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
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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

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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)

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

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)

Sector	Policy of West Java	Strategies of West Java
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

Source: The National Action Plan for Greenhouse Gas Emissions Reduction, Presidential Regulation of the Republic of Indonesia No.61 Year 2011

With respect to the greenhouse gas emissions reduction target for the West Java provincial government, CO_2 and CH_4 associated with waste constitute the greatest part; for example, 479.78 million ton of CO_2 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 CO_2 from fertilizer etc. as well as CH_4 associated with livestock manure. In terms of CO_2 emission from general households in association with energy, LP gas, kerosene, and charcoal are major sources, amounting to 3.18 million ton of CO_2. 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

Area/Activities	Reduction target (million t-CO_2)	Organization in charge
I. Agriculture: 12.89 million t-CO_2		
• **Development of organic rice farming using System Rice Identification Method**	12.54 (2010-2020)	DIPERTA[1]
• **Increase rice production and productivity in 19 regencies and 7 cities**	0.0067 (2010-2020)	DIPERTA
• **Development of BATAMAS**	0.34 (2013-2020)	DISNAK[2]
• **Distribution and application of feed technology**	0.006 (2013-2020)	DISNAK
II. Forest: 0.34 million t-CO_2		
• **Rehabilitation of Degraded Forest Lands**	0.34 (2013-2020)	DISHUT[3]
III. Energy: 3.18 million t-CO_2		
• **Energy saving program of West Java Province**	3.18 (2013-2020)	DESDM[4]
IV. Transport area: 1.1 million tons of CO_2 Eq		
• **Mandatory biofuel by 15% in 2025 for the type of premium fuel and diesel oil**	1.1 (2013-2020)	DESDM DISHUB[5]
V. Industry: 7.2 million tons of CO_2 Eq		
• **Obligation on utilizing alternative energy with substitution Target by 25% in 2025**	7.2 (2013-2020)	DESDM DISPERINDAG[6]
VI. Waste: 479.78 million tons of CO_2 Eq		
• **Waste reduction (3R program)**	42.71 (2013-2020)	DISKIMRUM[7]
• **Construction of integrated waste disposal**	0.00009 (2013-2020)	DISKIMRUM
• **Operations of semi-aerobic landfill and sanitary landfill, as well as procurement of hoard land**	139.74 (2015-2020)	DISKIMRUM
• **Recovery of Methane gas in Sumur Batu Final Disposal (CDM – Project)**	103.67 (2010-2020)	DISKIMRUM
• **Conversion of Pit-Latrines to Septic-Tank**	193.66 (2014-2018)	DISKIMRUM

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

No	Action Plan
A.	**Major programs**
1	**Convert kerosene for household use to LPG**
2	**Promote energy efficiency improvement for the household sector**
3	**Convert kerosene for commercial use to LPG**
4	**Promote energy efficiency improvement for the commercial sector**
B.	**Secondary programs**
1	**Supporting activities**
2	**Development and management of the use of coal**
3	**Make the coal inspection in West Java Province simpler**
4	**Develop the use of gas in West Java**
5	**Increase awareness activities concerning energy conservation and energy savings**
6	**Promote self-supporting distributed renewable energy power generation in the remote villages of West Java Province**
7	**Monitor the method of fuel & lubricant use and their quality**
8	**Create a database of geothermal reserves in West Java Province**
9	**Make the development of petroleum oil, gas, and geothermal WKP easier**
10	**Put in place environmentally friendly engineering in West Java Province in relation to geothermal energy, petroleum oil, and gas**
11	**Develop, monitor, and control the use of plant-derived electricity**

Figure 2.4: West Java Province Action Plan for Reducing Greenhouse Gas Emissions (RAD-GRK) - List of Action Plans in Waste Area

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

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

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

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

Fiscal year	Regulation	Remarks
1982	Presidential Decree No. 9	Energy conservation in Government and public buildings and official vehicles
1991	Presidential Decree No. 43	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.
1995	Ministerial Decree No. 100.k/48/M.PE/1995	The National Energy Conservation Master Plan (RIKEN); revised in 2005.
2004	Ministerial Decree No. 0002	Promotion of renewable energy and energy conservation ("Green Energy Policy")
2006	Presidential Decree No. 5	"National Energy Policy"
2007	Act No. 30/2007	Energy
2008	Presidential Decree No. 2	The Government shall report on the energy-saving and water-saving efforts at least every two years
2009	Government Decree No. 70	Energy conservation
2010	Ministerial Decree No. 13	Mandated that energy management personnel be assigned for industrial construction
2010	Ministerial Decree No. 14	Set the standards for building management personnel
2011	Presidential Decree No. 13	Energy-savings and water-savings
2011	Presidential Decree No. 61	Presidential Decree on the action plan for reducing greenhouse gas emissions and greenhouse gas inventory management
2012-2013	The Ministry of Energy and Mineral Resources' energy savings and water savings-related Ministerial Decree • MEMR No. 13/2012 about electricity saving • MEMR No. 14/2012 about energy management • MEMR No. 01/2013 about fuel consumption reduction	

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)

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

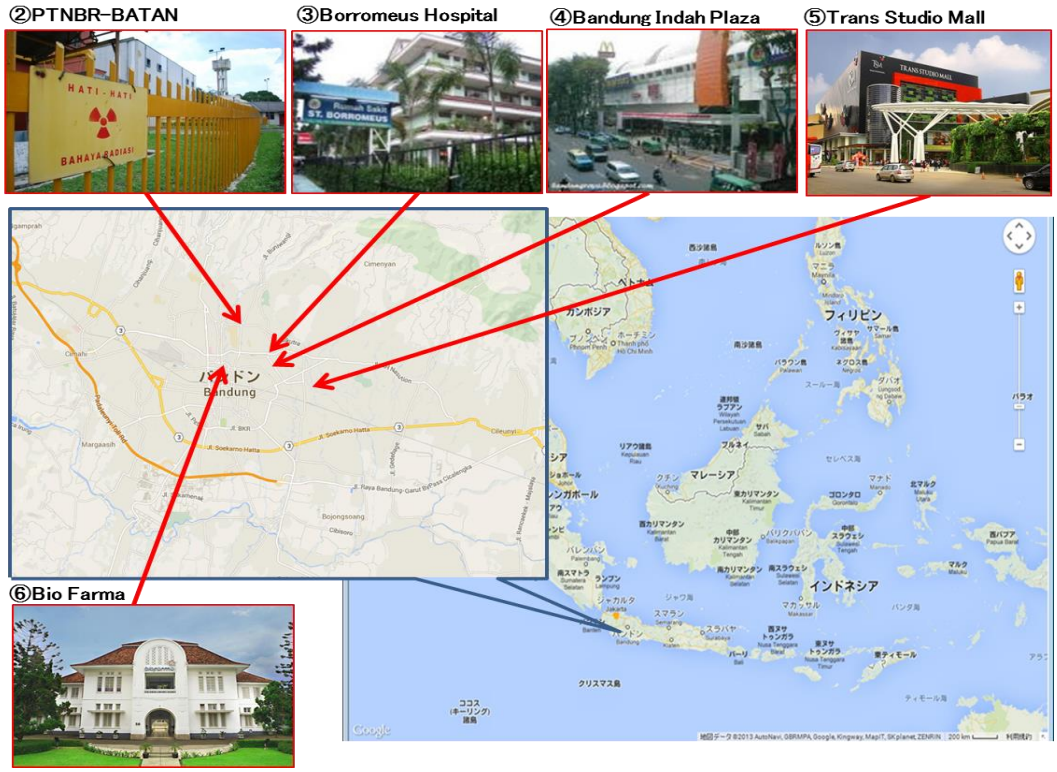


Figure 4.0-1: Walk-through survey implemented facilities

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.

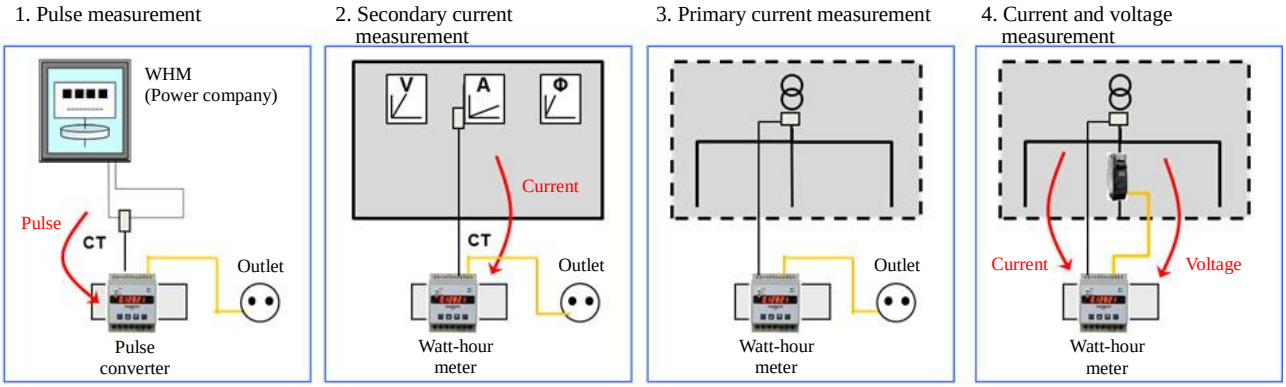


Figure 4.0-2: Measurement methods

Walk-through survey results
① LED street lamps
■ The hearing
a) At the pole top is the smart box, and at the bottom is the junction with the PLN.
b) 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.
c) 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.
d) Sixteen LED street lamps surveyed this time are installed in the vicinity.

Photo 1: Smart box (top)
Power-receiving box (bottom)

Photo 2: Inside the smart box

Photo 3: Inside the smart box

Photo 4: LED street lamp (lighting part)

Photo 5: LED street lamp (full view)

■ 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.

② 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/m^2-month (50.04 kWh/m^2-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)

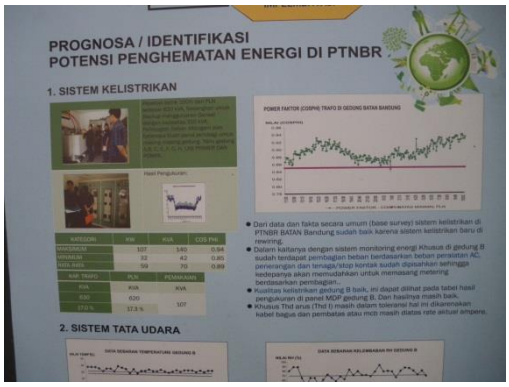


Photo 7: In-house energy conservation awareness raising activity panel


Photo 8: Packaged air conditioning unit (wall-mounted)

Photo 9: Power-receiving transformer (630 kVA)

■ 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 CO_2 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.

③ Borromeus Hospital (hospital)
■ The hearing
a) This hospital mainly has four buildings (the Maria Building, the Yosef Building, the Carolus Building, and the Irine Building).
b) Currently, LPG is used as the fuel for the boilers. It is planned to be switched to city gas in the future.
c) The manual switch for the outdoor lighting has been replaced by a timer type to reduce waste of energy.
d) 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.

e) 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/m^2-year.

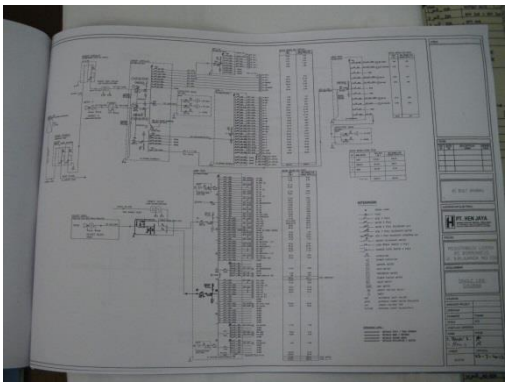


Photo 10: Packaged air conditioning unit (wall-mounted)

Photo 11: Incoming transfer room (in the Yosef Building)

■ 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.

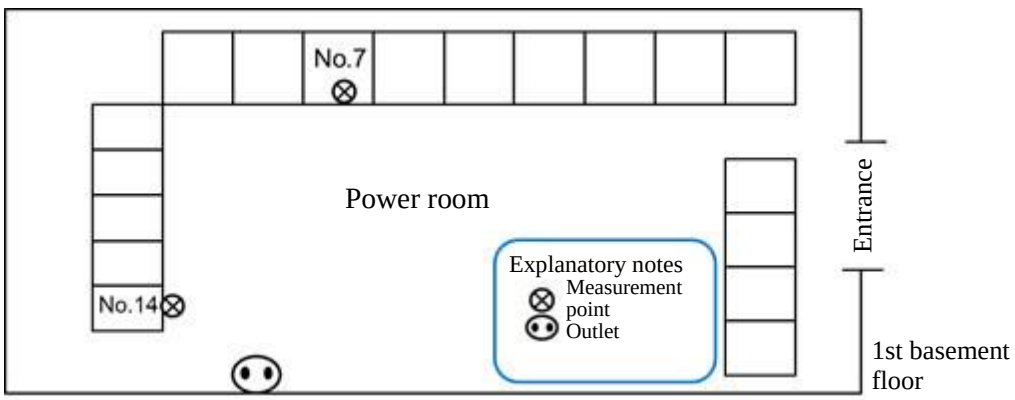


Figure 4.0-3: Plan view of the power room

④ 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.

