and the “Eco-Village Plan” established by Bandung in 2014.

(Note) The urban area of Bandung is divided into 30 districts (Kecamantan). The average amount of food waste generated from each district is nearly equal to the target amount of food waste collected per biodigester (12 tons/day).

1) Selection of methane fermentation method
There are two types of methods for methane fermentation, according to moisture contained in waste: “dry type” and “wet type.” Methods can also be sorted according to methane fermentation temperature: “high-temperature type” and “mid-temperature type.” Bandung has adopted the “dry and mid-temperature method,” because wastes contain a lot of water, because digestion is rapid even in the case of the mid-temperature type because of a comparatively high air temperature throughout the year, and because necessary energy for heating is far less by the use of the mid-temperature method than by the use of high-temperature method.

2) Places for installation of biodigester facilities
(Basic concept of selection of sites)
Because a biodigester with a size of 15 tons/day is installed, top priority is given to “having an area wide enough for the installation.” It is also necessary to consider “ensuring the capacity for the required amount of waste” and “using products (biogas and liquid fertilizer).” Therefore, the selection of sites was based on the following evaluation items:

(Results of study examination)
The following four candidate sites were selected after consultation with Bandung’s relevant departments. (See Reference 1.)
- EX TPS Cicabe
- TPS Ciswastra
- Pasar Induk Caringan
- TPS Ence Azis
Another consultation was held with Bandung’s relevant departments about the advantages and disadvantages of the four candidate sites. As a result, the candidate sites were narrowed down to EX TPS Cicabe, and TPS Ciswastra, taking in the advantages of “large area of the site” and “consent obtained from the local residents.”

(Reference 1) Locations of candidate sites

3) Selection of discharging enterprises
3)-1 Food waste discharging enterprises

(Concept of selection)
Top priority for selection is given to “being able to collect sorted waste of 12 tons/day without fail.” Consideration was given also to “being located as near as possible to the biodigester” and “being located within the eco village area.”

(Order of priority in selection of discharging enterprises based on the concept of selection)
Because the sorting of organic waste has not been developed very much, whether food business waste or household waste, new education in the sorting of waste is necessary for selecting discharging enterprises covering transportation to biodigesters.

From this viewpoint, because “food waste discharging enterprises” “discharge more waste per workplace” and “can more easily sort food waste” than “households,” they are advantageous in terms of both “easiness” and “efficiency” in sorting education.

Moreover, if, among the food waste discharging enterprises, “enterprises discharging a large amount of waste” are compared with “enterprises discharging a small amount of waste,” the former are advantageous in terms of both efficiency in sorting education and collection/transportation after sorting.

Therefore, the following order of priority should be adopted to select discharging enterprises:
No. 1: Enterprises discharging a large amount of waste, such as food markets, large restaurants, and hotels
No. 2: Enterprises discharging a small amount of waste, such as small local restaurants and food wagons
No. 3: Households

In addition to this order of priority, geographical conditions, such as “near the biodigester” and “located within the eco village,” should be taken into consideration.
(Study results)
Because large-scale workplaces that discharge food waste exist near Cicabe and Cisawastra, both of which are candidate places for the biodigester, top priority should be given to the collection of waste from them.

In addition, selection should be made from among the following:
• Large-scale workplaces that discharge food waste and that are relatively near the place where the biodigester system has been installed
• Workplaces that discharge food waste and are located within the eco village area
• Nearby household waste (limited to households that are carrying out sorting or have a plan to carry out sorting education)

Reference 1: Amount of food waste collected in the eco village area
In or around the eco village, there are 13 TPSs, into which waste of a little more than 101 m³/day is brought from households and workplaces. (If the bulk specific gravity is 0.4 and the amount is converted into weight, a little more than 40 tons/day are brought into them.)

Among the waste, the food waste that can be subjected to methane fermentation is estimated to be a little more than 15 tons/day. (Grounds for the estimation: it can be supposed that 52% of the waste collected by the TPSs is organic waste and 70% of the organic waste is food waste.)

(Reference 2) TPSs in or near the eco village

<table>
<thead>
<tr>
<th>No</th>
<th>Location</th>
<th>Volume m³/day (mixed domestic waste)</th>
<th>Service area</th>
<th>Disposal to TPA Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1 TPS at bottom of pasopati bridge</td>
<td>12 m³</td>
<td>Kelurahan temanmori RW 05, RW 15 dan RW 10, Kel. Cipaganti RW 01, ruangan jalan Cipaganti, Pasteur, Cihampelas dan dari trida – trida Bandung Uga</td>
<td>1 trip/day</td>
</tr>
<tr>
<td></td>
<td>2 TPS at Jl. Wastukencana</td>
<td>3 m³</td>
<td>Flower Market at Jl. Wastukencana</td>
<td>2 trip/week</td>
</tr>
<tr>
<td></td>
<td>3 TPS Tamansari (near the zoo)</td>
<td>16 m³</td>
<td>Kelurahan Lebak Siliwangi 8 RW, Kelurahan Lebak Siliwangi 8 RW, Kelurahan Lebak Siliwangi 8 RW</td>
<td>1 trip/day</td>
</tr>
<tr>
<td></td>
<td>4 TPS Babakan Siliwangi (in city forest area)</td>
<td>6 m³</td>
<td>Kel. Cipaganti RW 1, Kel. Hegarmanah RW 10</td>
<td>1 trip/day</td>
</tr>
<tr>
<td></td>
<td>5 TPS Babakan Siliwangi (TPS at bottom of pasopati bridge)</td>
<td>6 m³</td>
<td>komplek ITB + sebaga area</td>
<td>1 trip/day</td>
</tr>
<tr>
<td></td>
<td>6 TPS at Jl. Cihampelas</td>
<td>10 m³</td>
<td>Kelurah Farmer RW 07, RW 15 dan Kelurahan Cipaganti RW 04 dan RW 05</td>
<td>1 trip/day</td>
</tr>
</tbody>
</table>

| B  | 1 TPS at BALTOS MALL (include traditional market) | 10 m³ | Komplek Pusat Perbelanjaan Balubur (Mall) | 3-4 trip/week |
|    | 2 TPS PT Lion Superindo Bandung | 10 m³ | Komplek Superindo | 1 trip/day |
|    | 3 Universitas Pasundan | 8 m³ | Komplek Universitas Pasundan | 1 trip/day |
|    | 4 PT Multi Nusantara Karya (Pengurusan Kebersihan BIP) | 6 m³ | Pusat Perbelanjaan BIP Mall BIP | 1 trip/day |
|    | 5 RS St Borromeus | 6 m³ | Pusat Perbelanjaan BIP Mall BIP | 1 trip/day |
|    | 6 RS St Borromeus | 10 m³ | Komplek RS St Borromeus | every day |
|    | 7 PT Kardos Sukho (Hotel Garselin) | 5 m³ | komplek Hotel Garselin | every day |

3-2 Septic tank sludge
(Basic concept)
It was found that rainwater and gravel got mixed in tanks installed a long time ago due to poor maintenance and that the generation of biogas could not be expected due to progress in sludge digestion. Because of this, priority is given to the collection of sludge from “communal toilets” and “public toilets,” into which rainwater and gravel hardly enter.
(Study results)
Because public toilets and communal toilets were installed in the eco village relatively recently, priority is given to the collection of sludge from them.

4) Use methods and users of biogas
(Basic concept)
There are two methods to use biogas: “buyers’ use of biogas as fuel for a private electric generator, such as a boiler” and “selling of biogas to PLN (state electricity company) after conversion into electricity.”

A decision will be made as to which method to adopt after a decision about the place of installation, research on the surroundings, and consultation with the parties concerned.

(Study results)
The candidate sites for the biodigester (Cicabe and Ciswastra) are adjoined by “a market (in the case of Ciswastra)” or “a vocational training school (in the case of Cicabe).” These facilities are highly likely to have private electric generators. If so, they are expected to become prospective biogas users.

On the other hand, if biogas is sold to PLN for power generation, Indonesia’s system for purchasing renewable energy at a fixed price (feed-in tariff: FIT) is applied, which may make it possible to sell biogas at a higher price than usual.

(Reference) FIT system for electricity (in the case of JAWA Island) No. 27/2014 and No. 19/2015
Production of biogas from waste (up to 10 MW):
- Medium pressure: Rp 1,450 Rp/KWh
- Low pressure: Rp 1,798 Rp/KWh

5) Use methods and users of liquid fertilizer
(Basic concept)
In principle, liquid fertilizer is sold in the premises of the biodigester. (If it is transported to buyers, the actual transportation cost is collected as a hauling charge in addition to the selling price.)

Liquid fertilizer is used for “grain for human consumption,” “park trees and flowers,” and “grain for livestock consumption.” Because the fertilizer registration system is applied to grain for human consumption, it may take a lot of time to carry out examinations for the registration. Therefore, it is desirable to start with use for parks and grain for livestock consumption and, based on the results, shift to “grain for human consumption.”

(Results of study and examination)
In the suburbs of Bandung (to the southeast of the urban area), needs for liquid fertilizer have been found to be high from the results of visiting farmers who grow organic products by the use of liquid fertilizer. The main visited districts were Cigagak (mainly flower cultivation), Gabung (paddy rice), and Tasik (paddy rice).

In addition, Bandung has promoted the use of organic fertilizer for parks. Although liquid fertilizer has never been used, composts have been used in some parks.

Because it is expected that the area of parks will increase and the use of organic fertilizer will expand at the existing parks, parks can become prospective users of liquid fertilizer. However, there are conditions for the use: “the fertilization has an effect” and “liquid fertilizer has no bad smell.” In addition, the park department thinks that “liquid fertilizer will be used mainly for flower cultivation, but there seems to be no necessity for the use of fertilizer for tree cultivation, except at the time of tree planting.”

Moreover, livestock agriculture is prosperous in the suburbs of Bandung (the Cikole district), it may be possible to use liquid fertilizer for feed grain (pasture). In addition, it may be possible to use it for tea plantations in the suburbs of Bandung.
With regard to the area of use of liquid fertilizer suitable for the production of liquid fertilizer (about 15 tons/day), because “the amount of liquid fertilizer used per hectare is about 82 tons/year” in Japan (in the case of double-cropping of rice and wheat), the area of use of liquid fertilizer of 15 tons/day is estimated to be about 54 ha.

6) Role allotment among the parties concerned
The parties concerned allot roles to manage and operate the facilities safely as follows:

6)-1 Process of bringing in waste
(Food waste)
   a. Sorted discharge
   In principle, both enterprises and households sort and discharge waste. Neither sectors conduct sorting at this point. Kawasaki City has offered their experience on both enterprise and household waste in detail this year.

   b. Transportation after discharge
   In principle, households and small-scale discharging workplaces temporarily store waste at the neighboring TPS, while the city cleaning authority (PDK) transports it from the TPS to the biodigester. With regard to large-scale discharge workplaces, if such workplaces use the neighboring TPS, they should continue to store sorted and discharged waste in the TPS. Those that bring it directly in the final disposal plant without using the TPS should bring it directly in the biodigester in principle. In principle, if the TPS is used, PDK should transport it to the biodigester; if the TPS is not used, PDK (or private disposal services) should transport it to the biodigester.

(Septic tank sludge)
At present, septic tank sludge is drawn out and transported by the city’s water utility company (PDAM) directly or by a private transporter. In either case, sludge is disposed of at the “final sewage disposal plant (Bojongsoang disposal plant).”

Because sludge that meets advantageous conditions for bringing in to the biodigester (such as containing a lot of organic substances and being discharged near to the biodigester) is selected, sludge is transported to the biodigester by PDAM (or a private transporter) as before.

Flow of waste

![Flow chart]

(Reference)
PDK: city cleaning authority
PDAM: city water utility company

6)-2 Process of methane fermentation at the facilities
The operating manager of the facilities carries out all the processes of “receipt of waste,” “methane fermentation,” “biogas purification and storage,” and “storage of liquid fertilizer.”
6)-3 Process of use of biogas
If biogas is sold to another person:
- The installation of biogas conduits to the facility of the biogas user should be determined after consultation between the seller and the buyer of biogas.

If biogas is sold to PLN after being converted into electricity:
Power generating facilities (gas generating facility) is installed to generate power, and then the electricity is transmitted to PLN. Consultation is held with PLN about the establishment of facilities for power transmission, including the payment of the cost.

6)-4 Process of use of liquid fertilizer
In principle, the user transports liquid fertilizer to the place where it is used.

(4) Legal procedures necessary for commercialization
1) Procedure for gaining approval for the installation of facilities
   - AMDAL
   - Urban planning
   - Fertilizer registration system

The registration procedure is carried out as follows:
No. 1: analysis of components of fertilizer
No. 2: Demonstration cultivation
No. 3: Fertilizer registration (the national government’s Ministry of Agriculture registers it through the city government’s department of agriculture and food.)

2) Procedures within the city government
   - Budgeting for the city’s cost of constructing the biodigester
   - The city government’s approval for the city cleaning authority’s participation in this project
     (If SPC is installed, if it participates in an international consortium, etc.)

5.3 Estimation of the potential for reducing greenhouse effect

5.3.1 Waste composition study
When Bandung introduced wet-type technology for methane fermentation of organic waste, a study was carried out on the amount of discharged waste in the city and each component. The study was carried out for each of household waste and business waste in the city as follows:

(1) Study on sorting at each place of discharge
(2) Study on the amount of waste discharged at each place of discharge
(3) Analysis of waste components at each place of discharge

In addition, the study was carried out at the following targeted places of discharge:

Household waste: the low-income households that participate in the raising-awareness program for 3R sorting by a volunteer group called “Green Citarum.”
Business waste: small restaurants (local Indonesian cuisine)

(1) Study on sorting at each place of discharge
   1) Household waste
      1. Interviews on sorting conditions were held with four households that participate in the raising-awareness program for sorting, and samples of organic waste were obtained from two of the four households.
2. The households that participate in the sorting program could sort organic waste, and no impurities were mixed.
3. Recycling vendors come and buy plastic and paper waste.

![Photo 1: Interview on sorted collection](image1.jpg) ![Photo 2: Collection service of valuables](image2.jpg)

2) Business waste
1. Interviews were held in an area where local restaurants gathered and waste was sampled at a restaurant.
2. Waste discharged from the restaurants has generally been brought into the temporary disposal station (TDS) once a day.
3. Waste is not sorted, but is discharged in one bundle.

![Photo 3: Sampled restaurant](image3.jpg) ![Photo 4: Unsorted waste](image4.jpg)

(2) Study on the amount and composition of waste discharged at each place of discharge
1) Household waste
1. The amount of discharged organic waste was about 110 to 160 gram/day/person.
2. Organic waste did not contain meat or fish, and there was almost nothing other than vegetable waste. A small amount of leftover rice was contained.

2) Business waste
1. The amount of waste discharged from the restaurants was about 25 kg/day, and the ratio of organic waste was about 50%.
2. The composition of the waste was as shown in Table 1 below.

<table>
<thead>
<tr>
<th>Content</th>
<th>Ratio (%)</th>
<th>Content</th>
<th>Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-organic waste</td>
<td></td>
<td>Organic waste</td>
<td></td>
</tr>
<tr>
<td>Sandbags</td>
<td>2.6</td>
<td>Vegetables</td>
<td>12.3</td>
</tr>
<tr>
<td>Paper</td>
<td>22.8</td>
<td>Meat (chicken, bone-in)</td>
<td>7.0</td>
</tr>
<tr>
<td>Plastic waste</td>
<td>1.4</td>
<td>Fish &amp; shellfish (bony parts, liver)</td>
<td>5.0</td>
</tr>
</tbody>
</table>
Table 1: Composition of business waste

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinyl waste (bags, cords)</td>
<td>15.0</td>
<td>Rice &amp; vegetables (leftover rice)</td>
<td>23.9</td>
</tr>
<tr>
<td>Other</td>
<td>0.4</td>
<td>Subtotal</td>
<td>48.2</td>
</tr>
<tr>
<td>Bones (chicken, fish)</td>
<td>5.6</td>
<td>Subtotal</td>
<td></td>
</tr>
<tr>
<td>Eggshells</td>
<td>4.0</td>
<td>Total</td>
<td>100.0</td>
</tr>
<tr>
<td>Subtotal</td>
<td>51.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Results of analysis of ingredients

<table>
<thead>
<tr>
<th>Moisture content</th>
<th>Unit</th>
<th>Household waste</th>
<th>Business waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content</td>
<td>%, ar</td>
<td>86.3</td>
<td>78.5</td>
</tr>
<tr>
<td>Ash content</td>
<td>%, adb</td>
<td>7.6</td>
<td>10.1</td>
</tr>
<tr>
<td>TS</td>
<td>%, ar</td>
<td>13.7</td>
<td>21.5</td>
</tr>
<tr>
<td>VTS</td>
<td>%, adb</td>
<td>71.8</td>
<td>78.2</td>
</tr>
<tr>
<td>COD</td>
<td>g/L, ar</td>
<td>50.9</td>
<td>119</td>
</tr>
<tr>
<td>n-hexane extract</td>
<td>%, adb</td>
<td>25.48</td>
<td>35.09</td>
</tr>
<tr>
<td>C</td>
<td>%, adb</td>
<td>45.44</td>
<td>50.10</td>
</tr>
<tr>
<td>H</td>
<td>%, adb</td>
<td>7.05</td>
<td>7.51</td>
</tr>
<tr>
<td>N</td>
<td>%, adb</td>
<td>2.76</td>
<td>3.77</td>
</tr>
<tr>
<td>O</td>
<td>%, adb</td>
<td>27.88</td>
<td>28.21</td>
</tr>
<tr>
<td>Ca</td>
<td>dry%</td>
<td>5.89</td>
<td>19.95</td>
</tr>
<tr>
<td>Mg</td>
<td>dry%</td>
<td>1.11</td>
<td>1.01</td>
</tr>
<tr>
<td>K</td>
<td>dry%</td>
<td>24.76</td>
<td>4.29</td>
</tr>
<tr>
<td>Na</td>
<td>dry%</td>
<td>9.87</td>
<td>4.61</td>
</tr>
</tbody>
</table>

Table 2: Results of analysis of ingredients

5.3.2 Estimated amount of generated biogas

To estimate the amount of biogas that can be collected when organic waste discharged in Bandung is treated by the wet-type methane fermentation technology, a sequencing batch test was carried out by the use of mock
organic waste whose composition was the same as that of the organic waste discharged in Bandung. The test was carried out for each of mock household waste and mock business waste.

(1) Amount of generated biogas

The amount of biogas generated per input of organic waste was 95.5 L/kg-raw garbage in the case of household waste and 205.5 L/kg-raw garbage in the case of business waste.

Figure 1 below shows the results of a load change test.

![Figure 1: Amount of generated biogas per input load](image)

It can be confirmed from the results of the sequencing batch test that it is possible to gain an amount of generated biogas similar to the standard amount gained from raw garbage in Japan.

5.4 Estimation of potential for reducing greenhouse effects

The amount of organic food waste collected in Bandung is estimated to be about 500 tons/day. If the organic food waste is used as biogas after being processed by methane fermentation together with septic tank sludge (100 tons/day), the amount of greenhouse effect reduction is estimated to be 116,000 tons per year (in terms of CO₂ conversion).

Calculation formula:

2,900 CO₂ tons/year × 600 tons/15 tons = 116,000 tons/year

Amount of greenhouse effect reduction at 6.5 target facilities (15 tons/day)

The amount of greenhouse reduction is estimated to be 29,198 tons in the decade after the start of operation (in terms of CO₂ conversion). (This is equivalent to 2,900 tons CO₂/year on annual average.) (See Table 4 in 5.7.1.8.1.)

5.5 Amount of greenhouse effect reduction by large-scale diffusion (60 tons/day)

If four biodigesters with a capacity of 15 tons each are test-driven by 2020 to generate and use biogas, the amount of greenhouse effect reduction is estimated to be 11,600 tons/year on annual average (in terms of CO₂ conversion).
5.6 Examination of JCM methodology

5.6.1 JCM methodology

5.6.1.1 Outline of JCM methodology

The implementation of this project reduces greenhouse gas emissions by the following three factors:

(1) Avoidance of methane from landfill disposal sites
Supplied from cogeneration equipment that operates by biogas collected from a methane fermentation facility:

(2) System power consumption partially replaced with electricity

(3) Fossil fuel consumption partially replaced with heat

In this study, JCM methodology was examined by reference to UNFCC’s approved integrated methodology ACM0022, small-scale methodology AMS-III.AO, AMS-I.C, and a methodology tool “Emissions from solid waste disposal sites.”

5.6.1.2 Definition of terms

For the purpose of this methodology, terms were defined as follows:

Table 1: Definition of terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airtight test</td>
<td>When the completion test of the equipment is carried out, an airtight test is carried out according the following procedure to confirm that there is no leakage of biogas from the gas tank and the pipes: 1) The airtight test is carried out under the designed pressure. (JIS B 8266 11.7 b), Appendix 17 3.3) 2) A leakage test is carried out after the airtight test pressure reaches the predetermined level and keeps the level for 10 minutes or longer. (JIS B 8266 Appendix 17 3.3)</td>
</tr>
<tr>
<td>Continuous anaerobic digestion system</td>
<td>1) A system whereby biogas can be collected by inputting waste without dilution (without using dilution water) and causing methane fermentation successively 2) The system consists of a conditioning tank whose temperature is controlled at a medium temperature (35 °C or higher) and a methane fermentation tank.</td>
</tr>
<tr>
<td>Biogas</td>
<td>Biogas collected from the anaerobic digestion tank and desulfurized.</td>
</tr>
<tr>
<td>Desulfurization equipment</td>
<td>H₂S contained in biogas is removed, because it corrodes equipment at a subsequent stage, becomes a sulfated compound by combustion, or has effects on the human body and the atmosphere.</td>
</tr>
</tbody>
</table>

5.6.1.3 Qualification requirements

The following are the qualification requirements for the JCM methodology established by this methodology and the grounds for the establishment:

Table 2: Qualification requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirement 1</td>
<td>The continuous anaerobic digestion system should be introduced to supply biogas for fuel replacement.</td>
</tr>
<tr>
<td>Requirement 2</td>
<td>The equipment’s scale of disposal should be 15 tons/day or more.</td>
</tr>
</tbody>
</table>
Requirement 3  A maintenance manual should be prepared, including the following:
  - Daily inspection checklist
  - Responsibility sharing guidelines
  - Implementation system chart in accordance with the maintenance plan

Requirement 4  If this project is not carried out, the raw materials to be input into the anaerobic digestion system should be organic waste to be disposed of in a landfill site and septic tank sludge.

Requirement 5  Organic waste should be stored in a methane fermentation tank for 20 days or shorter and biogas shall be collected at a rate of 100 Nm$^3$ per 1 ton of organic waste. A performance test should be carried out before the operation of the equipment, and the result shall be inspected by a third-party institution.

Requirement 6  After installation of the equipment, an airtight test shall be carried out for the anaerobic digestion system to confirm that there is no leakage of biogas.

Requirement 7  The system shall be equipped with desulfurization equipment.