Photo 12: Outside of the low-voltage main switchboard (System A)


Photo 13: Inside of the low-voltage main switchboard (System A)

Photo 14: Outside of the low-voltage main switchboard
(System B on the 2nd basement floor)

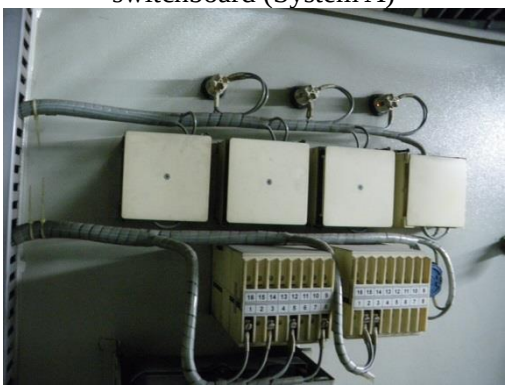


Photo 15: Door back of the low-voltage main switchboard
(System B on the 2nd basement floor)

Photos 16: Parking lot lighting
(one-lamp unit)

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

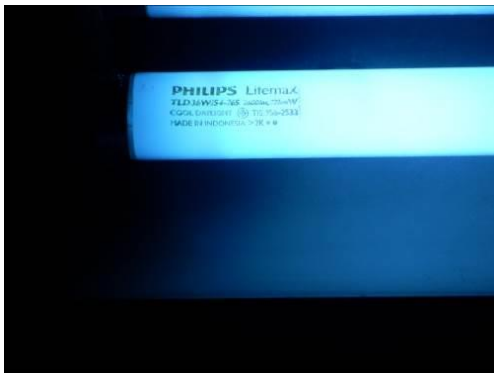
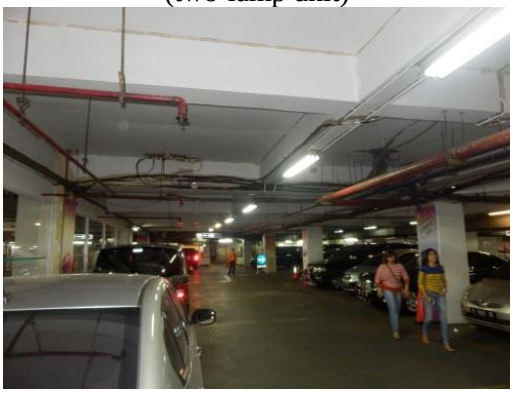


Photo 18: TL type fluorescent lamp
(36 W)



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)

Photo 24: Compact fluorescent lamp (Vertical installation)

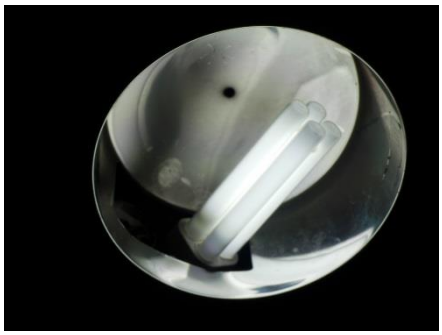


Photo 25: Compact fluorescent lamp (Horizontal installation)

Photo 26: Backyard

Photo 27: Backyard

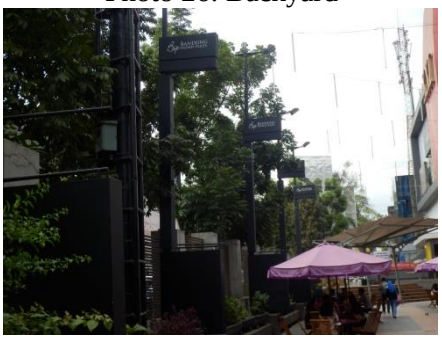


Photo 28: Street lamps in front of the building

Photo 29: Street lamps in front of the building

■ Survey findings

- Initially it was considered to be effective to renew the aged and deteriorated air-cooled chiller for CO_2 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 CO_2 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.

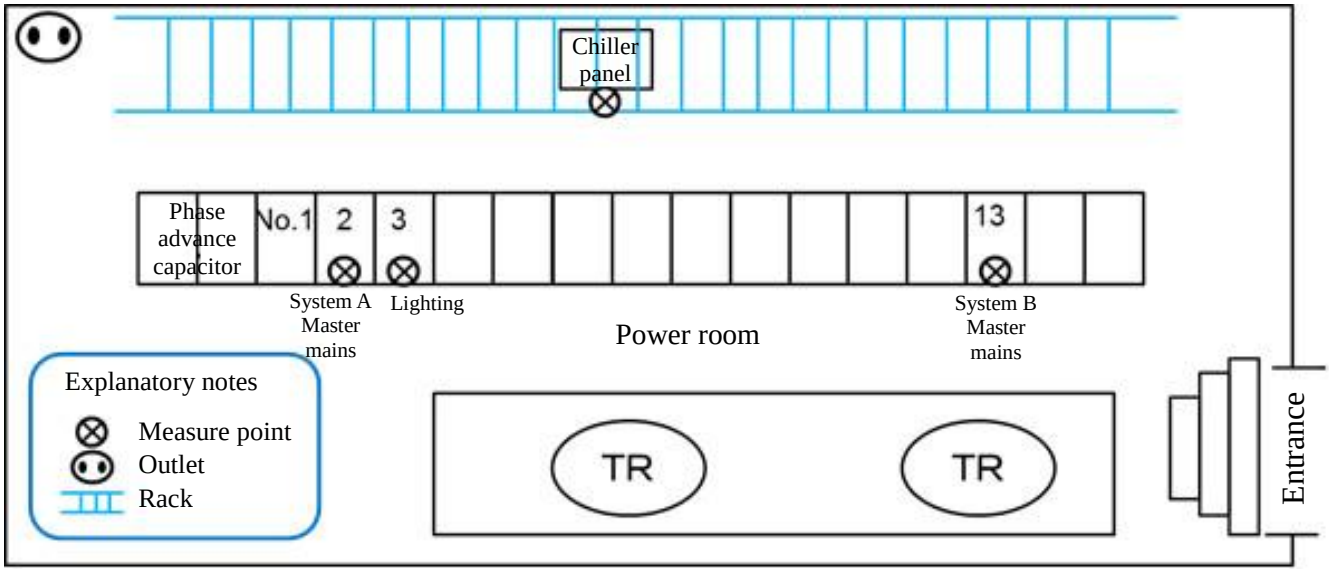


Figure 4.0-4: Plan view of the power room (on the 1st basement floor)

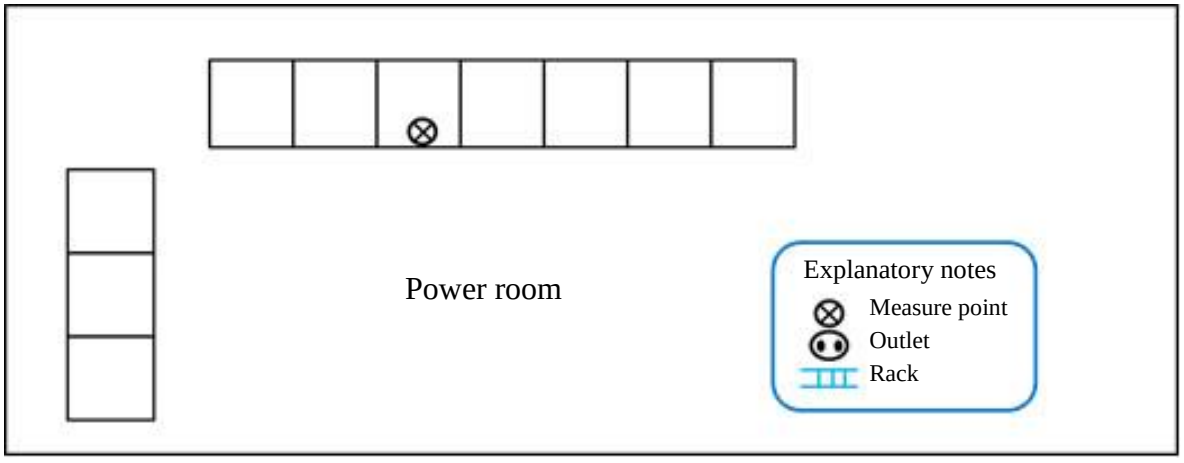


Figure 4.0-5: Plan view of the power room (on the 2nd basement floor)

⑤ Trans Studio Mall (shopping mall)

■ 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 30: TSB (near left) and TSM (far right)

Photo 31: TSM (far left), The Trans Luxury Hotel (near center), and Ibis Bandung Trans Studio (center back)

Photo 32: Power-receiving part of the Mall facility

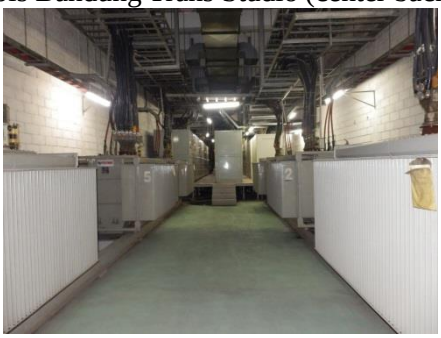


Photo 33: Transformers in the Mall facility

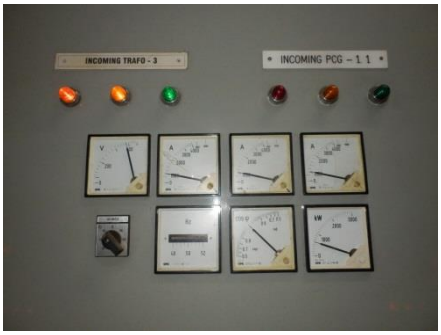


Photo 34: Transformer No. 1 distribution board

Photo 35: Chiller 1C System breaker (top)

Photo 36: Chiller 2C System breaker (top)

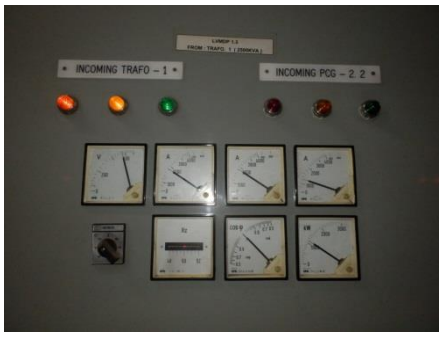


Photo 37: Transformer No. 3 distribution board

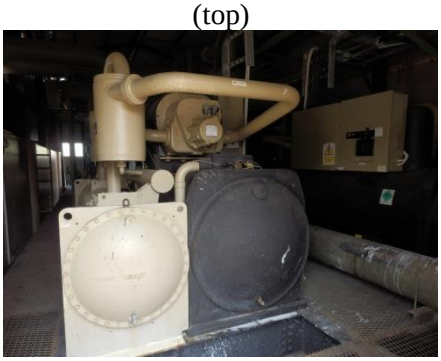


Photo 38: Water-cooled chiller

Photo 39: Cooling towers

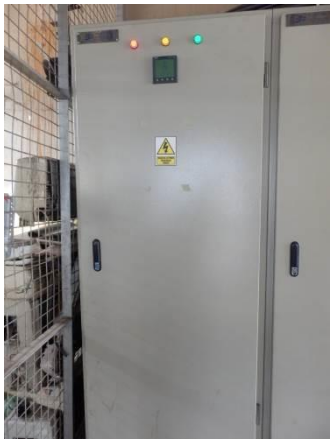


Photo 40: Water-cooled chiller distribution board

Photo 41: Water-cooled chiller multi meter

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

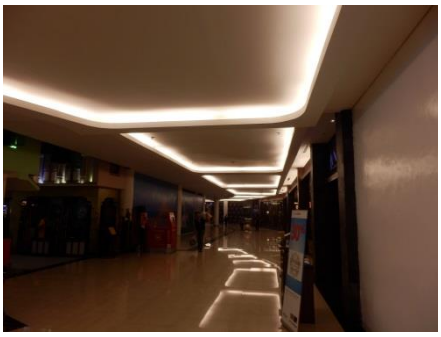
Photo 43: Air-cooled chiller (Mall System 1)

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

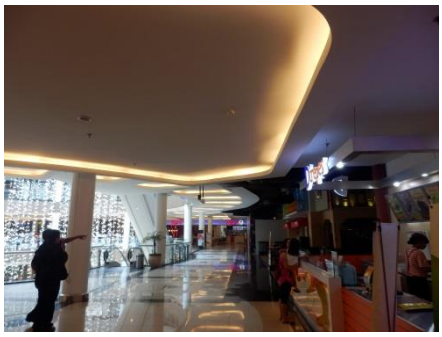
Photo 45: Air-cooled chiller distribution boards
(Mall System 2)

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)

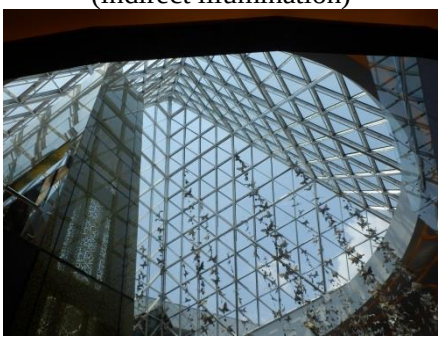


Photo 50: Stairwell top light

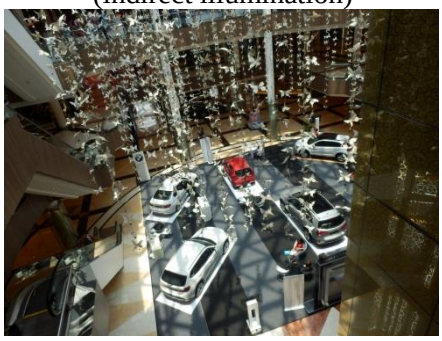


Photo 51: Stairwell top light bottom

Photos 52: Store passage lighting (indirect illumination)

Photos 53: Store passage lighting (indirect illumination)

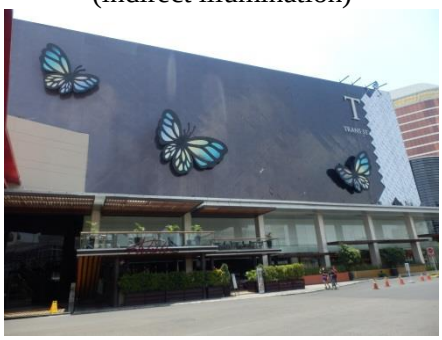


Photo 54: Building appearance (The butterflies are lit up at night)

Photo 55: Building entrance

Photo 56: Lighting for entrance pillar illumination

Photo 57: Lighting for entrance canopy illumination

■ 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 CO_2 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 CO_2 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.

⑥ 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.

Photo 44: Transformer System No. 1 instruments


Photo 45: Transformer System No. 1 instruments back

Photo 46: Transformer System No. 2 instruments


Photo 47: Transformer System No. 2 instruments back

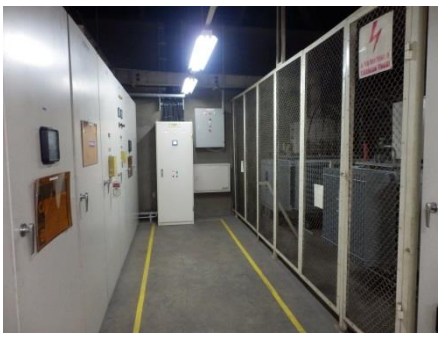


Photo 48: Internal view of Building 33 transformer room


Photo 49: External view of Building 33 transformer room


Photo 50: Air-cooled chiller


Photo 51: Air-cooled chiller piping

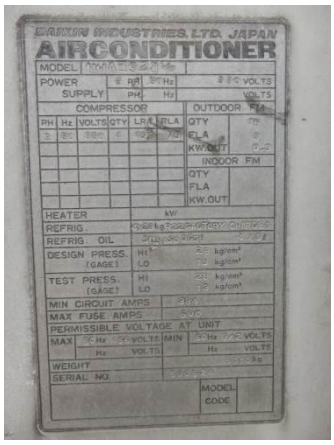


Photo 52: Air-cooled chiller nameplate


Photo 53: Air-cooled chiller fin tube heat exchangers

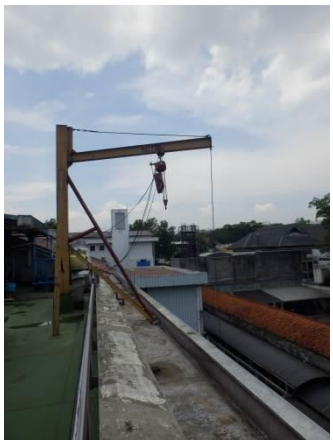


Photo 54: Equipment-lifting crane


Photo 55: Air-cooled chiller distribution board


Photo 56: Door back of the air-cooled chiller distribution board

■ 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 CO_2 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

	Average efficiency (lm/W)	Design life (h)	Power consumption (W)	Description
Low pressure fluorescent lamps	60-70	8,000-10,000	18-20; 36-40	- Local distribution roads and regional roads - Very high efficiency but short service life - Used in some areas
High pressure mercury lamps	50-55	16,000-24,000	125; 250; 400; 700	- Local distribution roads, regional roads, and intersections - Low efficiency but long service life - Used in some areas
Low pressure sodium lamps	100-200	8,000-10,000	90; 180	- Local distribution roads, junctions, railroad crossings, tunnels, and resting places - Very high efficiency and long service life - Larger lamp sizes, light control is difficult, and very poor color - Use is recommended for high efficiency
High pressure sodium lamps	110	12,000-20,000	150; 250 400	- Expressways, highways, local distribution roads, junctions, and interchanges - High efficiency and very long service life - Use is recommended for high efficiency

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.