5.6.1.4  Target greenhouse effects and emission sources

The following are the types of greenhouse effects to be considered by this methodology, the emission sources, and the grounds for setting the targets:

<table>
<thead>
<tr>
<th>Target greenhouse effect</th>
<th>Emission source</th>
<th>Grounds for setting the target</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH$_4$</td>
<td>The amount of CH$_4$ emissions from organic waste buried in landfills if this project were not carried out</td>
<td>Main greenhouse effect to be reduced by this project</td>
</tr>
<tr>
<td>CO$_2$</td>
<td>The amount of CO$_2$ emissions from fossil fuel consumed if this project were not carried out</td>
<td>Same as above</td>
</tr>
<tr>
<td>CO$_2$</td>
<td>The amount of CO$_2$ emissions from system power consumed by methane fermentation equipment</td>
<td>Main greenhouse gas emitted through project activities</td>
</tr>
</tbody>
</table>

- Items omitted from the calculation targets
  - The disposal of organic waste by methane fermentation equipment to be installed near the sources of emissions will reduce the amount of waste transported to landfills, resulting in reduction in CO$_2$ emissions. However, the amount of waste transported by each truck and the greenhouse gas emissions by each truck are omitted from the calculation targets, because they are difficult to grasp.

5.6.1.5  Information and data for calculation

The following are the information and data to be acquired for the calculation under this methodology:

<table>
<thead>
<tr>
<th>Table 4: Information for calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information/data</td>
</tr>
<tr>
<td>1 Weight of waste input into methane fermentation equipment (tons)</td>
</tr>
<tr>
<td>2 CO$_2$ emission coefficient of system power (tCO$_2$/MWh)</td>
</tr>
<tr>
<td>3 CO$_2$ emission coefficient of diesel (tCO$_2$/TJ)</td>
</tr>
<tr>
<td>4 Adjustment factor for uncertainty</td>
</tr>
<tr>
<td>5 Ratio of methane to be flared/burned/used in recovered methane</td>
</tr>
<tr>
<td>6 Global warming potential of methane</td>
</tr>
<tr>
<td>7 Oxidation ratio</td>
</tr>
<tr>
<td>8 Ratio of methane in waste disposal site gas</td>
</tr>
<tr>
<td>9 Ratio of carbon to be decomposed in decomposable organic carbon</td>
</tr>
</tbody>
</table>
5.6.1.6 Setting of default values

The following are default values under this methodology:

Table 4: default values

<table>
<thead>
<tr>
<th>No.</th>
<th>Data</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$\text{EF}_{e,y}$ CO$_2$ emission coefficient of system power (tCO$_2$/MWh)</td>
<td>0.814</td>
</tr>
<tr>
<td>2</td>
<td>$\text{EF}_{FF,CO2}$ CO$_2$ emission coefficient of diesel (tCO$_2$/TJ)</td>
<td>72.6</td>
</tr>
<tr>
<td>3</td>
<td>$\eta_{\text{thermal}}$ Efficiency of fossil fuel-consuming equipment that would be used if the project did not exist</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>$\phi$ Adjustment factor for uncertainty</td>
<td>0.90</td>
</tr>
<tr>
<td>5</td>
<td>GWP$_{\text{CH}_4}$ Global warming potential of methane</td>
<td>25</td>
</tr>
<tr>
<td>6</td>
<td>OX Oxidation ratio</td>
<td>0.1</td>
</tr>
<tr>
<td>7</td>
<td>F Ratio of methane in waste disposal site gas</td>
<td>0.5</td>
</tr>
<tr>
<td>8</td>
<td>DOC$_j$ Ratio of carbon to be decomposed in decomposable organic carbon</td>
<td>0.5</td>
</tr>
<tr>
<td>9</td>
<td>MCF Methane correction factor</td>
<td>1.0</td>
</tr>
<tr>
<td>10</td>
<td>DOC$_j$ Ratio of decomposable organic carbon in waste $j$</td>
<td>15%</td>
</tr>
<tr>
<td>11</td>
<td>$k_j$ Decomposition speed of waste $j$ (1/year)</td>
<td>0.17</td>
</tr>
<tr>
<td>12</td>
<td>$J$ Composition ratios of waste $j$ (on weight basis)</td>
<td>Organic waste 100%</td>
</tr>
</tbody>
</table>

The following are grounds for setting each default value:

1. $\text{EF}_{e,y}$ (CO$_2$ emission coefficient of system power (tCO$_2$/MWh))
   The CO$_2$ emission coefficient of system power announced officially by the Indonesian National Council on Climate Change was adopted as the default value.

2. $\text{EF}_{FF,CO2}$ (CO$_2$ emission coefficient of diesel (tCO$_2$/TJ))
   The CO$_2$ emission coefficient of diesel specified in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories was adopted as the default value.

3. $\eta_{\text{thermal}}$ (Efficiency of fossil fuel-consuming equipment that would be used if the project did not exist)
   The efficiency was fixed at 1 to guarantee conservativeness of the reference emissions.

4. $\phi$ (Adjustment factor for uncertainty)
   The value specified in IPCC’s CDM methodology tool “Emission from solid waste disposal site” (version 06.0.1) was adopted as the adjustment factor for uncertainty.

5. GWP$_{\text{CH}_4}$ (Global warming potential of methane)
   This value was adopted because it was changed to 25 in IPCC’s Fourth Assessment Report (2007).

6. OX (Oxidation ratio)
   The oxidation ratio specified in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories was adopted as the default value.
7. F (Ratio of methane in waste disposal site gas)
   As above, the ratio specified in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories was adopted as the default value.

8. DOC (Ratio of carbon to be decomposed in decomposable organic carbon)
   As above, the ratio specified in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories was adopted as the default value.

9. MCF (Methane correction factor)
   As above, the factor specified in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories was adopted as the default value.

10. DOC (Ratio of decomposable organic carbon in waste j)
    As above, the ratio specified in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories was adopted as the default value.

11. k (Decomposition speed of waste j (1/year))
    As above, the value of 0.17 specified in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories was adopted as the default value to guarantee conservativeness of the reference emissions.

5.6.1.7 Method to set values to be set beforehand
None in particular

5.6.1.8 Grounds for calculating the reference amount of emissions
At present, more than 70% of the urban waste generated in Bandung is transported to landfill disposal sites and disposed of there. Moreover, Bandung has no large-scale methane fermentation facilities for organic waste or urban waste incineration facilities and has never promoted a plan for establishing them. Because urban waste generated in Bandung is likely to be buried in the landfill disposal sites also in the future, this amount becomes the BaU emissions. A conservative default value was set for calculating the reference amount of emissions.

5.6.1.9 Result of calculation of BaU emissions
With regard to the avoidance of methane gas from the landfill disposal sites, among “5.6.1.6 Setting of default values,” the following three values are calculated by the use of the values specified in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, which is used for the CDM Project, and the composition ratios of waste j for the preliminary sampling survey.

Table 5: Calculation of BaU emissions

<table>
<thead>
<tr>
<th>No.</th>
<th>Data</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>DOC (Ratio of decomposable organic carbon in waste j)</td>
<td>Wood &amp; wood products 43%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Paper 40%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Raw garbage 15%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cloth 24%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Garden, park refuse 20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Glass, plastic, other inorganic matters 0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IPCC</td>
</tr>
</tbody>
</table>

95
Decomposition speed of waste $j$ (1/year)

- Wood & wood products: 0.035
- Raw garbage: 0.4
- Paper: 0.07
- Others, organic waste other than food: 0.17

IPCC (Tropical (MAT>20°C) Wet, MAP>1000 mm)

Composition ratios of waste $j$ (in weight basis)

- Wood & wood products: 0.4%
- Paper: 22.8%
- Raw garbage: 57.8%
- Cloth: 2.6%
- Garden, park refuse: 0%
- Glass, plastic, other inorganic matters: 16.4%

Sampling survey results

5.6.1.10 Comparison of calculation results by the use of BaU emissions and conservative default values

The following is a comparison between the calculation results of BaU emissions and those of reference emissions.

Table 8: Comparison of BaU emissions and reference emissions

<table>
<thead>
<tr>
<th>Year</th>
<th>BaU emissions (tCO$_2$)</th>
<th>Reference emissions (tCO$_2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,042</td>
<td>693</td>
</tr>
<tr>
<td>2</td>
<td>1,791</td>
<td>1,278</td>
</tr>
<tr>
<td>3</td>
<td>2,342</td>
<td>1,772</td>
</tr>
<tr>
<td>4</td>
<td>2,756</td>
<td>2,188</td>
</tr>
<tr>
<td>5</td>
<td>3,075</td>
<td>2,539</td>
</tr>
<tr>
<td>6</td>
<td>3,328</td>
<td>2,836</td>
</tr>
<tr>
<td>7</td>
<td>3,534</td>
<td>3,086</td>
</tr>
<tr>
<td>8</td>
<td>3,706</td>
<td>3,297</td>
</tr>
<tr>
<td>9</td>
<td>3,854</td>
<td>3,474</td>
</tr>
<tr>
<td>10</td>
<td>3,982</td>
<td>3,625</td>
</tr>
<tr>
<td>Total</td>
<td>29,410</td>
<td>24,787</td>
</tr>
</tbody>
</table>

5.6.1.11 Method to calculate reference emissions

The following is the method to calculate reference emissions:

$$RE_y = RE_{CH_4,SWDS,y} + (EG_{thermal,y}/\eta_{thermal}) \times EF_{FCO2}$$

1,342 = 693 + (8.95 / 1.00) * 72.6

1) Changes in reference emissions in the decade

- 1st year: 1,342 = 693 + (8.95 / 1.00) * 72.6
- 2nd year: 1,927 = 1,278 + (8.95 / 1.00) * 72.6
- 3rd year: 2,421 = 1,772 + (8.95 / 1.00) * 72.6
- 4th year: 2,837 = 2,188 + (8.95 / 1.00) * 72.6
- 5th year: 3,188 = 2,539 + (8.95 / 1.00) * 72.6
- 6th year: 3,485 = 2,836 + (8.95 / 1.00) * 72.6
- 7th year: 3,735 = 3,086 + (8.95 / 1.00) * 72.6
- 8th year: 3,946 = 3,297 + (8.95 / 1.00) * 72.6
- 9th year: 4,123 = 3,474 + (8.95 / 1.00) * 72.6
- 10th year: 4,274 = 3,625 + (8.95 / 1.00) * 72.6
Reference emissions from waste landfill disposal sites \( 693 \text{ tCO}_2 \)

Net amount of heat generation from steam/heat supplied through the project activities \( 8.95 \text{ TJ} \)

Heat efficiency under the reference scenario \( 100\% \)

\[
RE_{\text{CH4,SWDS,y}} = \phi_y(1-f_y)GWP_{\text{CH4}}(1-OX)16/12*F_*\text{DOC}_{i,y}MCF_y\sum W_{j,x}\text{DOC}_{j}(1-e^{-k_j})e^{-k_j}(y-x)
\]

\[
693 = 0.90(1-0.9)*25(1-0.1)*16/12*0.5*0.5*1.0\sum W_{j,x}\text{DOC}_{j}(1-e^{-k_j})e^{-k_j}(y-x)
\]

2) \( RE_{\text{CH4,SWDS,y}} \) in the decade

<table>
<thead>
<tr>
<th>Amount of waste disposal (t)</th>
<th>4,380</th>
<th>4,380</th>
<th>4,380</th>
<th>4,380</th>
<th>4,380</th>
<th>4,380</th>
<th>4,380</th>
<th>4,380</th>
<th>4,380</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>693</td>
<td>585</td>
<td>416</td>
<td>351</td>
<td>296</td>
<td>250</td>
<td>211</td>
<td>178</td>
<td>150</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>693</td>
<td>585</td>
<td>493</td>
<td>416</td>
<td>351</td>
<td>296</td>
<td>250</td>
<td>211</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>693</td>
<td>585</td>
<td>493</td>
<td>416</td>
<td>351</td>
<td>296</td>
<td>250</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>693</td>
<td>585</td>
<td>493</td>
<td>416</td>
<td>351</td>
<td>296</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>693</td>
<td>585</td>
<td>493</td>
<td>416</td>
<td>351</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>693</td>
<td>585</td>
<td>493</td>
<td>416</td>
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<tr>
<td>7</td>
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<td>0</td>
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<td>0</td>
<td>693</td>
<td>585</td>
<td>493</td>
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<td>8</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
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<td>0</td>
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<td>0</td>
<td>693</td>
<td>585</td>
</tr>
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<td>10</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>693</td>
</tr>
</tbody>
</table>

\[
RE_{\text{CH4,SWDS,y}} \text{(CO}_2\text{)} = 693, 1,278, 1,772, 2,188, 2,539, 2,836, 3,086, 3,297, 3,474, 3,625
\]

5.6.1.12 Grounds for calculating project emissions

The project emissions in this project are associated with the system power consumed by the methane fermentation equipment.

5.6.1.13 Method to calculate the project emissions

The project emissions can be calculated as follows:

\[
PE_y = PEC_y*EF_{e,y} + \Sigma (PEC_{i,y}*NCF_{y} *EF_{CO2,i,y})
\]

\[
208 = 256 *0.814
\]

PEC\(_i\_y\) Power consumption of project equipment \( 256 \text{ MWh/y} \)

* No fossil fuel is used for the project activities.

System power consumption necessary for the calculation is monitored by the use of an electricity meter installed at the electricity inlet.

5.6.1.14 Monitoring method

The following are the monitored items and the monitoring methods:

<table>
<thead>
<tr>
<th>P</th>
<th>Item</th>
<th>Target</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Weight of waste inputted into</td>
<td>Truck scale</td>
<td>Estimate record</td>
</tr>
<tr>
<td></td>
<td>methane fermentation equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td>Supply of gas</td>
<td>Exit of methane</td>
<td>Constant monitoring by</td>
</tr>
<tr>
<td></td>
<td>fermentation equipment</td>
<td>fermentation</td>
<td>gas flow meter</td>
</tr>
<tr>
<td>P3</td>
<td>Methane gas concentration</td>
<td>Exit of methane</td>
<td>Constant monitoring by</td>
</tr>
<tr>
<td></td>
<td></td>
<td>fermentation</td>
<td>gas concentration meter</td>
</tr>
</tbody>
</table>
5.6.1.15 Greenhouse emissions and reductions

The following are estimates of greenhouse emissions and reductions:

\[ ER_y = RE_y - PE_y \]

\[ 1,134 = 1,342 - 208 \text{ (Reduction in emissions in the first year)} \]

Changes in reduction in emissions in the decade (tCO₂)

<table>
<thead>
<tr>
<th>Year</th>
<th>( RE_y )</th>
<th>( PE_y )</th>
<th>( ER_y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,342</td>
<td>208</td>
<td>1,134</td>
</tr>
<tr>
<td>2</td>
<td>1,927</td>
<td>208</td>
<td>1,719</td>
</tr>
<tr>
<td>3</td>
<td>2,421</td>
<td>208</td>
<td>2,213</td>
</tr>
<tr>
<td>4</td>
<td>2,837</td>
<td>208</td>
<td>2,629</td>
</tr>
<tr>
<td>5</td>
<td>3,188</td>
<td>208</td>
<td>2,980</td>
</tr>
<tr>
<td>6</td>
<td>3,485</td>
<td>208</td>
<td>3,277</td>
</tr>
<tr>
<td>7</td>
<td>3,735</td>
<td>208</td>
<td>3,527</td>
</tr>
<tr>
<td>8</td>
<td>3,946</td>
<td>208</td>
<td>3,738</td>
</tr>
<tr>
<td>9</td>
<td>4,123</td>
<td>208</td>
<td>3,915</td>
</tr>
<tr>
<td>10</td>
<td>4,274</td>
<td>208</td>
<td>4,066</td>
</tr>
<tr>
<td>Total</td>
<td>31,278</td>
<td>2,080</td>
<td>29,198</td>
</tr>
</tbody>
</table>
5.6.2 Study for preparation of PDD

5.6.2.1 Project implementation system and project participants

The following is the implementation system under consideration in this project:

Hitachi Zosen designs, procures, and constructs equipment, while PDK coordinates with local administrative agencies, collects and transports waste, and maintains and monitors facilities.

5.6.2.2 Project emission sources and monitoring points

The following figure shows the greenhouse gas emission sources and the monitoring points under this project:

P1: Amount of collected waste
P2: Heat value of biogas
P3: Biogas supply
P4: Amount of power used in the facilities

5.6.2.3 Monitoring plan

Because all the monitoring points are set up in the facilities, PDK collects and records data.

5.7 Financial plan

<Construction cost>
- Main body: 200 million yen
- (Power generation facilities) 60 million yen (100 kW facilities 1 working, 1 spare)
<Operation/management cost>
8 million yen (such as personnel cost and cost of equipment maintenance, including repairing)

<Securing finance resources>
The construction cost of the facilities is financed by construction subsidies under the Ministry of Environment’s JCM and Bandung’s budget fifty-fifty.
On the other hand, the operation/management cost of the facilities is financed by revenues from the operation (sales of biogas, sales of liquid fertilizer, and charges for disposal of waste).

<Securing finance resources>
The construction cost of the facilities is financed by construction subsidies under the Ministry of Environment’s JCM and Bandung’s budget fifty-fifty.
On the other hand, the operation/management cost of the facilities is financed by revenues from the operation (sales of biogas, sales of liquid fertilizer, and charges for disposal of waste).

<Example of calculation of revenues and expenditures>
(Concept of calculation)
• The operation/management cost (personnel cost, equipment repairing cost) is financed by revenues from the operation.
• Revenues from the operation are “waste disposal charges paid by the cleaning authority,” “sales of electricity,” and “sales of liquid fertilizer.” The selling price of electricity is calculated on the assumption that the FIT price is applied (purchase price of electricity generated from waste: 600 Rp/kWh). Liquid fertilizer is sold gratis. In addition, “waste disposal charges paid by the cleaning authority” are set at the lowest charges necessary for maintaining the revenue and expenditure balance of operation and management.

(Calculation results) Revenue and expenditure balance of operation/management

<table>
<thead>
<tr>
<th>Annual revenue (10,000 yen)</th>
<th>Annual expenditure (10,000 yen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste disposal charges</td>
<td>240</td>
</tr>
<tr>
<td>Sales of biogas (electricity)</td>
<td>560</td>
</tr>
<tr>
<td>Sales of liquid fertilizer</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>800</td>
</tr>
<tr>
<td>Operation/management cost</td>
<td>800</td>
</tr>
</tbody>
</table>

(Note) “Waste disposal charges (2.4 million yen)” paid by the cleaning authority are equivalent to about 440 yen/ton, which is lower than the cost that Bandung is now paying for the transportation and final disposal of waste.

5.7.1 Finance scheme

In consultation with PDK, the counterpart, the two schemes below are now being compared with local laws and ordinances.
5.8 Points of attention for introduction of a biodigester

To operate and manage a biodigester continuously, it is important to “educate site workers about operation and management skills.” It is also important to cope with social and management problems, such as “thorough sorting of waste,” “securing continuous users of biogas and liquid fertilizer,” and “securing sufficient incomes to finance the maintenance cost of the biodigester.”

These problems are related to not only waste but also energy and agriculture. In addition, because there are a wide range of parties concerned, including administrative agencies, local residents, and farmers, it is necessary to cooperate with them continuously.

For the biodigester to continue to operate there needs to be regular revenue through waste collection fees, sales of fertilizers an biogas. It should ideally operate under full capacity from the beginning, but when this is difficult, projections on income and expenditures should be made on waste volume that could be collected.
For the biodigester to be installed throughout Indonesia the case of Bandung would be important as a good case scenario. Japan has been making efforts on how to become a recycling-oriented society and for that reason the food recycling law and its related policies have been implemented. Already positive impacts are showing in the food manufacturing industry, food wholesale and retail industries. Such regulations are not seen in Indonesia which is why support from the municipality to include food waste recycling as a priority in its waste management plan and also to raise the biodigester would be most helpful.

5.9 Action plan from next fiscal year

FY2015: PS of JCM
FY2016-2018: JCM verification

Bandung has implemented a waste master plan in December 2014 which still requires more details such as action plans that would help to reach the mid to long term targets in the plan. This study has shown that for this technology to be implemented it would be important to have an action plan for sorting and recycling of food waste as well as other waste. Therefore, it is hoped that PD Kebersihan (PDK) could refer to Kawasaki city government’s case scenarios when developing the action plan while developing those for the food waste management in the business sector (an area of focus of this year) in the following year’s JCM studies. Steps to handle household food waste will follow and should be in tune with Bandung city’s overall vision on how to handle its waste.

(2) Support service for capacity building

Through this support service, we contributed to the following: smooth holding and management of workshops to deepen the relevant Bandung Government officers’ understanding of JCM and the Japanese technologies covered by this study; planning and holding of domestic training; invitation of Bandung Government officers to Japan; and the promotion of Japan’s effective and efficient strategic international environmental cooperation, including JCM. In the domestic training especially, information was provided to improve Bandung’s relevant measures, presenting details about the reason why Kawasaki City’s officials, who have long engaged in environmental problems, began to carry out the current activities, and giving concrete examples of the activities. The following are concrete details of each meeting:

2.1 Kick-off meeting (August 25; Bandung)

A kick-off meeting was planned and held in order to explain the outline of the JCM system and request cooperation in this fiscal year’s feasibility study, and drew 59 participants from Bandung, including government officials, private entrepreneurs, and NGO members. For details of the following materials used for this service, see the Appendix.

1) Agenda

2.2 Domestic training (July 21 to 23; Yokohama, Kawasaki)

During the International Forum for Sustainable Asia and the Pacific (ISAP), which was sponsored by IGES, two Bandung officials were invited as participants in a JCM-related seminar so that they could understand the purpose and outline of the JCM feasibility study. In addition, preparations were made about training in waste management, and the officials took a tour of facilities of relevant companies in Kawasaki City, including JFE Kankyo and Kawasaki Biomass, to study the most advanced waste recycling technology.

2.3 JCM workshop and domestic training (October 27 to 30; Yokohama, Kawasaki, Tokyo)

One Bandung official was invited as a participant in a JCM-related seminar which was held under the sponsorship of the Ministry of the Environment during Smart City Week Yokohama so that the official could
understand the characteristics of the financing scheme of JCM and the requirements for an application. In addition, the official took a tour of the facilities of NTT FACILITIES and the Toshiba Science Museum to understand building energy-saving technology and the necessity for wide-area development in Bandung. For details of the following material used for this service, see the Appendix.

1) Agenda

2.4 Tour of facilities for methane fermentation energy technology and training in waste management (December 1 to 4; Niigata, Tokyo, Kawasaki)

Seven participants were invited from the Bandung Government and universities and took a tour of active waste disposal facilities (Maihira Clean Center, New Senami Biomass Energy Plant) according to the plan made by the Japan Environmental Sanitation Center and Hitachi Zosen to share technological issues for the promotion of the project. Through the tour of prospective buyers, the participants understood the purposes and selling method of methane gas and liquid fertilizer fermented as a result of methane fermentation, enabling Bandung to gain materials for identifying prospective buyers.

Because Bandung needs to sort and dispose of waste like Japan, the participants were taught by the Kawasaki City Government’s official in charge about details of planning, relevant laws, and various measures for promoting private enterprises’ recycling activities and activities for the enlightenment of residents. It was found that the next steps for sharing information on Bandung’s waste management master plan and carrying out the plan include the following: 1) a review of the waste management action plan; and 2) implementation of enlightenment activities, such as environmental study in cooperation with schools. These steps should be based on Kawasaki City’s example measures, the collection of relevant data, and analysis of the data. For details of the following materials used for this service, see the Appendix.

1) Agenda
2) Materials presented by lecturers
3) Minutes

2.5 Talk with the Bandung Mayor (January 7, 2015; Bandung)

With regard to the biodigester project among the support projects between Bandung and Kawasaki City, we requested an interview with the Bandung Mayor. In response to our request, the Mayor explained the City’s waste-related measures and promised to provide support to the biodigester project, which accelerated discussions held on January 8-9 with Bandung’s officer in charge about the promotion of the project.