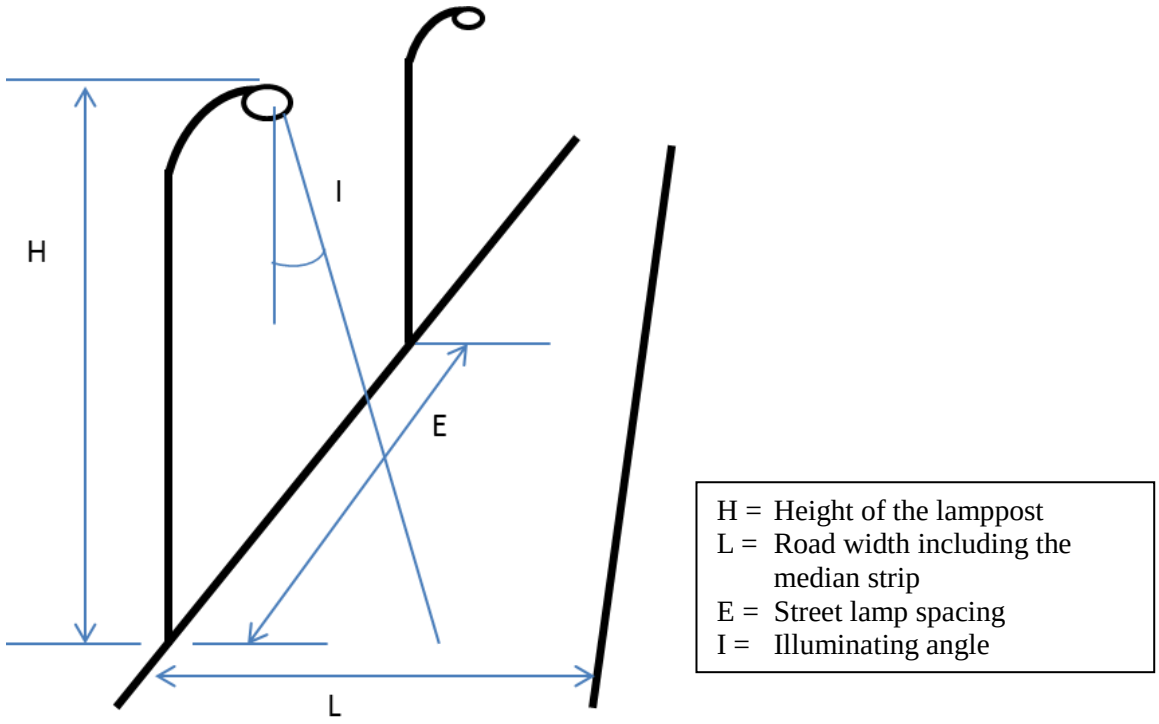


Figure 4.3.1-1: Street lamp arrangement image

Table 4.3.1-2: Lighting fixtures Type A

Type	H (m)	L (m)								Illuminance level
		4	5	6	7	8	9	10	11	
35 W SOX*1	4	32	32	32	-	-	-	-	-	3.5 LUX
	5	35	35	35	35	35	34	32	-	
	6	42	40	38	36	33	31	30	29	
55 W SOX	6	42	40	38	36	33	32	30	28	6.0 LUX
90 W SOX	8	60	60	58	53	52	50	48	46	
90 W SOX	8	36	35	35	33	31	30	29	28	10.0 LUX
135 W SOX	10	46	45	45	44	43	41	40	39	
135 W SOX	10			25	24	23	22	21	20	20.0 LUX
180 W SOX	10			37	36	35	33	32	31	
180 W SOX	10					22	21	20	20	30.0 LUX

* 1: Low pressure sodium lamp

Table 4.3.1-3: Lighting fixtures Type B

Type	H (m)	L (m)								Illuminance level
		4	5	6	7	8	9	10	11	
50 W SON*[2] 80 W MBF/U*[3]	4	31	30	29	28	26	-	-	-	3.5 LUX
	5	33	32	32	31	30	29	28	27	
70 W SON 125 W MBF/U	6	48	47	46	44	43	41	39	37	
70 W SON 125 W MBF/U	6	34	33	32	31	30	28	26	24	6.0 LUX
100 W SON	6	48	47	45	42	40	38	36	34	
150 W SON 250 W MBF/U	8	-	-	48	47	45	43	41	39	10.0 LUX
100 W SON	6	-	-	28	26	23	-	-	-	
250 W SON 400 W MBF/U	10	-	-	-	-	55	53	50	47	20.0 LUX
250 W SON 400 W MBF/U	10	-	-	36	35	33	32	30	28	
400 W SON	12	-	-		-	39	38	37	36	30.0 LUX

*[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.

Table 4.3.1-4: Indices for the renewal to LED lighting

Lamp type (Before renewal)	Power consumption (W)	Power consumption after renewing to LED (W)
Sodium lamp (SON)	70	60-70
Sodium lamp (SON)	150	80-100
Sodium lamp (SON)	250	100-120
Mercury lamp (HPL)	250	80-100
Mercury lamp (HPL)	125	80-100
Mercury lamp (HPL)	70	60-70
Fluorescent lamp (LHE)	45	60-70
Fluorescent lamp (LHE)	85	60-70

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 4.3.1-5: LED street lighting equipment specifications

Power consumption (W)	Manufacturer	Efficiency (lm/W)	Dimension
70	A	93-100	488100 specifications
70	B	120	656100 specifications
90	C	88	606100 specifications
100	A	93-100	488100 specifications
100	B	124	656100 specifications

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

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

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 CO_2 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.

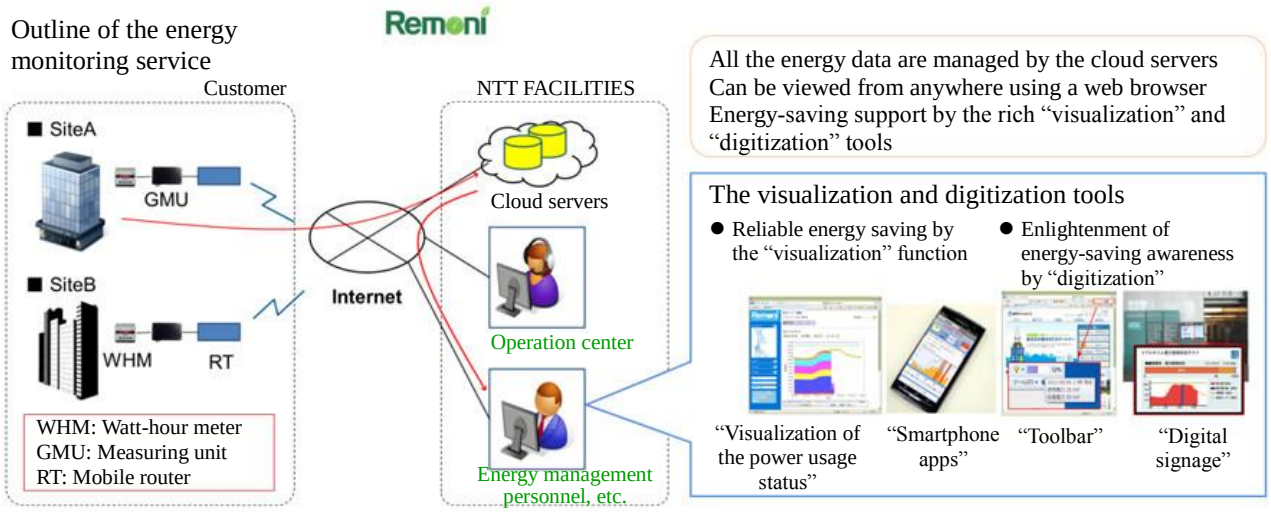


Figure 4.3.2-1: Outline of Remoni® service

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

Component	Part number	Manufacturer	Use
Measuring unit (GMU)	MC310B	Contec	Data collection and data transmission to the servers
Watt-hour meter (WHM)	TWPM	Takemoto Denki	Addition of power usage

Table 4.3.2-2: Instrument specifications (measuring unit)

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

Table 4.3.2-3: Instrument specifications (measuring unit)

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

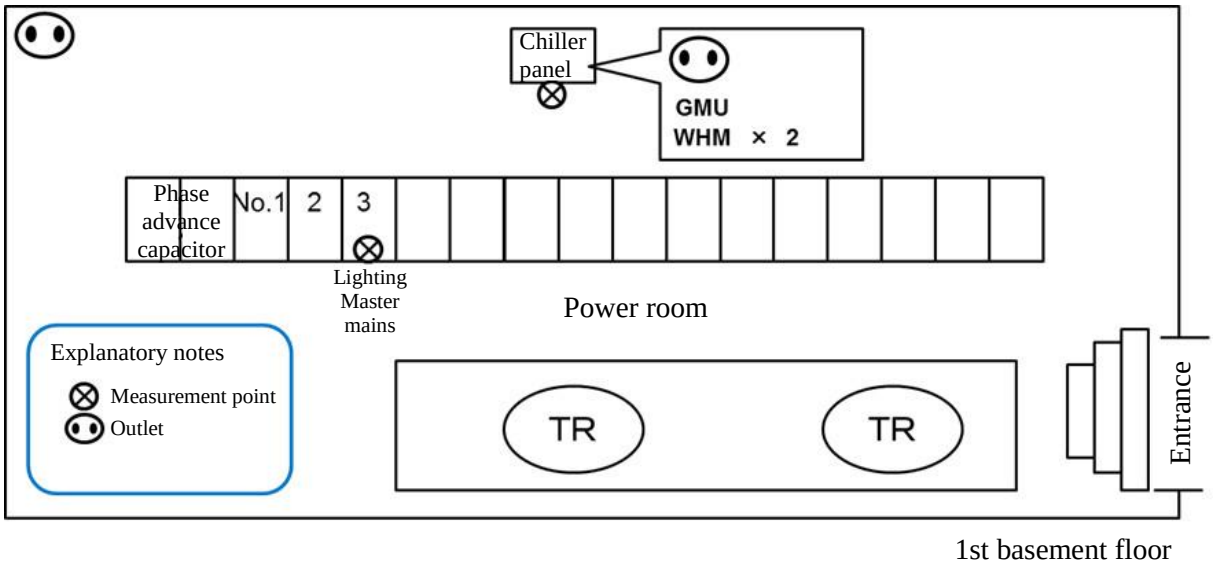


Figure 4.3.2-2: Instrument installation locations

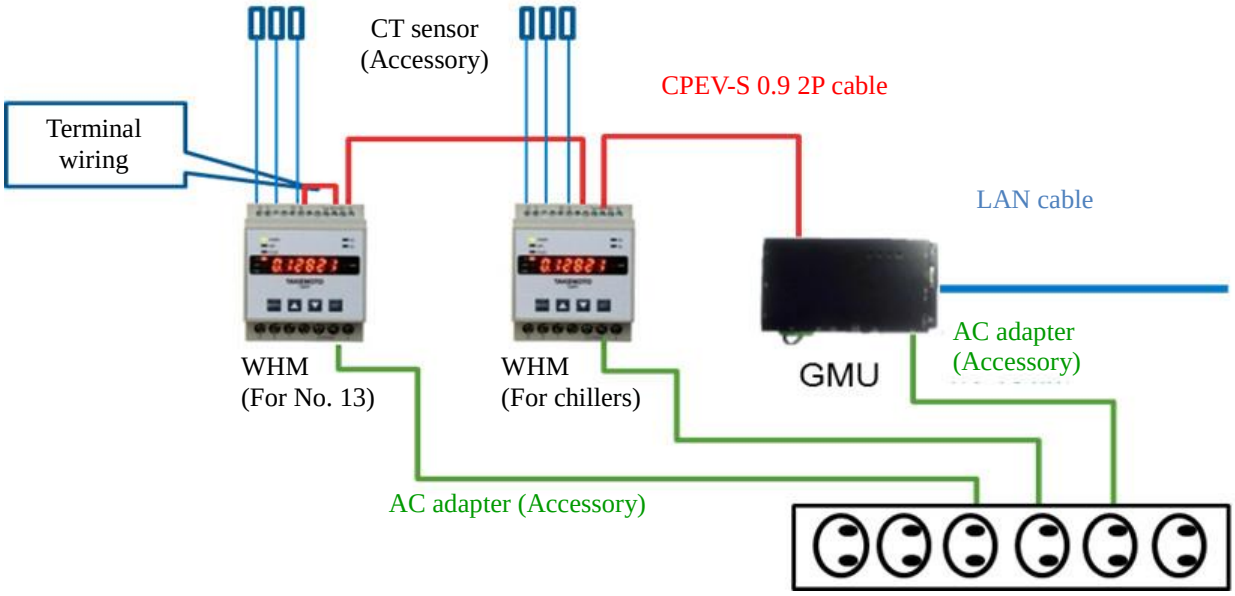


Figure 4.3.2-3: Wiring connection diagram

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.

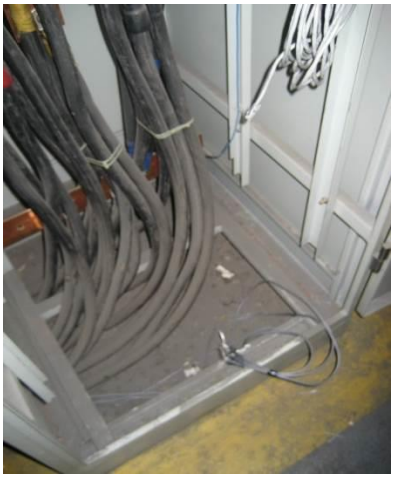


Photo 1: Before installation of the unit

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)

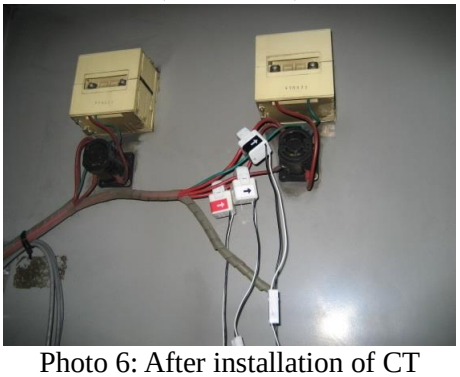


Photo 6: After installation of CT (for lighting)

Photo 7: Performing the under-panel wiring work

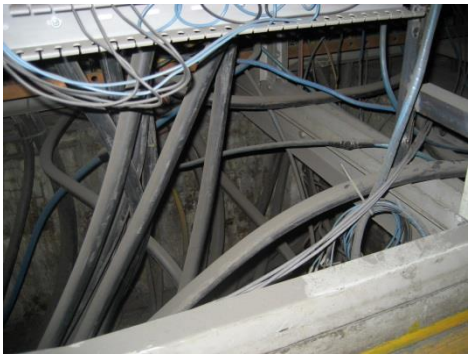


Photo 8: After the under-panel wiring work

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 4.3.2-4 Current measurement test results (for chillers)

	Measured value	Newly installed watt-hour meter	Panel watt-hour meter
R phase	510 A	508 A	511 A
S phase	468 A	456 A	464 A
T phase	496 A	496 A	494 A

[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 4.3.2-5 Current measurement test results (for lighting)

	Measured value	Newly installed watt-hour meter	Panel watt-hour meter
R phase	154 A	158 A	110 A
S phase	160 A	169 A	120 A
T phase	184 A	185 A	120 A

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.

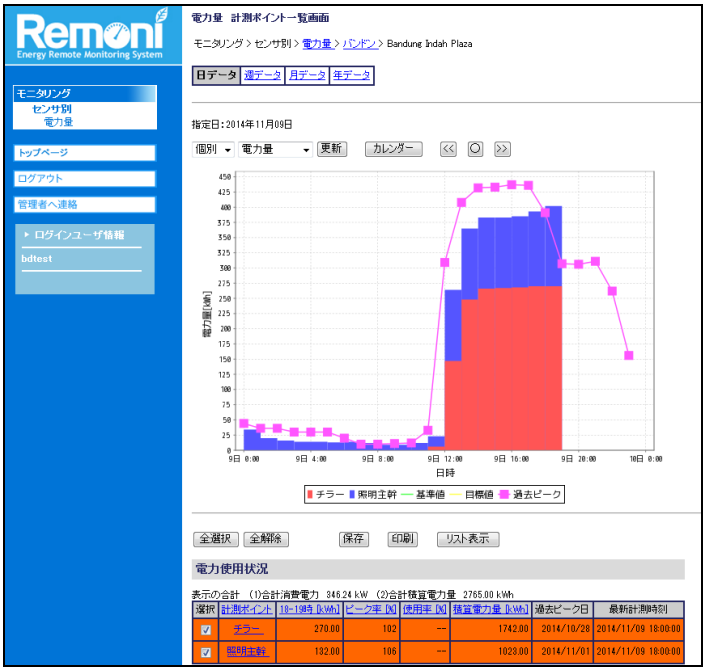


Figure 4.3.2-4 Remoni® web screen

■ 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.

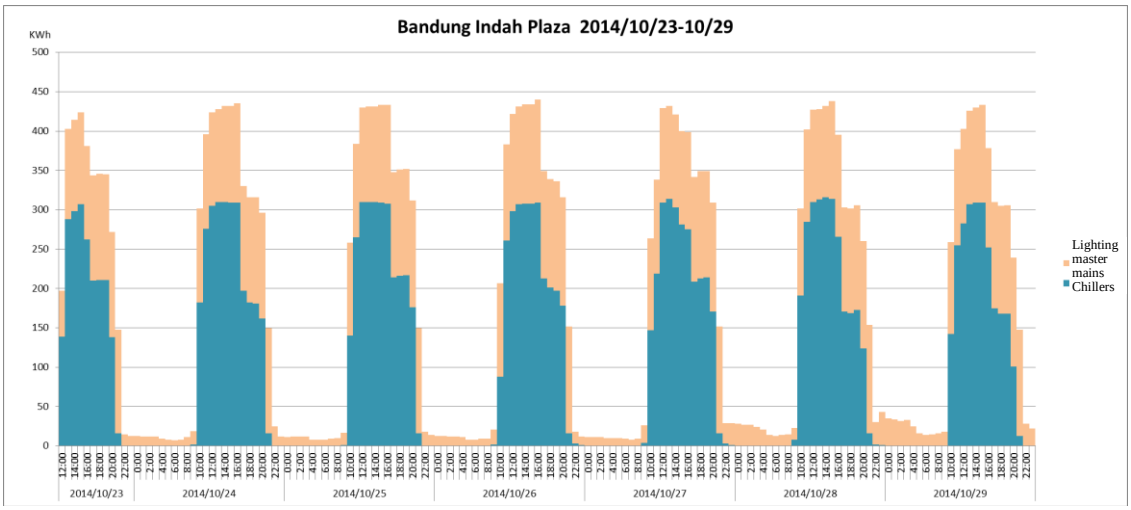


Figure 4.3.2-5: Hourly total power consumption (chillers and lighting added) 10/23/2014-10/29/2014

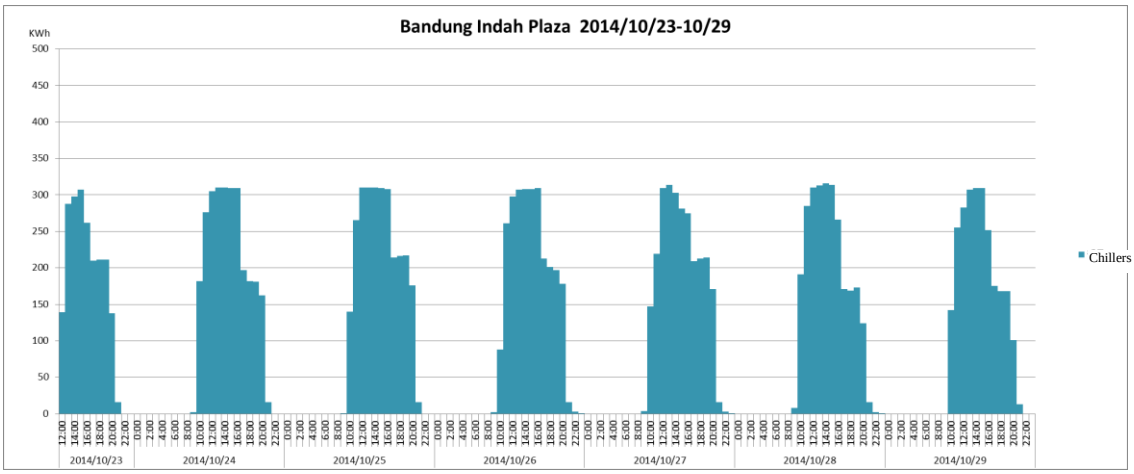


Figure 4.3.2-6: Hourly total power consumption (chillers) 10/23/2014-10/29/2014

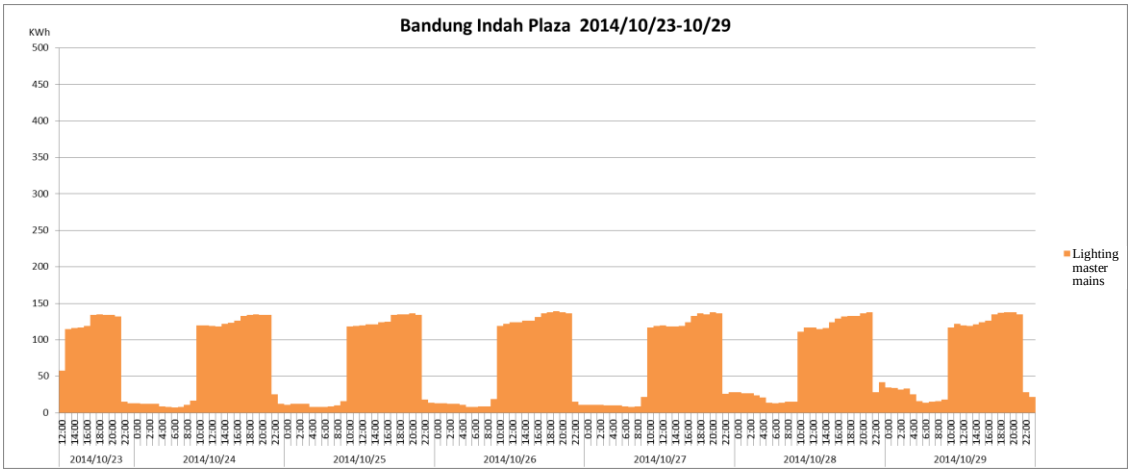


Figure 4.3.2-7: Hourly total power consumption (lighting) 10/23/2014-10/29/2014

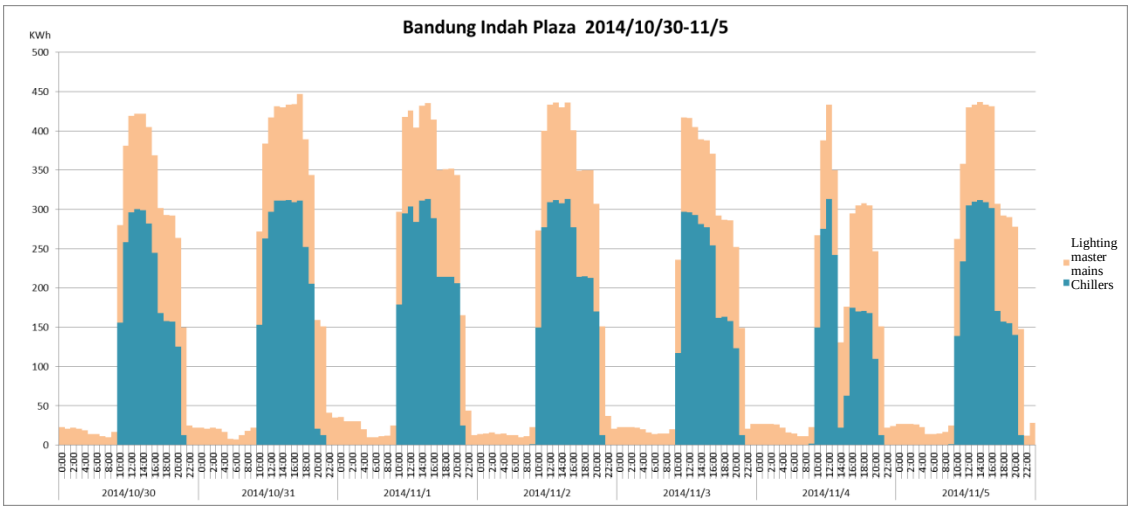


Figure 4.3.2-8: Hourly total power consumption (chillers and lighting added) 10/30/2014-11/5/2014

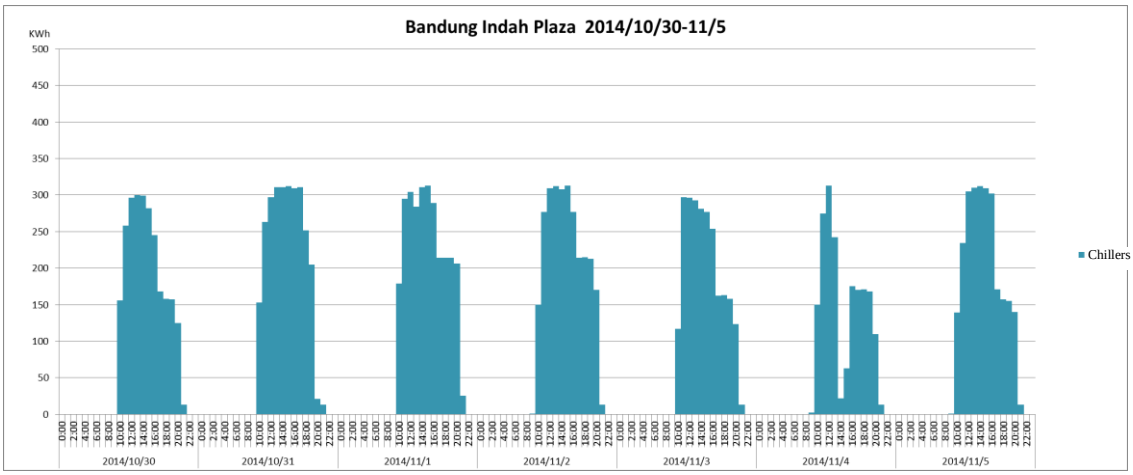


Figure 4.3.2-9: Hourly total power consumption (chillers) 10/30/2014-11/5/2014

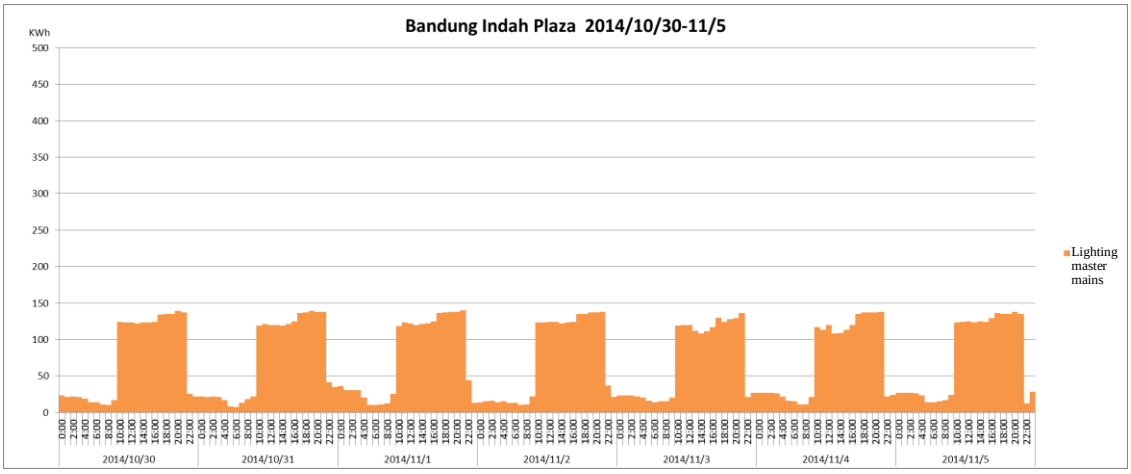


Figure 4.3.2-10: Hourly total power consumption (lighting) 10/30/2014-11/5/2014

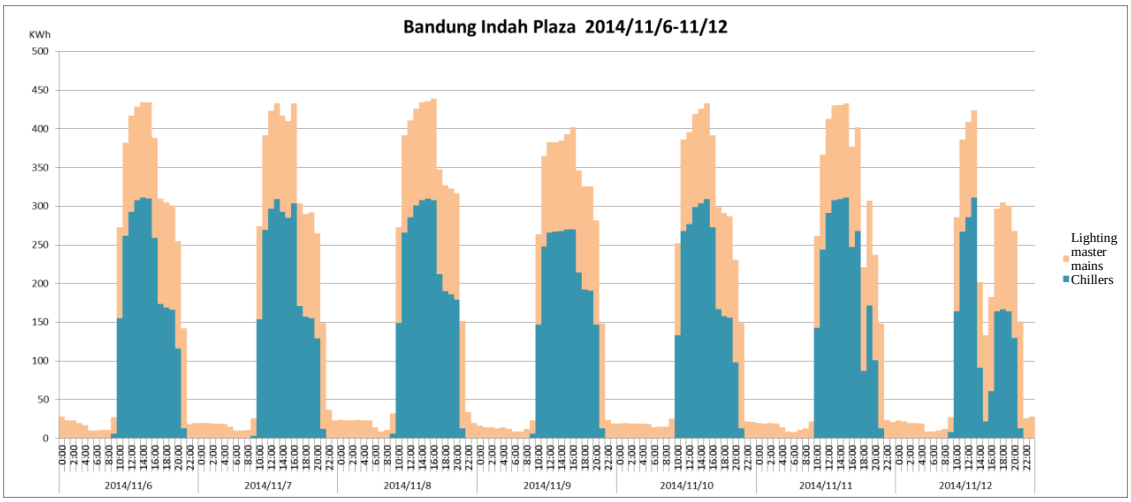


Figure 4.3.2-11: Hourly total power consumption (chillers and lighting added) 11/6/2014-11/12/2014