2.6 Wrap-up meeting (January 30, 2015; Bandung)

The Japanese parties concerned reported the results of this fiscal year’s feasibility study to Bandung to share the results. The Indonesian JCM Secretariat explained the first JCM project and the method for applying for the financial scheme, and discussions were held about the issues to be resolved for promoting the formation of the project. About 30 persons from the Bandung Government and private enterprises participated in the meeting. For details of the following materials used for this service, see the Appendix.

1) Agenda
Inception meeting of Project for Developing a Low Carbon Society under collaboration between Bandung city and Kawasaki city in Bandung, Indonesia

Date: August 25th 2014 9:00-16:30
Venue: Unamuno-Lautze Room, Novotel Hotel Bandung

Agenda

9:00-10:15
Overview of JCM Feasibility Studies - Information exchange among FS stakeholders - JCM Secretariat and others

Participants:
- Indonesia JCM Secretariat
- Kawasaki City
- NTT Facilities Inc.
- Japan Environmental Sanitation Center
- Hitachi Zosen Corporation
- Japan International Agency for Cooperation (JICA)
- Institute for Global Environmental Strategies (IGES)

10:15-10:45
Introduction to Feasibility Study (1): Waste to Energy

Topic: Descriptions of the technologies and data required for MRV

Moderator: Ms. Ayu Sukenjah, Head of Division for Environmental Rehabilitation, Bandung City

9:15-9:45
Overview of the Joint Crediting Mechanism (JCM) and Climate Change

Moderator: Mr. Dicky Edwin Hindarto (Head of Indonesia JCM Secretariat)

10:00-10:15
Overview of JCM Feasibility Studies

Moderator: Ms. Ratu Keni Atika (Monitoring, Evaluation and Dissemination Specialist, Indonesia JCM Secretariat)

10:55-11:05
Q & A

Moderator: Dr. Priana Sudjono, Bandung Institute of Technology

11:05-11:25
Introduction to Feasibility Study (2): Energy efficiency for streetlamps and buildings

Topic: Descriptions of the technologies and data required for MRV

Moderator: Mr. Naoki Ishitani, Director, NTT GP-Eco communication, Inc.

11:25-11:35
Q & A

Moderator: Ms. Ayu Sukenjah

11:35-13:00
Lunch (lunch to be provided)

Opening Remarks

Moderator: Mr. Aki Okumura, Chairman, Japan Environmental Sanitation Center

13:00-13:20
Sharing and scaling of low carbon development

Moderator: Dr. Eric Zusman, Principal Policy Researcher, Institute for Global Environmental Strategies

Notes:
- Translation will be provided for Bahasa <-> English, Bahasa <-> Japanese
Sharing of current status - Bandung City

City master plan, energy master plan, GHG emissions inventories, building energy efficiency, Mr. Eric Mohamad Atthauriq, Head of Environment Management Board, Bandung City Government

Street lightings plan: Dr. Bona Frazila Russ, Institute of Technology Bandung

Waste management plan: Mr. Cece Iskandar, Head of PD Kebersihan

Green innovations for sustainable and low carbon society from Kawasaki city to the world

Dr. Eric Zusman, Principal Policy Researcher, Institute for Global Environmental Strategies

Inauguration and reception of Workshop Participants

Date and time: August 29th 8:30-12:00
Venue: Novotel Hotel

Site visit and courtesy call

Agenda

Date and time: August 26th 8:30-16:00

Energy Team

8:30- Depart hotel lobby, head to site survey
8:30-12:30 Waste to energy (biogas plant + energy efficiency) site survey

Waste Team

8:30- Depart hotel lobby, head to site survey
8:30-12:30 Waste to energy (biogas plant + energy efficiency) site survey

Participants

Kawasaki City:
Mr. Yokota, Mr. Ogihara

Japan Environmental Sanitation Center:
Mr. Okumura, Mr. Ohbayashi, Mr. Misaki

Hitachi Zosen:
Mr. Kobayashi, Mr. Mukai

Indonesia JCM Secretariat:
Ms. Ratu Keni Atika, Ms. Aryanie Amellina

IGES:
Dr. Nugroho (Mr. Toto)

ITB:
Mr. Jongga Jihann

Venue:
Madame Sari Kartika Sari Restaurant (tentative)

12:30-13:45 Lunch

14:00 - Discussions at ITB

15:00-16:30 Overall discussions and small group discussions

16:15-16:30 Closing Remarks

Dean of Bandung Institute of Technology
Participants 参加者

NTT Facilities Inc.  Mr. Ozaki, Mr. Muto

NTT GP-Eco communication, Inc.  Mr. Ishitani

Indonesia JCM Secretariat  Mr Dicky Edwin Hindarto

ITB  Dr. Widyarini Weningtyas (Ms. Rini)

IES  Ms. Ryoko Nakano

12:30-13:45  Lunch  午食
Venue 場所: Madame Sari Kartika Sari Restaurant (tentative)

13:45-15:45  Energy FS site survey (2)
エネルギー調査 FS の検査地探察 (2)
※ To visit the remaining locations and also the LED streetlight panel board
残りの検査地を訪問。

Aug 27th 2014 8月27日

Japanese participants departing Bandung should check-out from the hotel in the morning.
当日出発される方は朝チェックアウトを済ませて下さい。

To be divided into two teams  二チームに分かれて終日行動

TEAM A) 9:30  Depart hotel from lobby  ホテル・ロビーを出発

10:00-11:00  Visit to Mr. CECE ISKANDAR, Head, PD Kebersihan
チェチェ・イスカナルダル バンドン市清掃公社 責任者への表敬訪問

Participants  日本側参加者

Japan Environmental Sanitation Center  Mr. Ohbayashi

Hitachi Zosen  Mr. Kobayashi, Mr. Mukai

IGES  Dr. Nugroho (Mr. Toto)

ITB  Mr. Jongga Jihann

TEAM B) 10:30  Depart hotel from lobby  ホテル・ロビーを出発

11:00-12:00  Visit to Mr. Eric Mohamad Atthauriq, Head of Environment Management Board
エリック アタウリク 環境運営委員会 責任者 への表敬訪問

Participants  日本側参加者

Kawasaki City  Mr. Yokota, Mr. Oghara

Japan Environmental Sanitation Center  Mr. Okumura, Mr. Misaki

NTT Facilities Inc.  Mr. Ozaki, Mr. Muto

NTT GP-Eco communication, Inc.  Mr. Ishitani

ITB  Dr. Widyarini Weningtyas (Ms. Rini)

IES  Ms. Ryoko Nakano

※ All members return to hotel and depart for Sukarno Intl Airport or Jakarta after lunch
※ 参加者は一旦ホテルに戻り昼食後、空港あるいはジャカルタ市内へ向かう

Contact mobile phones  領略先電話番号

<table>
<thead>
<tr>
<th>Name 氏名</th>
<th>Cellphone携帯電話</th>
<th>Notes 備考</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ms. Ryoko Nakano (中野) IGES</td>
<td>+81-80-5888-7387</td>
<td>（Japan &amp; Indonesia 日本及びインドネシアにおいて）</td>
</tr>
<tr>
<td>Dr. Sudarmanto Nugroho (トト氏) IGES</td>
<td>+62-0819-3222-2658</td>
<td>（Indonesia, インドネシア国内のみ）</td>
</tr>
<tr>
<td>Ms. Yoriko Itakura (伊武氏) IGES</td>
<td>+81-46-855-3830</td>
<td>（Japan 日本）</td>
</tr>
<tr>
<td>Dr. Widyarini Weningtyas (リニ氏) ITB</td>
<td>+62-817-9250225</td>
<td>（Indonesia, インドネシア国内のみ）</td>
</tr>
<tr>
<td>Mr. Jongga Jihann (ジョンガ氏) ITB</td>
<td>+628153809266</td>
<td>（Indonesia, インドネシア国内のみ）</td>
</tr>
</tbody>
</table>
アジアにおける低炭素都市形成セミナー（案）

主催：日本国環境省、共催：公益財団法人環境健康調査研究機関（IGES）
日時：10月29日（木）、会場：バニオ横浜301

【プログラム】

15:00-15:05
開会

15:05-15:50
全体セッション1：都市間連携を通じアジアを低炭素化（パネルディスカッション）
発表

15:55-16:55
全体セッション2：自律体が低炭素化を促進するために～低炭素行動計画の策定と持続性の定量評価～
発表

16:55-1700
閉会
Bio-Digester Workshop 概要

目的：環境省に採択されたJCM大規模案件形成可能性調査事業"パンドン市・川崎市の都市間連携による低炭素都市形成支援事業"の活動のひとつとしてパンドン市の政府職員を招集し、同市が導入を検討する廃棄物のメタン発酵エネルギー技術の観察、および廃棄物管理に関する研修を実施し知識を高めていきたい。

望まれるアウトプット：
● 日本で実際に稼働している廃棄物処理施設を実務担当者が視察し技術への理解を深めながら、事業化に向けた技術的な課題を確認して見たい。
● メタン発酵処理の結果、醸成されるメタンガス及び液体の用途を示す一覧表を示し、発酵廃棄物の利用について説明して見たい。
● 同技術を導入した際、現在一括埋立処理となっているところパンドン市においても日本同様に発酵廃棄物が発生する必要があることを示し、景観の面での対策に関する事例を示すことについて理解を深めて見たい。
● 日インドネシアの関係者を来年年度の事業化に向けて説明し、事業規模・財源・関係者の役割などの課題を解決した。

12月1日 舞平清掃センターの視察
舞平清掃センターでは、下水と浄化槽汚泥の処理を目的する施設で、加えて汚泥を受け入れ、浄化槽汚泥を発酵を行い、生成したメタンガスはボイラ燃焼料として利用できる。同センターは「新しい発酵技術を利用した新たな環境対策活動」を行っています。各地で実施される小規模な施設で、パンドン市における日立造船の取組みに比例するものと期待される。

12月2日 新潟市バイオマスエネルギープラントの視察
新潟市バイオマスエネルギープラントでは、廃棄物処理施設を活用した発電施設を活用し、バイオマスプラントにてメタンガスを作り出す「発電と生活に利用している」パンドン市においてもガス発電による収入が今後の事業のパンドン政府へのメリットであり、成功事例に触れていただくことで前向きに検討いただくことが期待される。

12月3日 関係者会合 議題
1. 「発酵施設の収支バランスをとることの重要性及びその具体的方法や課題」
2. 「施設の管理運営主体に関すること」

12月4日 川崎市・GESの一斉廃棄物分別回収、市民啓発活動の研修

<table>
<thead>
<tr>
<th>日付</th>
<th>行動予定</th>
<th>宿泊予定先</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-Nov</td>
<td>11/31 NH 836 30NOV ジャカルタ 06:25-成田 15:45 (予定) 着後、滞在先へ移動</td>
<td>品川プリンスホテル Tel: 03-3507-0606</td>
</tr>
<tr>
<td>1-Dec</td>
<td>新潟市 廃棄物処理施設 観察 9:30 東京駅出発 11:30 新潟駅着、バス移動（約20分） 13:00-15:00 舞平清掃センター見学（電話025-280-3131） 15:00 バス移動 新潟第一ホテルへ移動・宿泊</td>
<td>品川プリンスホテル Tel: 025-243-1111</td>
</tr>
<tr>
<td>2-Dec</td>
<td>新潟市 廃棄物処理施設 観察 9:30-11:30 新潟市バイオマスエネルギープラント見学 11:30-12:30 新潟駅へ移動（バス） 15:20 新潟駅発 17:20 東京駅着</td>
<td>品川プリンスホテル Tel: 03-3507-0606</td>
</tr>
<tr>
<td>3-Dec</td>
<td>水 バンドン市のバイオディーゼル事業の講演（場所：ＴＢＤ）</td>
<td>品川プリンスホテル Tel: 03-3507-0606</td>
</tr>
<tr>
<td>4-Dec</td>
<td>木 9:30-16:30 廃棄物関連業務の研修（川崎市市庁舎 ＴＢＤ）</td>
<td>品川プリンスホテル Tel: 03-3507-0606</td>
</tr>
<tr>
<td>5-Dec</td>
<td>金 12/5 NH 836 30NOV ジャカルタ 06:25-成田 15:45 (予定)</td>
<td>-</td>
</tr>
</tbody>
</table>
December 4, 2014

Waste Policy Section, Environment Bureau, Kawasaki City

Kawasaki City’s Efforts in Creating a Recycling Society

Overview of Kawasaki City

<table>
<thead>
<tr>
<th>Remarks</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eighth among government decreed cities</td>
<td>Eighth among government decreed cities</td>
</tr>
<tr>
<td>Smallest among government decreed cities</td>
<td>Smallest among government decreed cities</td>
</tr>
<tr>
<td>Highest among government decreed cities</td>
<td>Highest among government decreed cities</td>
</tr>
<tr>
<td>Youngest among government decreed cities</td>
<td>Youngest among government decreed cities</td>
</tr>
</tbody>
</table>

Municipal Solid Waste from Households and Businesses

In Kawasaki City

- Municipalities are responsible for the management of municipal solid waste from households.
  ⇒ The city performs the collection, processing, and disposal.