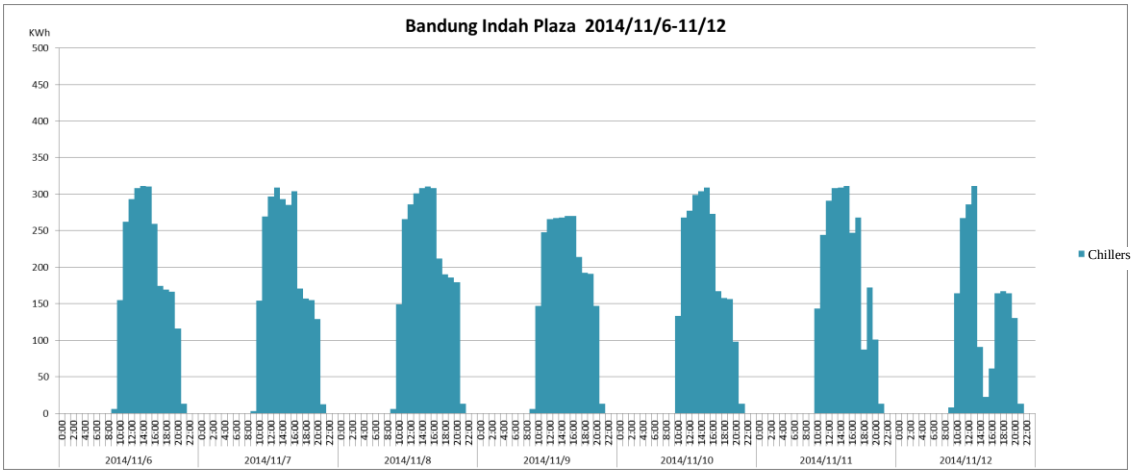


Figure 4.3.2-12: Hourly total power consumption (chillers) 11/6/2014-11/12/2014

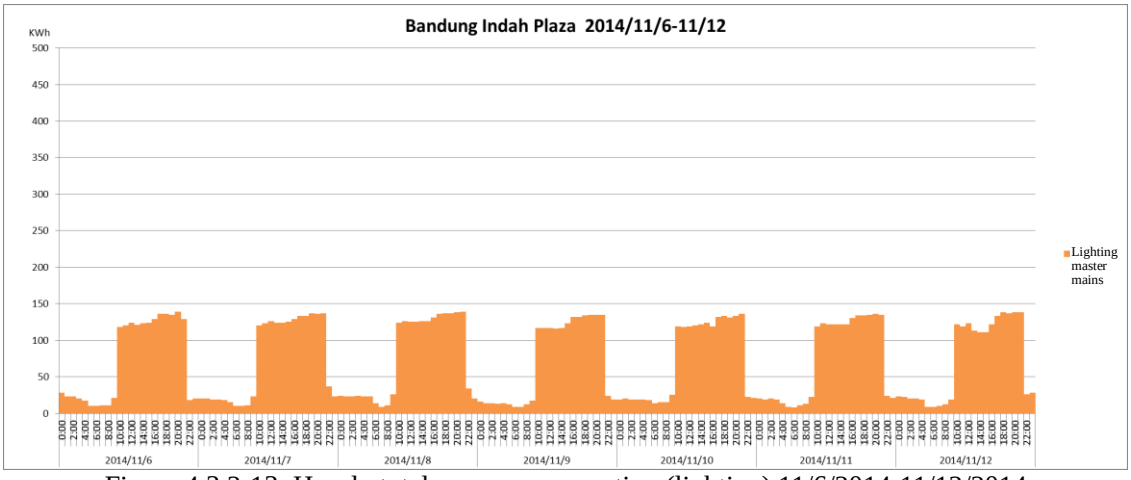


Figure 4.3.2-13: Hourly total power consumption (lighting) 11/6/2014-11/12/2014

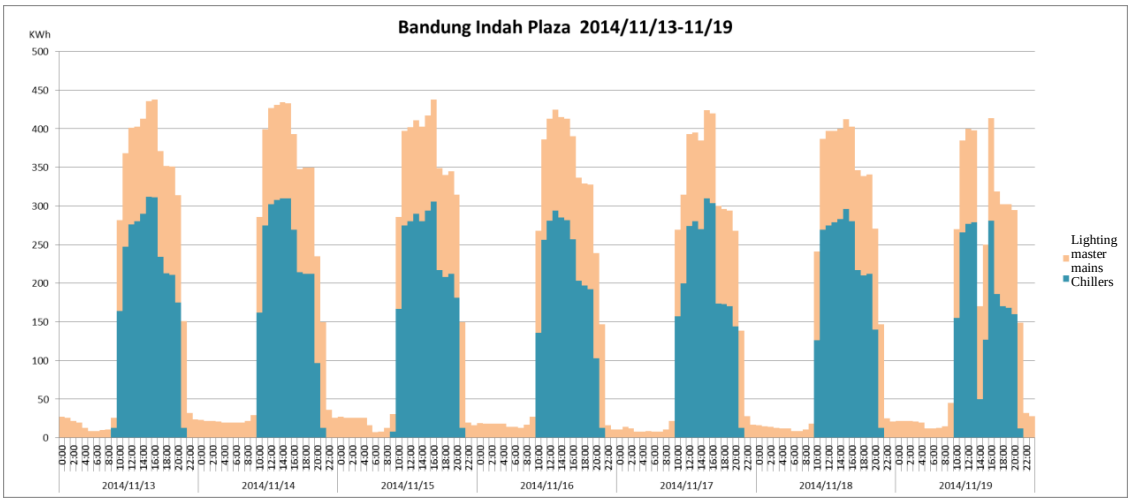


Figure 4.3.2-14: Hourly total power consumption (chillers and lighting added) 11/13/2014-11/19/2014

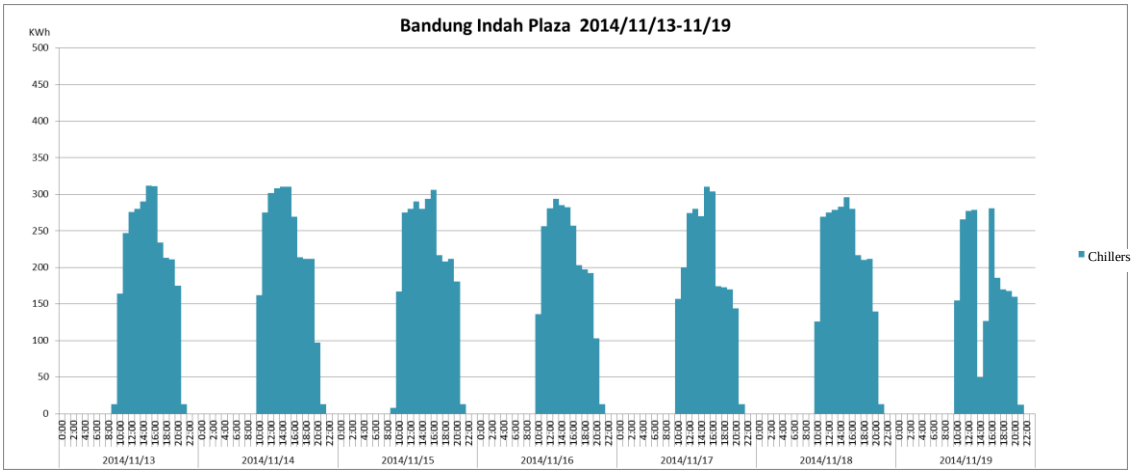


Figure 4.3.2-15: Hourly total power consumption (chillers) 11/13/2014-11/19/2014

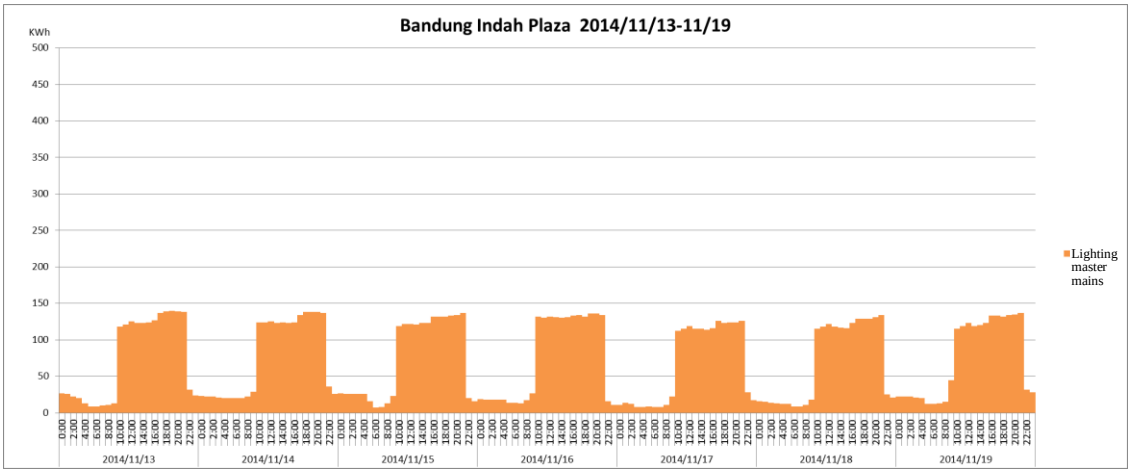


Figure 4.3.2-16: Hourly total power consumption (lighting) 11/13/2014-11/19/2014

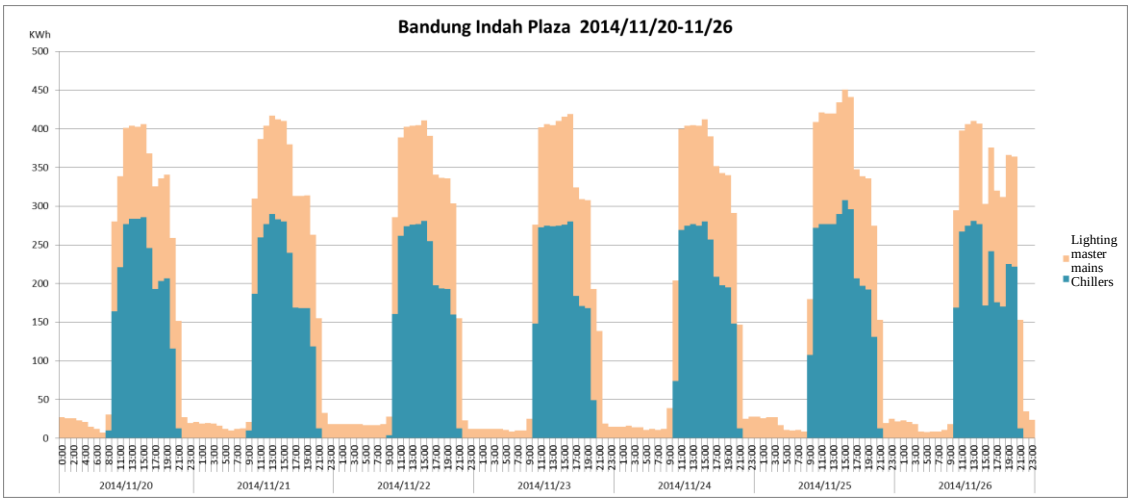


Figure 4.3.2-17: Hourly total power consumption (chillers and lighting added) 11/20/2014-11/26/2014

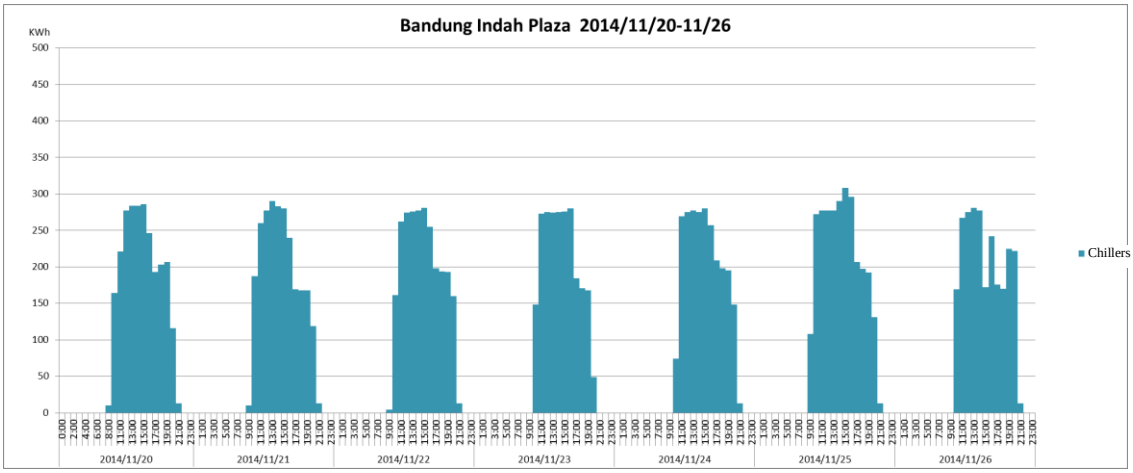


Figure 4.3.2-18: Hourly total power consumption (chillers) 11/20/2014-11/26/2014

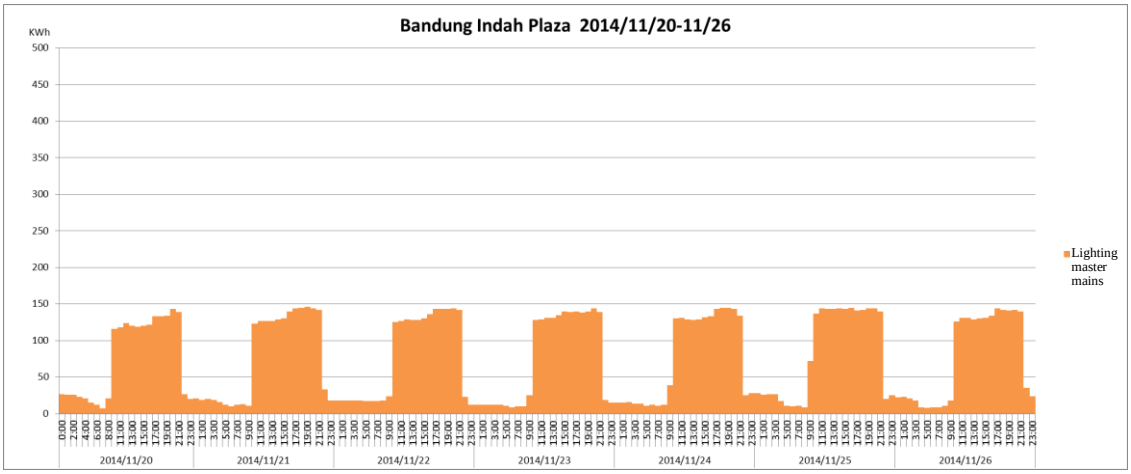


Figure 4.3.2-19: Hourly total power consumption (lighting) 11/20/2014-11/26/2014

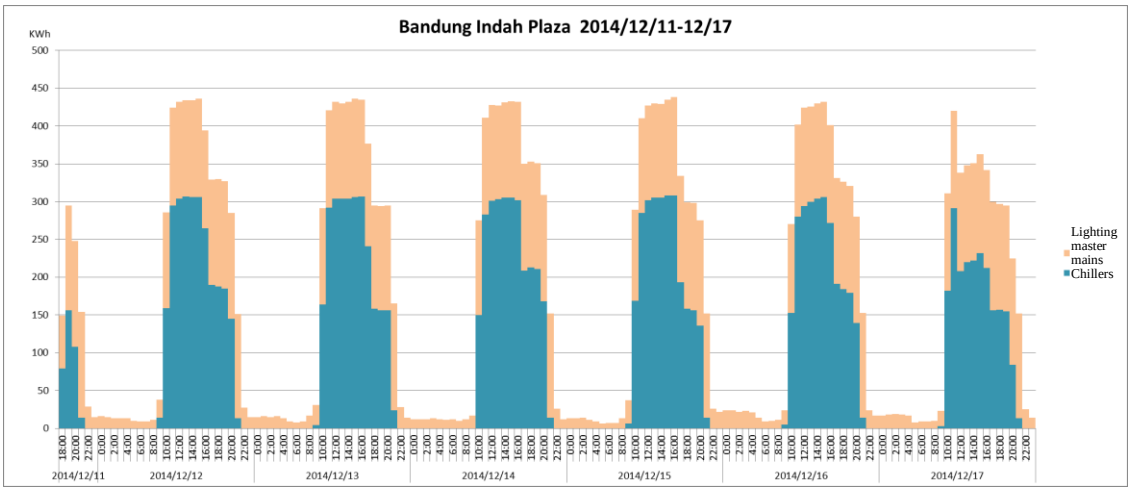


Figure 4.3.2-20: Hourly total power consumption (chillers and lighting added) 12/11/2014-12/17/2014

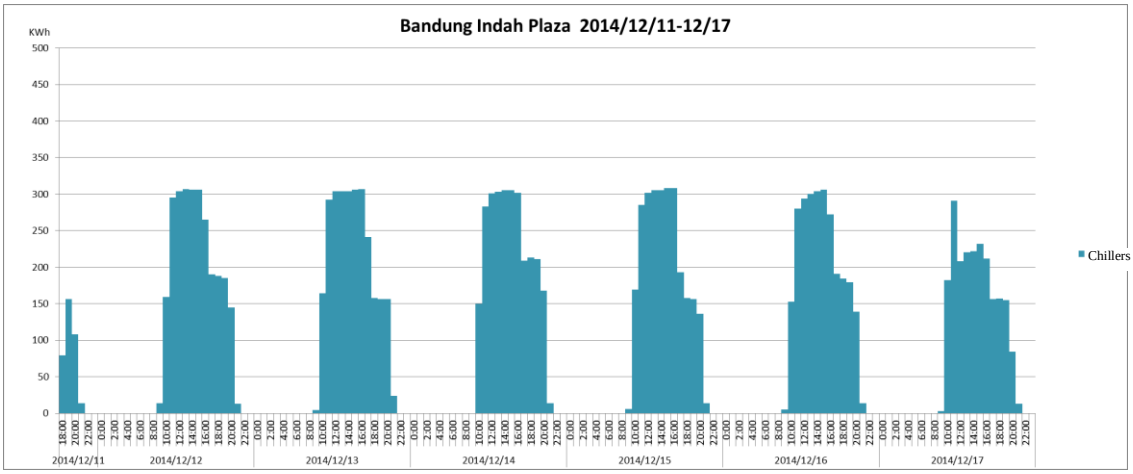


Figure 4.3.2-21: Hourly total power consumption (chillers) 12/11/2014-12/17/2014

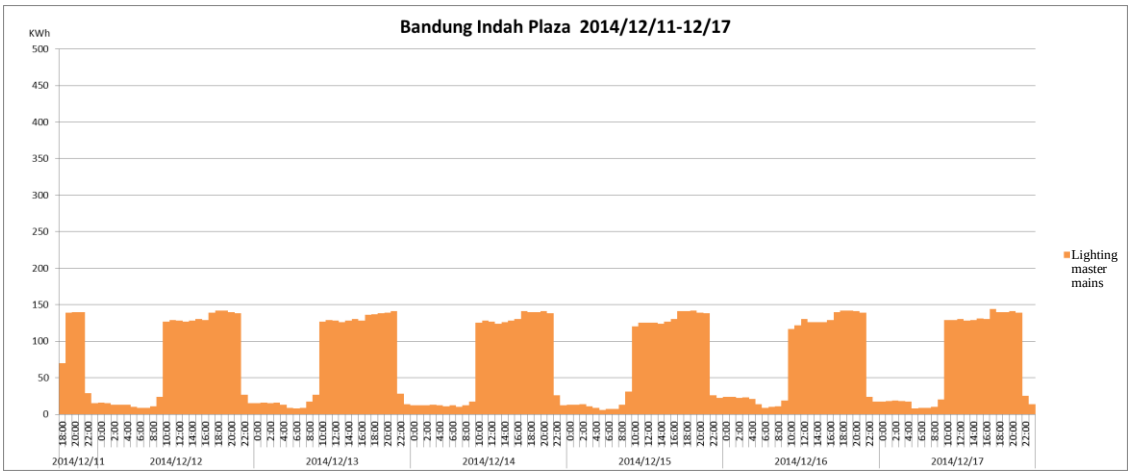


Figure 4.3.2-22: Hourly total power consumption (lighting) 12/11/2014-12/17/2014

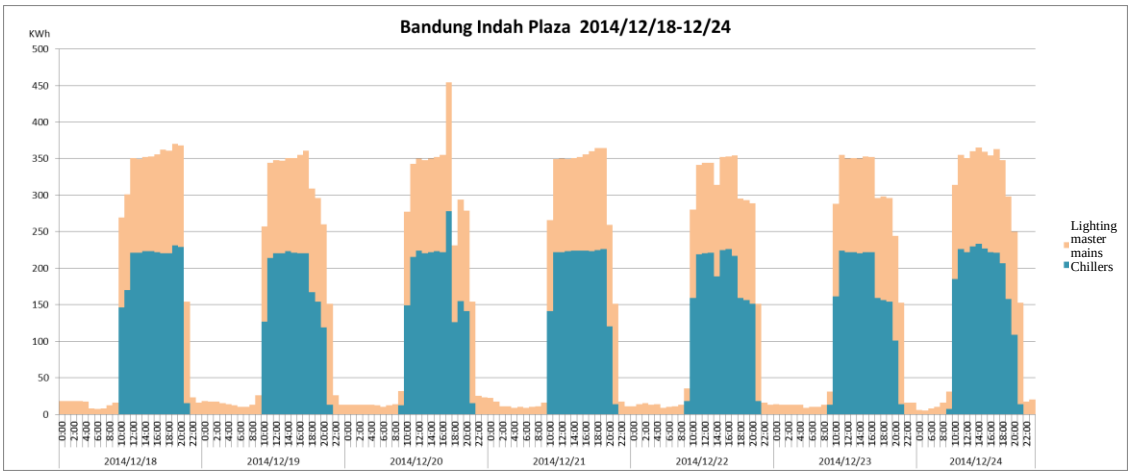


Figure 4.3.2-23: Hourly total power consumption (chillers and lighting added) 12/18/2014-12/24/2014

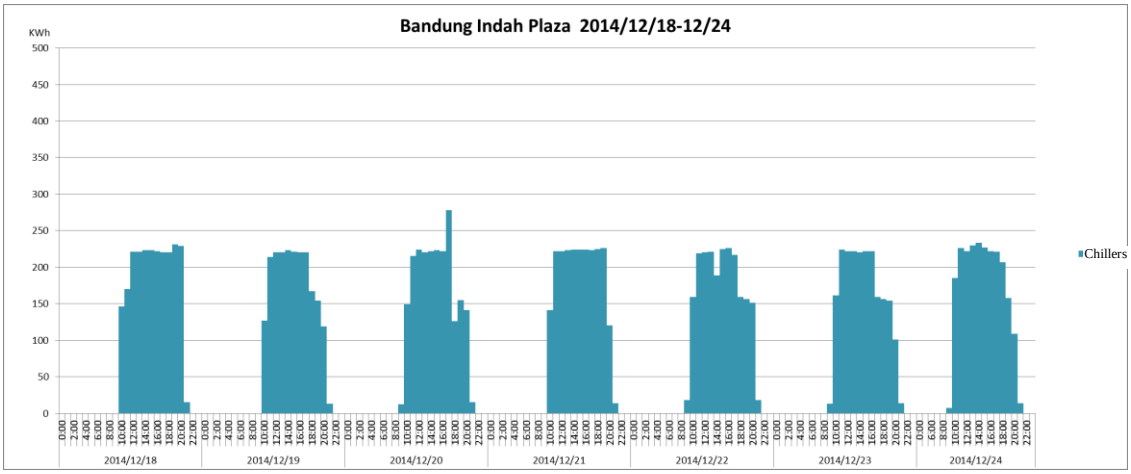


Figure 4.3.2-24: Hourly total power consumption (chillers) 12/18/2014-12/24/2014

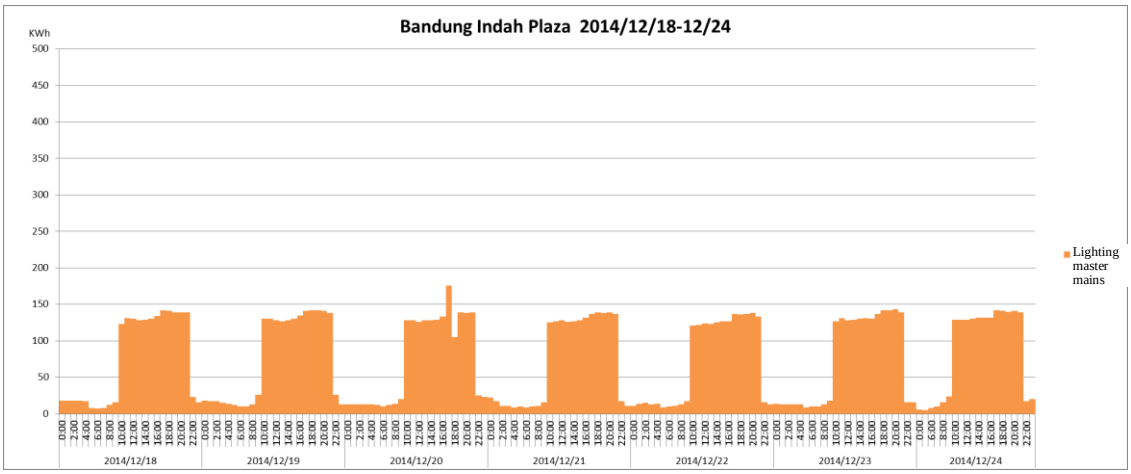


Figure 4.3.2-25: Hourly total power consumption (lighting) 12/18/2014-12/24/2014

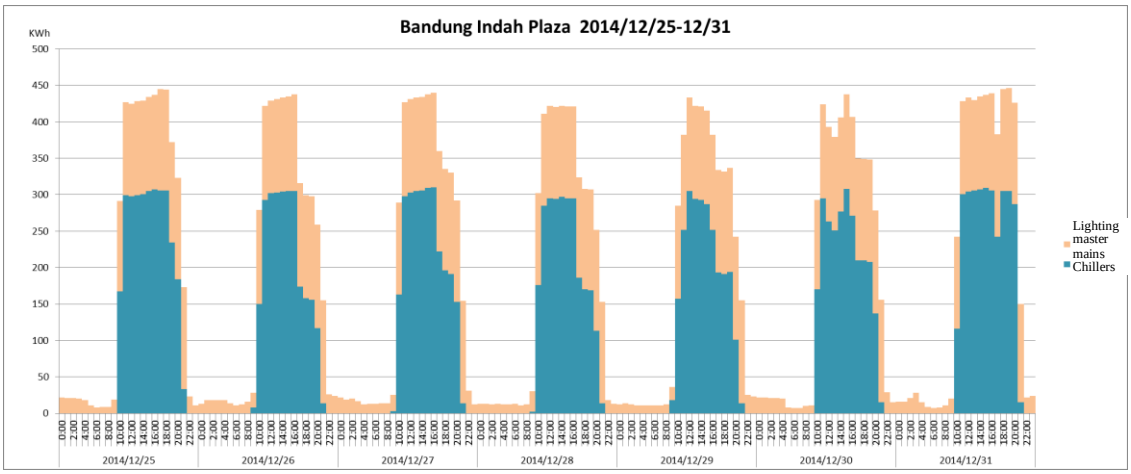


Figure 4.3.2-26: Hourly total power consumption (chillers and lighting added) 12/25/2014-12/31/2014