- Businesses are responsible for the management of municipal solid waste from businesses.
  Businesses that discharge waste collect and transport the waste by themselves or by commissioning collection and transport to businesses that have been granted permission from the city. The waste is brought into the city's facilities for incineration.
  ⇒ The city performs the processing and disposal.

Separation and Processing of Municipal Solid Waste (Household Waste) in Kawasaki City
**History of Waste Processing**

- Development of garbage trucks and collection started (1955)
- Daily collection started (six days/week) (1961)
- Total incineration structure established (four incineration facilities) (1971)

**Contemporary thinking**

- Preserving the living environment
- Improving public hygiene
- Appropriate processing (incineration) was the central concept

With the period of high economic growth, Japan entered the period of mass production, mass consumption and mass waste disposal.

1990: “Waste Emergency” declared

Promoting the reduction of waste and making it a resource

---

**Changes in waste collection and disposal treatment by Kawasaki City (1970’s ~ recent)**

- Started empty can collection (1977- , started city-wide collection in 1998)
- Started used dry cell collection (1984-)
- Started empty bottle collection (1991 - , started city-wide collection in 1999)
- Started railway transportation of garbage (1995-)
- Started small metal collection (1997-)
- Started charging for over-sized trash (2004-)
- Started a pilot test for various papers collection (2006, started city-wide collection in 2011)
- Started garbage collection 3 days a week Started plastic containers and packaging collection (2011+, started city-wide collection in 2013)
- Started collection 2 days a week (2013-)

After announcement of garbage emergency declaration on wastes (1990), Kawasaki City gradually started waste collection, and tried to reduce volumes the garbage which goes to incineration process (mainly general garbage).

---

**Waste and Resource Processing Flow**

---

**The map of KAWASAKI**

- Tama-Ward
- Tsurumi-Ward
- Nakahara-Ward
- Takatsu-Ward
- Miyamae-Ward
- Asao-Ward
- Saiwai-Ward
- Kawasaki-Ward

---

*1. Suehirocho Station
2. JR Freight Kawasaki Freight Station
*
Regular Waste
(Combustible Waste)

- Kitchen waste
- Twigs, pieces of boards
- Glass, china, ceramics, fluorescent lights
- Used cooking oil

Twice a Week

Collection of household waste

Waste-collection point of the morning of collection of combustible waste (general waste)

Garbage truck (packer vehicle)
Incineration Plant

- Ouzenji Incineration Plant: 150t/day, 3 furnaces
- Tachibana Incineration Plant: 200t/day, 3 furnaces
- Tsutsumine Incineration Plant: 300t/day, 2 furnaces
- Ukishima Incineration Plant: 300t/day, 3 furnaces

Total 4 Incineration Plants

Relay Transport Using Heavy Trucks

Kase Clean Center

- Commencement of operation: March 1995
- Compression facility: 300 tons per 5 hrs x 2 units
- Facility to receive the waste: 75 m³ x 2 units
One container truck has a capacity equivalent to three to four [medium-sized] garbage trucks.
Relay Transport Using Railroads

Transport Using Railroads Facilities for Reshipping Recyclables

<<Processing Capacity>>
- Reshipment of empty cans: Special container 10 containers per day
- Reshipment of empty bottles: Container of Japan Railways (JR) 10 containers per day
- Reshipment of mixed paper: Special container 15 containers per day
- Plastic containers and packaging: Special container 25 containers per day

Transport Using Railroads Freight Train (Clean Kawasaki)

The Subject of KAWASAKI

Transportation by a Dedicated Train of 21 Cars Carrying 83 Containers

The train transports regular waste, incineration ash, and recyclables, and discharges them at two stations. From there, they are transported by land using trucks for a short distance, and brought to incineration facilities, landfill sites, and recycling facilities, respectively.

Combustion capacity: 450t/day

Combustion capacity: 600t/day

Combustion capacity: 900t/day

Tokyo Bay
Flow of waste incineration in the waste incineration plant

- Incineration at high temperature
- Flue-gas treatment
- Incineration ash
- Collected waste

Thermal disposal and Power generation

- As much as possible, it recycles, thermal disposal of what remained is carried out, and recyclables are reclamation.
- Heat use and power generation are carried out also in incineration.

Waste disposal flash record

<table>
<thead>
<tr>
<th>Total amount of discharge</th>
<th>Recycled Quantity</th>
<th>Incinerated Quantity</th>
<th>Reclamation Quantity</th>
<th>Storage Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>531,949</td>
<td>154,299</td>
<td>377,363</td>
<td>47,671</td>
</tr>
</tbody>
</table>

Waste disposal and Power generation

- Heat use and power generation are carried out also in incineration.

<table>
<thead>
<tr>
<th>Unit: T</th>
<th>Total amount of discharge</th>
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</tr>
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<td>154,299</td>
<td>377,363</td>
<td>47,671</td>
<td>4,508</td>
</tr>
</tbody>
</table>

Combustion capacity

- **Ukishima Incineration Plant**: 900t/24h, 3 furnaces (300t/24h), 12,500kw
- **Tsutsumine Incineration Plant**: 600t/24h, 2 furnaces (300t/24h), 2,000kw
- **Tachibana Incineration Plant**: 600t/24h, 3 furnaces (200t/24h), 2,200kw
- **Ouzenji Incineration Plant**: 450t/24h, 3 furnaces (150t/24h), 7,500kw

Decreases to 1/8 by incineration

Landfill Site

- **Ukishima Landfill Site (1 Phase)**: Commencement of combined use in 1978
- **Ukishima Landfill Site (2 Phase)**: Closed in 2006

The Subject of KAWASAKI

- **Ukishima Landfill Site (1 Phase)**: Commencement of combined use in 1978
- **Ukishima Landfill Site (2 Phase)**: Closed in 2006
- **Ukishima Landfill Site (2 Phase)**: Commencement of combined use in 2000

Electricity sales to utilities -- quantity (kwh), Electricity sales to utilities -- amount of money (kwh) (X1,000yen)
Activities concerning Recyclables

Once a Week

Waste and Recyclables Processing Flow

Flow of waste and recyclables processing in Kawasaki City (as of April 2014)

Households
- Request by telephone or through the Internet

Regular waste
- Power generation (Once a week)

Used dry cells
- Private vendors (Once a week)

Empty bottles
- Private vendors (Once a week)

Empty cans and PET bottles
- Private vendors (Once a week)

Mixed paper
- Private vendors (Two times a month)

Plastic containers and packaging
- Private vendors (Two times a month)

Small metal items
- Private vendors (Two times a month)

Bulk waste
- JR Freight Kajigaya Freight Terminal Station
- Dry cell stock yard (Processing Center, JR Freight Kajigaya Terminal Station, Nambu Recycling Center, Tsutsumine Processing Center Recycling Facility)

*1. Suehirocho Station
*2. JR Freight Kawasaki Freight Station

Bulk waste processing facility
- Utilized at the center and partially sold to power companies
- Steam (Two times a week)
- Incinerated at processing centers

Recycled
- Utilized at the center and partially sold to reprocessing subcontractors
- Sold to reprocessing subcontractors
- Sold to reprocessing subcontractors
- Sold to metal dealers

Recycled
- Processed by recycling subcontractors
- Processed by recycling subcontractors
- Processed by recycling subcontractors
- Processed into raw materials

Incineration ash
- Transported
- Processed into raw materials
- Processed into raw materials
- Processed into raw materials
- Processed into raw materials

Landfills
- Iron, zinc, etc.
- New bottles
- Plastic products, etc.
- Iron construction products, aluminum cans, etc.
- Textile and stationery products
- Empty cans

Flow of “Paper” Recycling Process

Citizen Waste Output Survey

2012 – Citizen Waste Output Survey

Household Waste

Paper 59.7%
Plastics 18.5%
Cans 12.6%
Organic 5.1%
Bags 5.9%
Scenery of "Mixed paper" collection

① Citizens judge and it takes out wastes.
② Collection work (Privatization)

"Mixed paper" intermediate treatment

① It carries in to an Resource Recycling Facility
② It puts in a receiving conveyor
③ Foreign substance is removed by hand-sorting
④ Compression (baling)

"Mixed Paper Recycling"

Paper Factory
(Agent for hard to reuse waste paper)
Recycle into toilet paper
San-Ei Regulation Co Ltd
Kawasaki-ku, Misue-cho
Waste Paper: 81,000t/Year
Total Paper Production: 54,000t/Year

"Citizen Waste Output Survey"
2012 – Citizen Waste Output Survey

- Household Waste
  - Plastics containers and packaging 35%
  - PET bottles 13%
  - Other Plastic articles 52%
  - Tin 5.9%
  - Glass 4.8%
  - Fabric 1.3%
  - Miscellaneous 12.4%
  - Kitchen Goods 26.1%

Kawasaki ZERO Emission Industrial Complex
San-ei Regulator Co Ltd
Kawasaki-ku, Misue-cho
Waste Paper: 81,000t/Year
Total Paper Production: 54,000t/Year

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Container and Packaging Recycling Law

Enacted in 1995 with the purpose of ensuring proper management of container and packaging waste, which accounted for approximately 60% of municipal solid waste at the time, and for ensuring effective use of resources.

The Japan Container and Packaging Recycling Association

A designated corporation under the Container and Packaging Recycling Law. Receives containers and packaging that have been separated and collected by municipalities, and undertakes various activities for recycling with funding by businesses that are obliged to recycle them, such as specified business entities including manufacturers and sellers.

Flow of "Plastic containers and packaging" Recycling Process

2. Collection work (Privatization)
3. Intermediate treatment
4. Foreign substance is removed by hand-sorting
5. Compression (baling)
6. It is carried to an Recycling Company

Scene of "Plastic containers and packaging" collection

1. Collection work (Privatization)
“Plastic container and packaging” Recycling

Recyclable plastic and packaging materials are processed through the bidding process to recycling companies. The recycled materials are then used as pallets, blast furnace fuel, etc.

Waste plastic to ammonia raw material facility (Showa Denko K.K.)
PET to PET recycling facility (PET Refine Technology Co., Ltd.)
Waste plastic blast furnace recycling facility, waste plastic frame panels for pouring concrete production facility, discarded home appliance recycling facility (JFE Group)

Kawasaki City’s Plan for Processing Waste

The Subject of KAWASAKI
① The Superannuated Incineration Plant

- Superannuated incineration plant
  - Tachibana: Combustion capacity 600t/day since A.D. 1974
  - Tsutsumine: Combustion capacity 600t/day since A.D. 1979
  - Ushikama: Combustion capacity 900t/day since A.D. 1995
  - Ozenji: Combustion capacity 450t/day since A.D. 2012

- Kawasaki Zero Emission Industrial Complex
  - Difficult-to-recycle paper recycling facility (SAN-EI Regulator Co., Ltd.)
  - Recycled cement production facility (D.C. Co., Ltd.)

Kawasaki Ecotown Collection of Advanced Resource Recycling Facilities

- Used plastics to ammonia raw material recycling facility (Showa Denko K.K.)
The Subject of KAWASAKI

2. Lengthening the life landfill

- Ukishima Landfill Site (1 Phase)
  - Commencement of combined use in 1978
  - Closed in 2006

- Ukishima Landfill Site (2 Phase)
  - Commencement of combined use in 2000
  - Tokyo Bay

Residual volume

Expected to reach the limit in 40 years

Kawasaki City Basic Plan for Processing Regular Waste
(Kawasaki Challenge 3R)

- Basic principle: Aiming to create a sustainable recycling city that is easy on the global environment.

- Goals of the plan:
  - Promoting efforts to reduce waste: Reduce waste produced by 180 grams per citizen per day.
  - Promoting recycling: 300,000 tons of recycling for the entire city (35% recycling rate)
  - Reducing incinerated waste: Reduce incinerated waste by 130,000 tons

- Plan period: Fiscal 2005 to 2015

 Desired Direction

- Lengthening the life of landfills
  • Lengthening the remaining life of the final landfill.

- Achieving a structure using three processing centers
  • Establishing an effective and efficient waste disposal structure by having three of the four incineration facilities in operation.

Information and Data for Preparing the Plan (1)

- Preparation of annual reports and outlines of activities (every year)
  - Survey on waste composition
  - Calculation of waste processing costs
  - Citizen Waste Output Survey (Approximately every five years)

- Development of the basis of the plans, such as for estimating waste output over the long term.

Understanding the Current Situation of the City

- Composition of waste brought into incineration facilities is examined.
- Costs for processing waste and recyclables are calculated respectively.

Information and Data for Preparing the Plan (2)

- Developments concerning amendments of laws and enforcement of new laws
- Situation of other cities
- Trends in recycling technologies
### Comparison of Waste Composition

**Bandung City**
- Food: 4.0%
- Paper: 6.3%
- Glass: 5.1%
- Metal: 2.9%
- Kitchen Garbage: 4.4%
- Mixed: 0.3%
- Other: 0.2%

**Kawasaki City**
- Food: 3.8%
- Paper: 6.3%
- Glass: 5.1%
- Metal: 2.9%
- Kitchen Garbage: 4.4%
- Mixed: 0.3%
- Other: 0.2%

### Trends in Waste Processing Costs

### Main Efforts Based on the Plan
- Starting a new separated waste collection system
- Mixed paper • Plastic containers and packaging
- Changing the number of times regular waste is collected
  - Changing from four times a week to two times in stages.
- Subcontracting work to private vendors
- Improving publicity
  - Using characters, idol groups, lectures (over 1,000), and idea contests.

### The Situation Before and After the Change in the Collection System in September 2013

- After the change in the collection system, the amount of regular waste was reduced by 27,314 tons, or approximately 10.2%, compared to the period before the change.
- In addition to plastic containers and packaging, for which collection was implemented in the entire city, the amount of mixed paper collected also increased drastically. Together, the amount of recyclables increased by 12,342 tons.
- The amount of regular waste reduced exceeded the increase of mixed paper and plastic containers collected. In total, there was an effect of reducing waste by 14,972 tons or by approximately 5.6%.
The System of Three Processing Centers Has Been Enabled!

Goal 1 Promote reduction of waste generated
- Base fiscal year FY2003 1,308 g
- FY2013 1,006 g

Goal 2 Promote recycling
- Base fiscal year FY2003 118,000 t
- FY2013 154,000 t

Goal 3 Reduce the amount incinerated
- Base fiscal year FY2003 501,000 t
- FY2013 377,000 t

Results of the Plan (1) Status of Achieving the Goals

- The measure with the highest priority (2015)
  Transition to the system of three processing centers

- The measure with the highest priority (2014)
  Extend collection of plastic containers and packaging to the entire city, and revise the frequency of regular waste collection

Results of the Plan (2) Trends in the Amount of Waste Discharged

- Total amount discharged (the amount recycled plus the amount incinerated) is decreasing while the population is continuing to increase.

Results of the Plan (3) Trends in the Amount Landfilled

- Incineration ash for fiscal 2011 to fiscal 2013 are stored separately.
Results of the Plan (4)

- Lengthening the life of landfills
  When the plan was developed (2004) Another 24 years (2028)
  Approx. 10 years have passed (2013) Another 40 years (2053)

- Renovation of processing centers
  The target figure that will allow the operation of three centers while one is being renovated is 370,000 tons per year, which is expected to be achieved.

Development of the New Plan for Processing Waste

Currently in the process of developing the Kawasaki City Basic Plan for Processing Regular Waste, for 2016 onwards over a period of 10 to 15 years!!

Aiming to create a sustainable recycling city that is easy on the global environment

Thank you for your attention.
Toward a sustainable recycling city that is easy on the global environment!

Public Information Activities for Promoting Waste Reduction and Recycling

Waste Reduction Section, Environment Bureau, Kawasaki City

December 4, 2014

Introduction

The Transition in Separated Waste Collection

<table>
<thead>
<tr>
<th>Year</th>
<th>Activities Implemented</th>
</tr>
</thead>
<tbody>
<tr>
<td>1938</td>
<td>The City started waste collection</td>
</tr>
<tr>
<td>1977</td>
<td>Started separated waste collection of empty cans</td>
</tr>
<tr>
<td>1984</td>
<td>Started separated waste collection of used batteries</td>
</tr>
<tr>
<td>1990</td>
<td>“Waste Emergency” declared</td>
</tr>
<tr>
<td>1991</td>
<td>Started separated waste collection of empty bottles</td>
</tr>
<tr>
<td>1999</td>
<td>Started separated waste collection of PET bottles</td>
</tr>
<tr>
<td>2004</td>
<td>Started charging for oversized waste</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Activities Implemented</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>Started a pilot project for separated waste collection of mixed paper</td>
</tr>
<tr>
<td>2007</td>
<td>Frequency of ordinary waste collection changed from four days a week to three days a week</td>
</tr>
<tr>
<td>2011</td>
<td>Started city-wide separated waste collection of mixed paper (Kawasaki Ward, Saiwai Ward, and Nakahara Ward)</td>
</tr>
<tr>
<td>2013</td>
<td>Frequency of ordinary waste collection changed from three days a week to two days a week</td>
</tr>
</tbody>
</table>

Separated Waste Collection in Kawasaki City

<table>
<thead>
<tr>
<th>Nine items and eight separation categories</th>
<th>Frequency of collection</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinary waste</td>
<td>Twice a week</td>
<td></td>
</tr>
<tr>
<td>Empty cans and PET bottles</td>
<td>Once a week</td>
<td></td>
</tr>
<tr>
<td>Empty bottles</td>
<td>Once a week</td>
<td></td>
</tr>
<tr>
<td>Mixed paper</td>
<td>Once a week</td>
<td></td>
</tr>
<tr>
<td>Plastic containers and packaging</td>
<td>Once a week</td>
<td></td>
</tr>
<tr>
<td>Used batteries</td>
<td>Once a week</td>
<td></td>
</tr>
<tr>
<td>Oversized waste</td>
<td>Twice a month</td>
<td>Metal goods that are not less than 30 cm and furniture not less than 50 cm in size, etc.</td>
</tr>
<tr>
<td>Small metal articles</td>
<td>Twice a month</td>
<td>Metal goods less than 30 cm in size, umbrellas, and coat hangers made of wire</td>
</tr>
</tbody>
</table>

* The City does not collect waste from businesses.
The Use of a Friendly Character

- "Kawarun" the 3R promotion character was born in March 2013.
- The design was selected from those submitted by junior high school students in the City, who had been invited to apply.
- The name incorporates the hope that waste is changed (kawaru), and that Kawasaki City changes (Kawa) to a resource recycling city.

Kawasaki 3R Promotion Character

Introduction of "Kawarun"
- Personality: Very caring, and in particular, it cannot leave alone anyone who is confused.
- Birthday: March 18
- Favorite phrase: Mottainai (Too good to throw away)
- Features: The three "R" shapes of its ears and the body represent the 3Rs.
- Special talent: Remaking of secondhand clothing.
- Places where it appears: It shows up in places like flea markets and Kawasaki Eco Gurashi Mirai-kan.
- The ornament on the head is an azalea, which is Kawasaki City citizens' flower.
- There are approximately 42,000 waste collection points in Kawasaki City.
- Collection days of the week are set by region to collect the waste efficiently.
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Public Information to Ensure that Rules of Sorted Disposal Are Followed

- Issuance of "How to Separate and Dispose of Recyclables and Waste" to inform citizens of the rules of waste separation.
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Separated Waste Collection in Kawasaki City

An Example of Nakahara Ward

- There are approximately 42,000 waste collection points in Kawasaki City.
- Collection days of the week are set by region to collect the waste efficiently.
- The sheet is distributed to all households when there is a major change in the rules of disposal, such as a change in the rules of waste separation.
- The sheet contains information on items to be separated, the days of the week for collection, as well as points to note when disposing of waste, and an index for reference when one is confused.
- The City needs to ensure that citizens are informed of the rules of disposal, which are becoming increasingly complicated.
- The design was selected from those submitted by junior high school students in the City, who had been invited to apply.
- In particular, appealing to groups with relatively low awareness, such as one-person households and the younger generation, is a challenge.
- The City issued "How to Separate and Dispose of Recyclables and Waste" to inform citizens of the rules of waste separation.
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The City issues "How to Separate and Dispose of Recyclables and Waste" to inform citizens of the rules of waste separation.

- Try not to generate waste.
- Reduce the generation of waste by not generating waste.
- Reuse ordinary containers, plastic, and cans.
- Recycle PET bottles and others, but throw away batteries.
- Don't discard items that you can still use. Use them repeatedly.

Recycling
- Let us aim to do the "three Rs."
Display Boards Are Set at Waste Collection Points
- Waste collection points are managed by the citizens who use them.
- Boards are set so that collection days of the week for respective waste collection points are known.

Awareness Raising through Events and Other Opportunities (1)
- Implementation of awareness raising activities during events such as the Citizens' Festival.
- Making use of "Kawarun."
- Awareness raising of the 3Rs through quoits, garbage separation game, and other games.

Awareness Raising through Events and Other Opportunities (2)
- Garbage separation game at an event on the environment organized in cooperation with "Aeon Shinyurigaoka" shopping center
- Consultation on recycling kitchen waste by experienced citizens
- "Kawasaki junjo komachi," a local star group of Kawasaki City, has been designated as the 3R Promotion Public Information Ambassador
- Awareness raising of the 3Rs during concerts, campaigns, and other events

Issuance of the 3R News
- Dissemination of information on the "3Rs" familiar to citizens, such as on the status of waste disposal and progress made in recycling.
- Issued about three times a year and circulated by neighborhood associations.
4R Promotion in Cooperation with Waste Reduction Advisors

- Cooperation of citizens in the locality is essential to promoting waste reduction, recycling, and environmental beautification of the locality.
- Approximately 1,300 “Waste Reduction Advisors” recommended by neighborhood associations or residents’ associations work as local volunteer leaders.

**Four Roles of Waste Reduction Advisors**

1. Promotion and awareness raising of waste reduction
   - Activities concerning kitchen waste recycling, etc.
2. Advice on practicing recycling activities
   - Activities on group collection of recyclables
3. Guidance concerning compliance with the ways of disposal
   - Activities on manners concerning sorted disposal, etc.
4. Providing options and information on waste administration
   - Making rounds in the neighborhood and distributing information materials, etc.

Promotion of Environmental Education (1)

- Environmental education for children, who will lead the next generation, is important.
- Children learn about the significance of waste reduction and recycling. They are expected to put knowledge into practice, which may also spread in their households and other places around them.

- Supplementary reader “Our Lives and Garbage”
  - Classes using the supplementary reader “Our Lives and the Garbage” are given as part of social science curriculum for the fourth grade of elementary school.