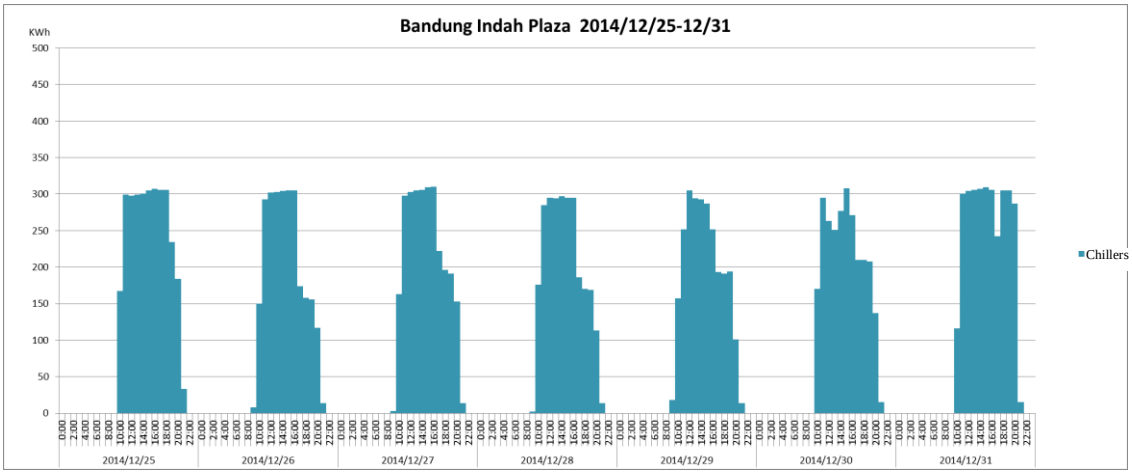


Figure 4.3.2-27: Hourly total power consumption (chillers) 12/25/2014-12/31/2014

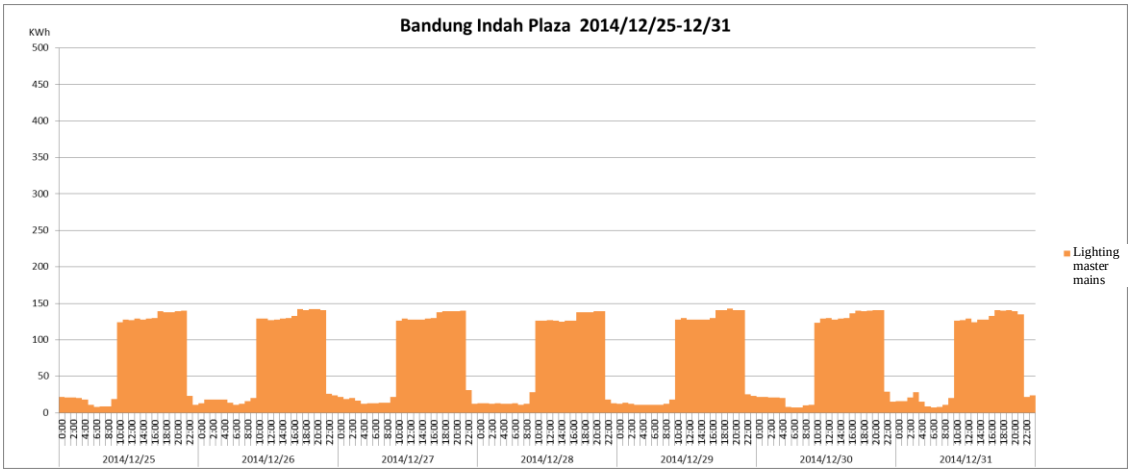


Figure 4.3.2-28: Hourly total power consumption (lighting) 12/25/2014-12/31/2014

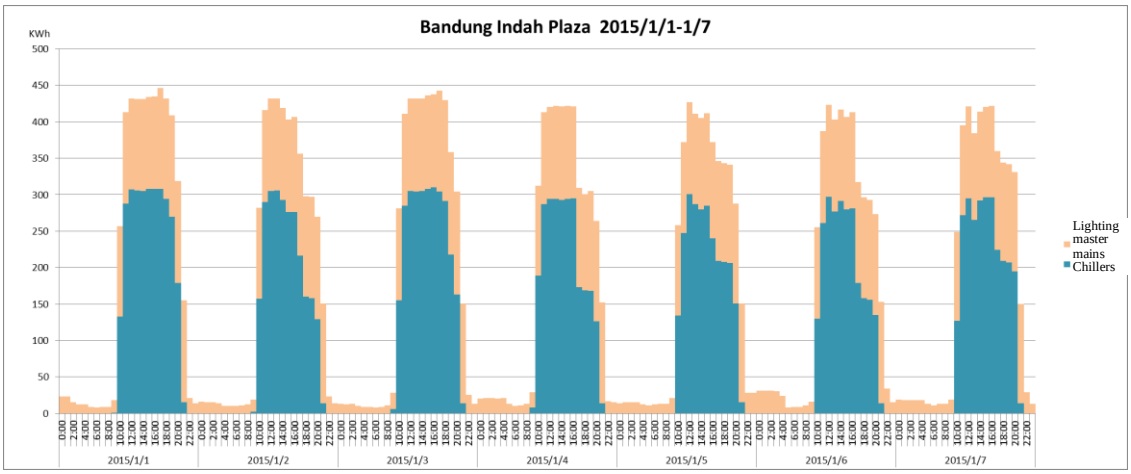


Figure 4.3.2-29: Hourly total power consumption (chillers and lighting added) 1/1/2015-1/7/2015

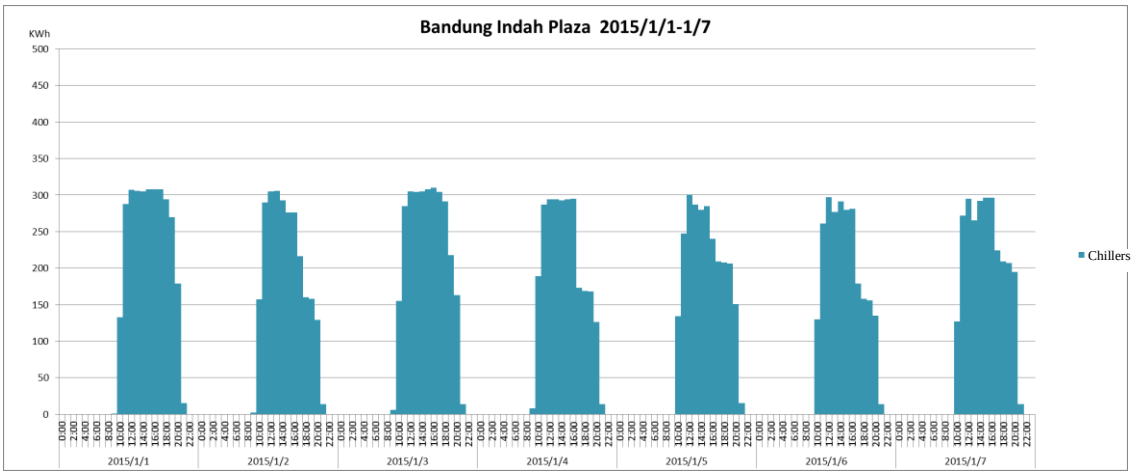


Figure 4.3.2-30: Hourly total power consumption (chillers) 1/1/2015-1/7/2015

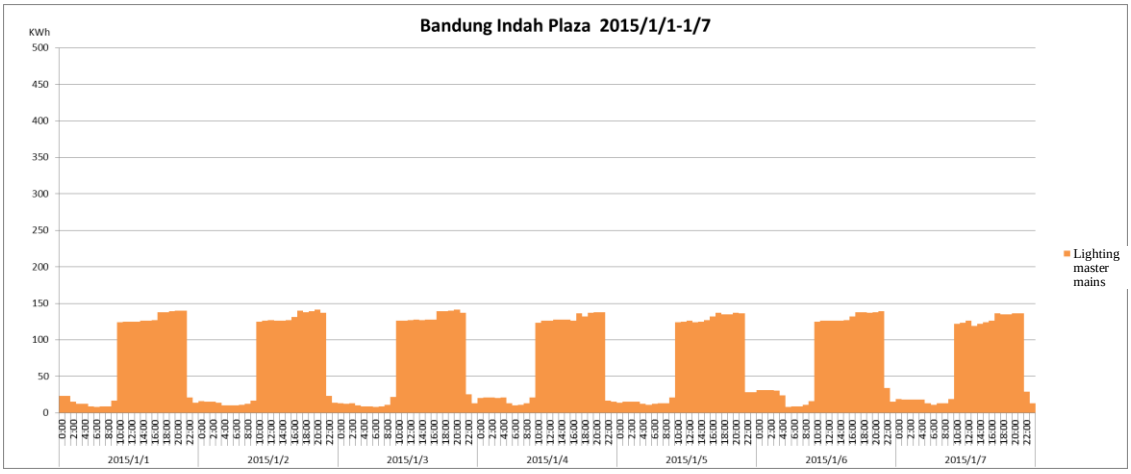


Figure 4.3.2-31: Hourly total power consumption (lighting) 1/1/2015-1/7/2015

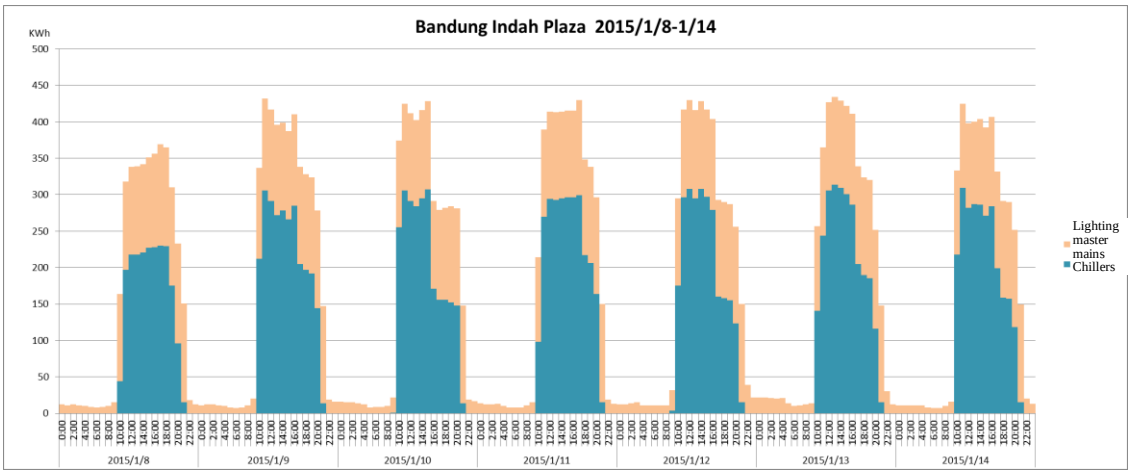


Figure 4.3.2-32: Hourly total power consumption (chillers and lighting added) 1/8/2015-1/14/2015

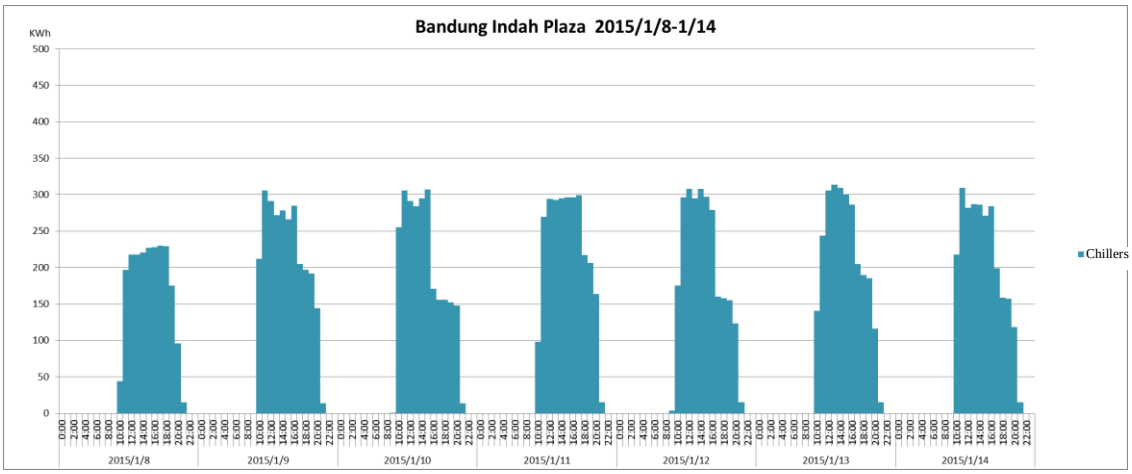


Figure 4.3.2-33: Hourly total power consumption (chillers) 1/8/2015-1/14/2015

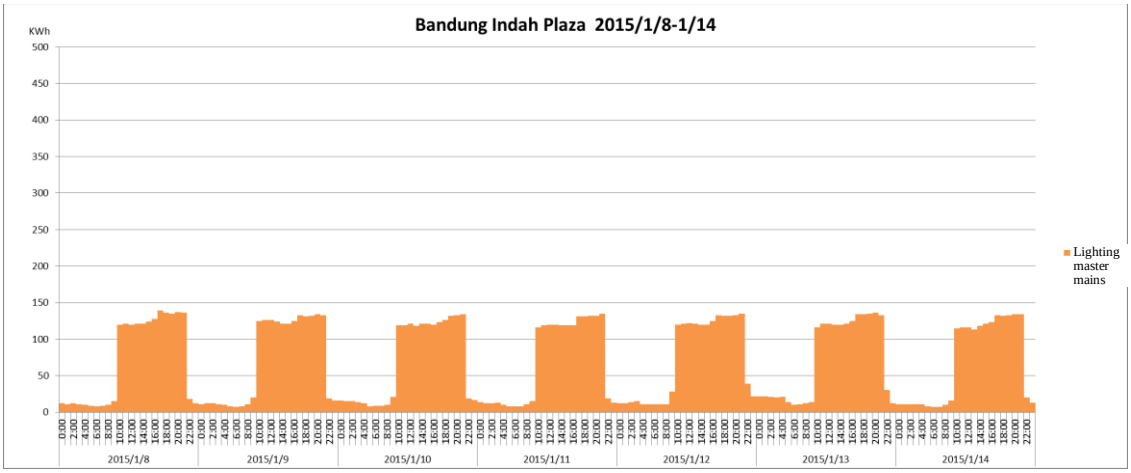


Figure 4.3.2-34: Hourly total power consumption (lighting) 1/8/2015-1/14/2015

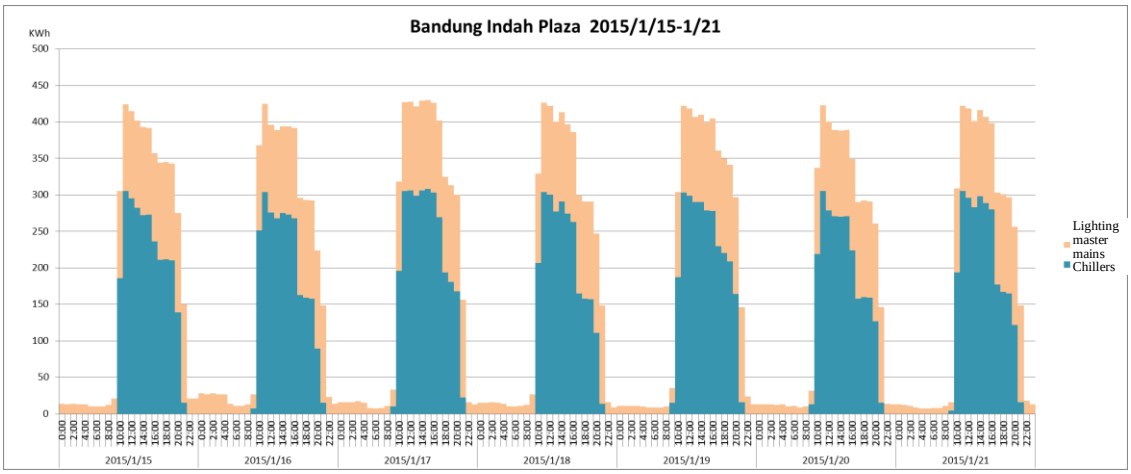


Figure 4.3.2-35: Hourly total power consumption (chillers and lighting added) 1/15/2015-1/21/2015