- On-site Garbage School
  - Garbage schools are held on-site, using the “skeleton truck” that allows children to see inside a garbage truck, and applying hands-on learning such as playing the garbage separation game.

Promotion of Environmental Education (2)

- Development of picture-story boards
  - Used in kindergartens and nursery schools.
  - Children showing interest in the garbage truck and deepening their understanding.

Briefing for Residents

- Local activities are effective in promoting waste reduction and recycling.
- Briefings are held for residents’ groups and organizations, condominium residents’ management associations, Parent Teacher Associations, and other groups.
- Briefing serves as a venue to explain the rules of waste separation, as well as to exchange ideas toward solving local issues.

- Briefing for residents concerning the separation of plastic containers and packaging, and the change of collection frequency of ordinary waste to twice a week.
  - The City has held 1,300 briefing sessions concerning these changes.
Activities Aiming at Improving Manners of Sorted Disposal

- In addition to promotion and public information activities, guidance on sorted disposal is important in promoting the 3Rs.

- By ensuring waste separation and improving manners of sorted disposal, the environment around waste collection points will be improved and beautified in addition to making progress in the 3Rs.

- A warning label is placed and collection is put on hold when waste is not separated.

- Waste collection points are improved and beautified using nets for waste collection points.

- Damage caused by crows and other animals has been reduced.

- Guidance on disposal is given in cooperation with local people, including Reduction Advisors.

Aiming to create a sustainable recycling city that is easy on the global environment

Thank you for your attention.
さらにUNEPは、2011年に対象となるESDの国際的基準3つとして、次に挙げる4つの観点を用いることとした。

（1）ESDの実践に向けた行動方針（外部）

（2）ESDの実践に向けた行動方針（内部）

（3）ESDの実践に向けた行動方針（地域）

（4）ESDの実践に向けた行動方針（国際）

これら4つの観点に基づき、ESDの実践に向けた行動方針を策定し、実施するための基準を設定することが求められている。
パドゥン・スマテチャー村について — Aya Sukenjah氏（パドゥン市建設委員会副委員長）

(4) パドゥン農業スマテチャー村について — Aya Sukenjah氏（パドゥン市建設委員会副委員長）

パドゥン農業スマテチャー村は、パドゥン市の中心部に位置しています。村の住民は主に農業を営んでおり、特に稲作が盛んです。村内の生活基盤の整備や農業の改善が村全体の発展に寄与しています。

村の住民の多くは、農業に従事しています。村内の農業面での需要は、パドゥン市の農業生産力の向上に繋がっています。村の住民は、地域の経済成長に寄与しています。

村内の公共施設の整備や交通機関の改善が進んできている。こうした取り組みは、村の発展に寄与しています。村の住民は、地域の経済成長に貢献しています。

パドゥン農業スマテチャー村は、パドゥン市内の農業発展に寄与しています。村の住民は、地域の経済成長に寄与しています。村内の公共施設の整備や交通機関の改善が進んできている。こうした取り組みは、村の発展に寄与しています。村の住民は、地域の経済成長に貢献しています。パドゥン農業スマテチャー村は、パドゥン市内の農業発展に寄与しています。
発表のまとめとして、最終処分場の延命化は、24年から40年まで使えるという状況まで改善した。ままた処理施設の更新に関しては、目標値達成まであとわずかの状況にある。長期的な計画を策定するため、市民の意見などを収集している最中である。

（6）川崎市の廃棄物政策について：市民への普及啓発について ～内田洋平氏（川崎市環境局生活環境部廃棄物課及び広報係）～
川崎市では1999年にゴミ管理規約（修正）が、以後、市全体でゴミの分別を拡大させている。川崎市内には各自治体が管理する40000カ所の集積場があり、現在は8分9項目で実施している。リサイクルゴミは各別の分類で回収しており、リサイクルゴミを集めずのゴミを地域ごとに回収日を決め、効率よく回収している。しかしゴミの分別が複雑化している。複雑化したゴミの分別に対する市民の理解拡大のためには広報が重要な役割を担っている。
市民の身近な広報活動を活用し、広報活動を展開している。たとえば、若年層は比較的ゴミ分別に対する意識が高いと考えており、ゆるキャラを活用し、イベントなどの参加者にも広報活動を行っている。その場では来場者がゆるキャラと一緒に写真を撮ったり、SNSなどに写真をアップしてもらうように心がけている活動展開。川崎市のご当地アイドルを大黒氏に任命し、ゆるキャラと一緒に広報活動を行うなどしている。また分別方法や回収日がわかるようなQRコードに関するチラシの発行なども行っている。
川崎市は2013年度、プラスチックゴミの回収回数の変更に伴い、市民に対して1300回の説明会を実施した。また環境教育の実施も行っている。さらに川崎市では「廃棄物管理計画」を設け、地域の環境変化を推進している。今後も地域と連携しながら3Rを進めていきたいと考えている。

表：川崎市における廃棄物分別・処理について

<table>
<thead>
<tr>
<th>廃棄物区分</th>
<th>ゴミの種類</th>
<th>ゴミ処理方法</th>
<th>適用家</th>
<th>通積度</th>
</tr>
</thead>
<tbody>
<tr>
<td>産業廃棄物</td>
<td>露天管理</td>
<td>露天管理</td>
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<tr>
<td>事業系一般廃棄物</td>
<td>事業系一般廃棄物</td>
<td>事業系一般廃棄物</td>
<td>事業系一般廃棄物</td>
<td>事業系一般廃棄物</td>
</tr>
</tbody>
</table>

表：発表資料に基づき作成

質疑応答

Lia氏（バンドン）：広報活動の重要性を痛感した。川崎市の住民への説明会を1300回行ったという努力はバンドンに欠けているところだと思う。3Rはバンドンも実施しているが、3Rのプロセスによって生産された商品の販売先が見つからない状況にある。川崎市では3Rによって再利用できるものや再使用できるものを次のステップに進めるために、どのようなことを行っているのか。

木下氏（川崎市）：川崎市の3Rは、大きなところでは「リサイクル」という基本方針で分けていて、その中で有機物のリサイクル法（事業者の責任、拡大者責任）の検討が必要である。リサイクル費用を事業者に負担させることで、商品自体をリサイクルしやすいものとして商品を作るなどの工夫をしている。また事業者がリサイクルを行ったときに、消費者もリサイクルが必要であるという意味では協議会に資金援助をするなどしている。市内に拠点を置く事業者がリサイクルしているという環境が整って
1991年から2001年までの10年間の期間、温室効果ガスの排出量が増加し、CO2排出量が特に顕著であったとされる。この期間、特に日本の産業部門では、産業活動による温室効果ガスの排出が増加していた。この増加傾向は、産業活動の増加やエネルギー消費の増加にともない、経済成長の一環として進化していた。さらに、CO2排出量の増加は、エネルギー消費の増加に伴うものであり、特にエネルギー消費の高い産業部門での増加が顕著であった。そのため、CO2排出量の増加は、経済成長とエネルギー消費の増加に伴うものであり、特にエネルギー消費の高い産業部門での増加が顕著であった。
### Wrap-Up Workshop

**Venue:** The Luxton, Riviera 2, Bandung

**Jalan Ir. H. Juanda No. 18 Bandung 40115, Indonesia**

**Participants:** Bandung city related agencies, JCM Indonesia secretariat, Kawasaki team members

#### Purpose

**Wrap up meeting for FS stakeholders**

**Language:** Translation will be provided for Bahasa <-> Japanese

### Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</thead>
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<tr>
<td>13:30-13:40</td>
<td>Opening Remarks by Hikmat Ginanjar, Director, Environmental Management Agency, Bandung</td>
</tr>
<tr>
<td></td>
<td>Mr. Naoki Ishihara, Director, NTT QIP-Eco‐Environment Institute</td>
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<tr>
<td></td>
<td>Mr. Rinto Kuni Arifin, Indonesia JCM Secretariat</td>
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<tr>
<td>13:40-14:00</td>
<td>Indonesia JCM Secretariat Presentation on 1st JCM Project approved</td>
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<td></td>
<td>Ms. Ratu Keni Atika, Indonesia JCM Secretariat</td>
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<tr>
<td>14:00-14:20</td>
<td>Indonesia JCM Secretariat Presentation on Financing and Implementation of JCM Project</td>
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<td></td>
<td>Mr. Dicky Edwin Hindarto, Indonesia JCM Secretariat</td>
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<tr>
<td>14:30-14:50</td>
<td>Report of Feasibility Study (1): Biodigester</td>
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<tr>
<td></td>
<td>Mr. Shigenobu Ohbayashi, Japan Environmental Sanitation Center</td>
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<tr>
<td></td>
<td>Mr. Naoki Ishihara, Director, NTT QIP-Eco‐Environment Institute</td>
</tr>
<tr>
<td>15:10-15:30</td>
<td>Q &amp; A</td>
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<td>15:30-15:40</td>
<td>Coffee Break</td>
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<td>Mr. Hidemasa Kobayashi, Hitachi Zosen Corporation</td>
</tr>
<tr>
<td>15:50-16:00</td>
<td>Report of Feasibility Study (2): Energy efficiency for streetlamps and buildings</td>
</tr>
<tr>
<td></td>
<td>Mr. Naoki Ishihara, Director, NTT QIP-Eco‐Environment Institute</td>
</tr>
<tr>
<td>16:00-16:10</td>
<td>Q &amp; A</td>
</tr>
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<td>16:10-16:20</td>
<td>Coffee Break</td>
</tr>
<tr>
<td>16:20-16:30</td>
<td>Regulations and legislations for developing and implementing international consortia for government projects in Bandung as a result of capacity building-training in Japan.</td>
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<tr>
<td></td>
<td>Dr. Russ Domi Fumio Institute Technology Research</td>
</tr>
<tr>
<td>16:30-16:40</td>
<td>Kawasaki presentation on possible input for Bandung as a result of capacity building-training in Japan.</td>
</tr>
<tr>
<td></td>
<td>Akira Ogihara, Head of project and research section, Kawasaki</td>
</tr>
<tr>
<td>16:40-16:50</td>
<td>Discussion on the way forward</td>
</tr>
<tr>
<td>16:50-17:00</td>
<td>Discussions on the way forward</td>
</tr>
<tr>
<td>17:00-17:10</td>
<td>Coffe Break</td>
</tr>
<tr>
<td>17:10-17:30</td>
<td>IGES &amp; ITB presentation on scaling technology transfer</td>
</tr>
<tr>
<td></td>
<td>Dr. Russ Domi Fumio Institute Technology Research</td>
</tr>
<tr>
<td></td>
<td>Ms. Ayu Sukenjah, Deputy Director, Environmental Management Agency, Bandung</td>
</tr>
<tr>
<td>17:30-17:40</td>
<td>Closing Remarks by Kawasaki City Government</td>
</tr>
<tr>
<td></td>
<td>Akira Ogihara, Head of project and research section, Kawasaki</td>
</tr>
</tbody>
</table>

#### Reception for Workshop Participants

**Date and time:** January 30th 18:30 – 20:00

**Venue:** Luxton Hotel 2nd Floor

**Dimensions:** 595.2x842.0

**Report of Feasibility Study (2): Energy efficiency for streetlamps and buildings**

**Purpose:**

Wrap up meeting for FS stakeholders

**Language:** Translation will be provided for Bahasa <-> Japanese

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Institute for Global Environmental Strategies (IGES)
2108-11, Kamiyamaguchi, Hayama, Kanagawa Prefecture 240-0115 JAPAN
TEL: +81-46-855-3700
http://www.iges.or.jp

Japan Environmental Sanitation Center (JESC)
10-6 Yotsuya Kami-Cho Kawasaki-Ku, Kawasaki City, Kanagawa Prefecture 210-0828 JAPAN
TEL: +81-44-280-0035

Kawasaki Environment Research Institute, Environment Bureau, Kawasaki City
3-25-13 Tonomachi, Kawasaki-Ku, Kawasaki City, Kanagawa Prefecture 210-0821 JAPAN
TEL: +81-44-276-8994

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