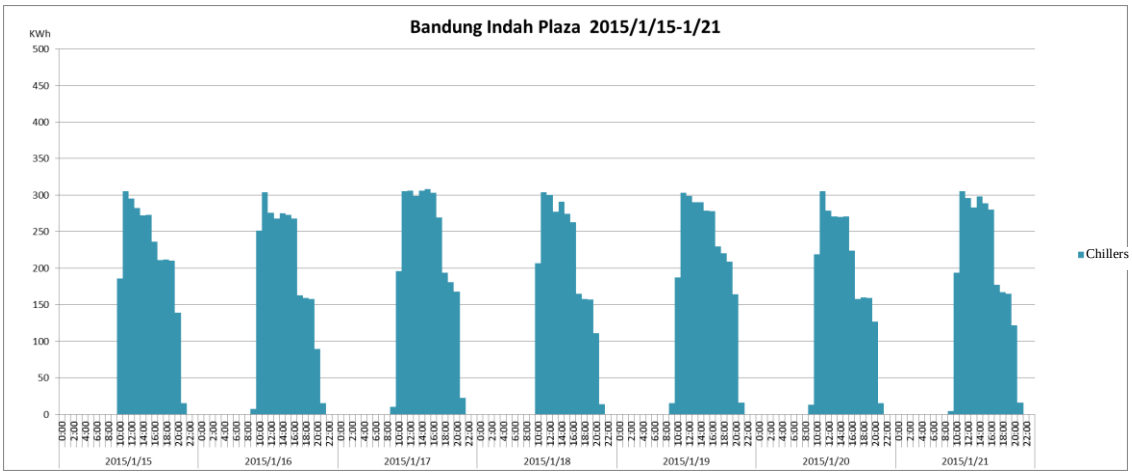


Figure 4.3.2-36: Hourly total power consumption (chillers) 1/15/2015-1/21/2015

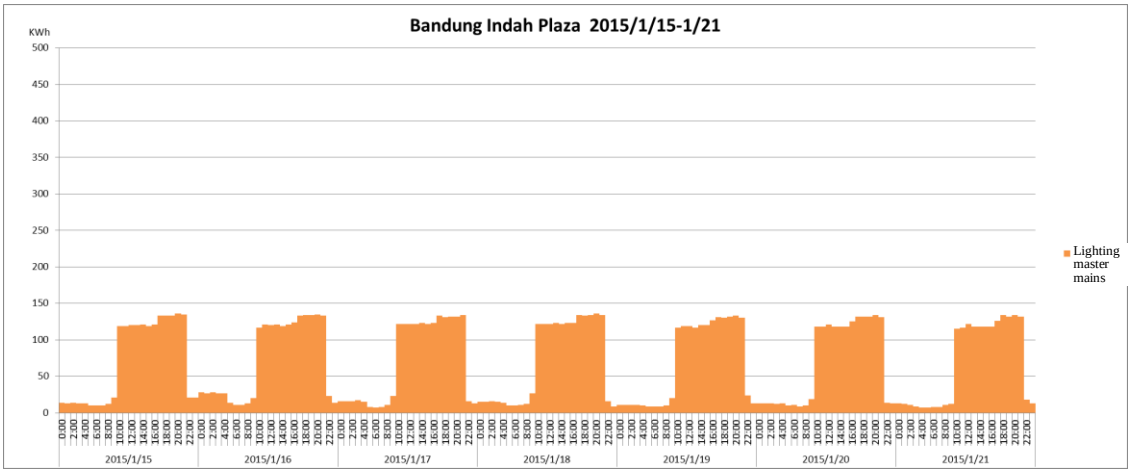


Figure 4.3.2-37: Hourly total power consumption (lighting) 1/15/2015-1/21/2015

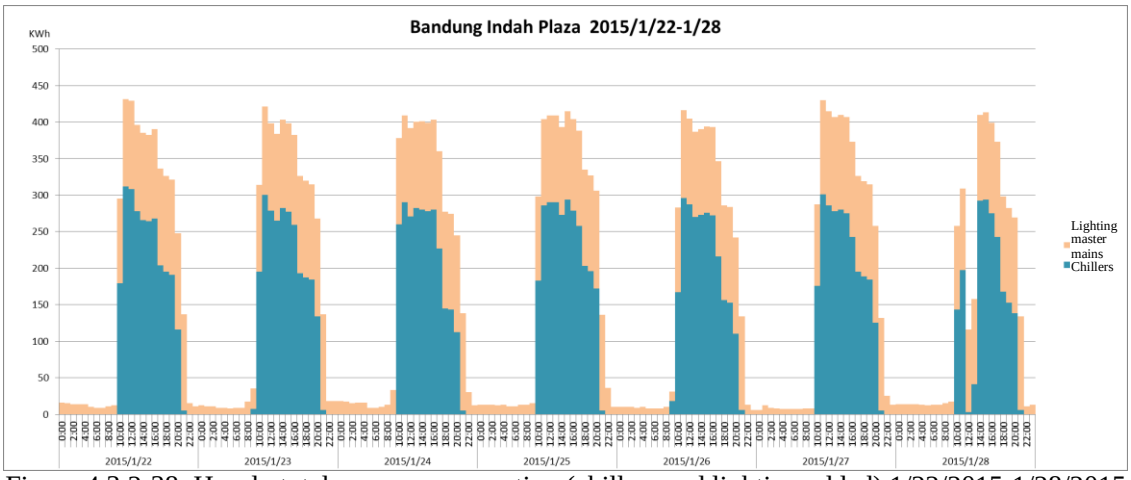


Figure 4.3.2-38: Hourly total power consumption (chillers and lighting added) 1/22/2015-1/28/2015

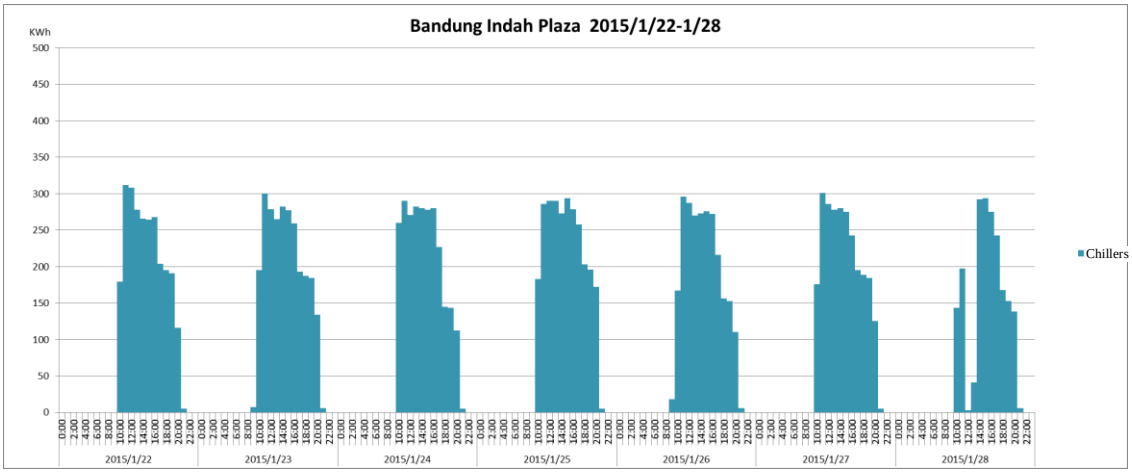


Figure 4.3.2-39: Hourly total power consumption (chillers) 1/22/2015-1/28/2015

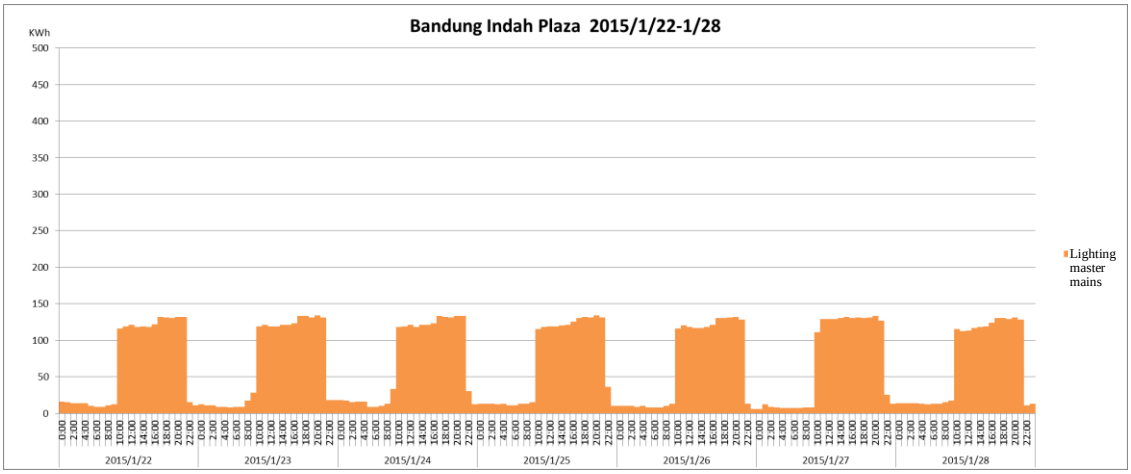


Figure 4.3.2-40: Hourly total power consumption (lighting) 1/22/2015-1/28/2015

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.

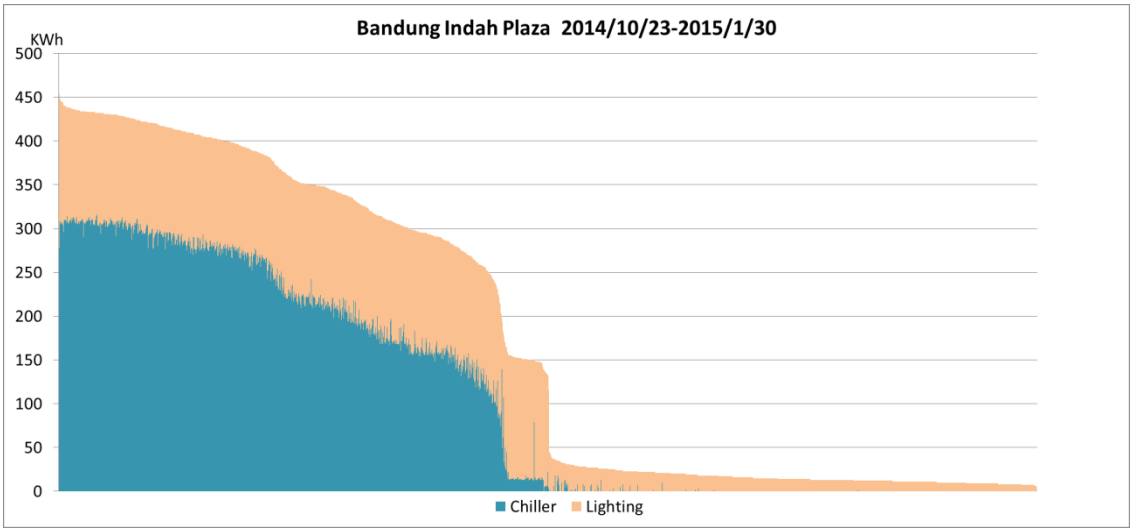


Figure 4.3.2-41: Hourly total amount of power consumption sorted 10/23/2014-1/31/2015

■ 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.

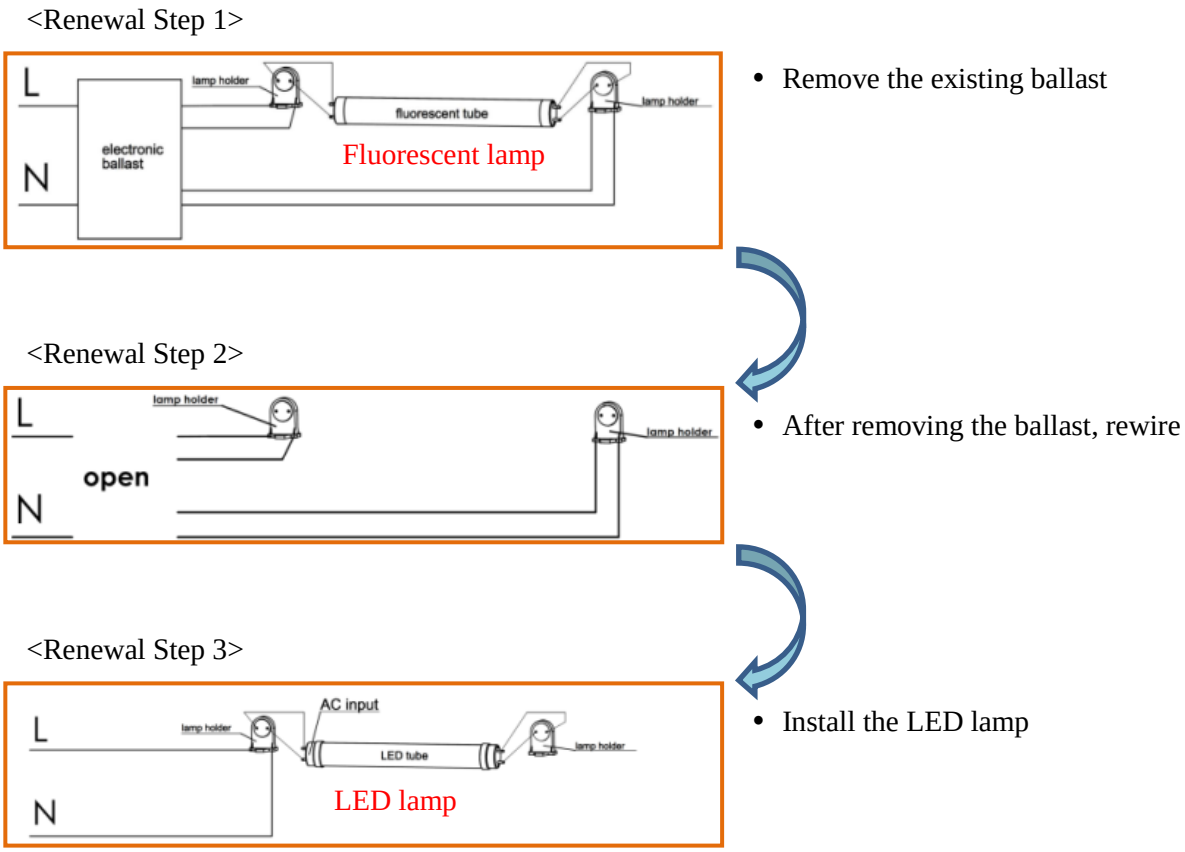
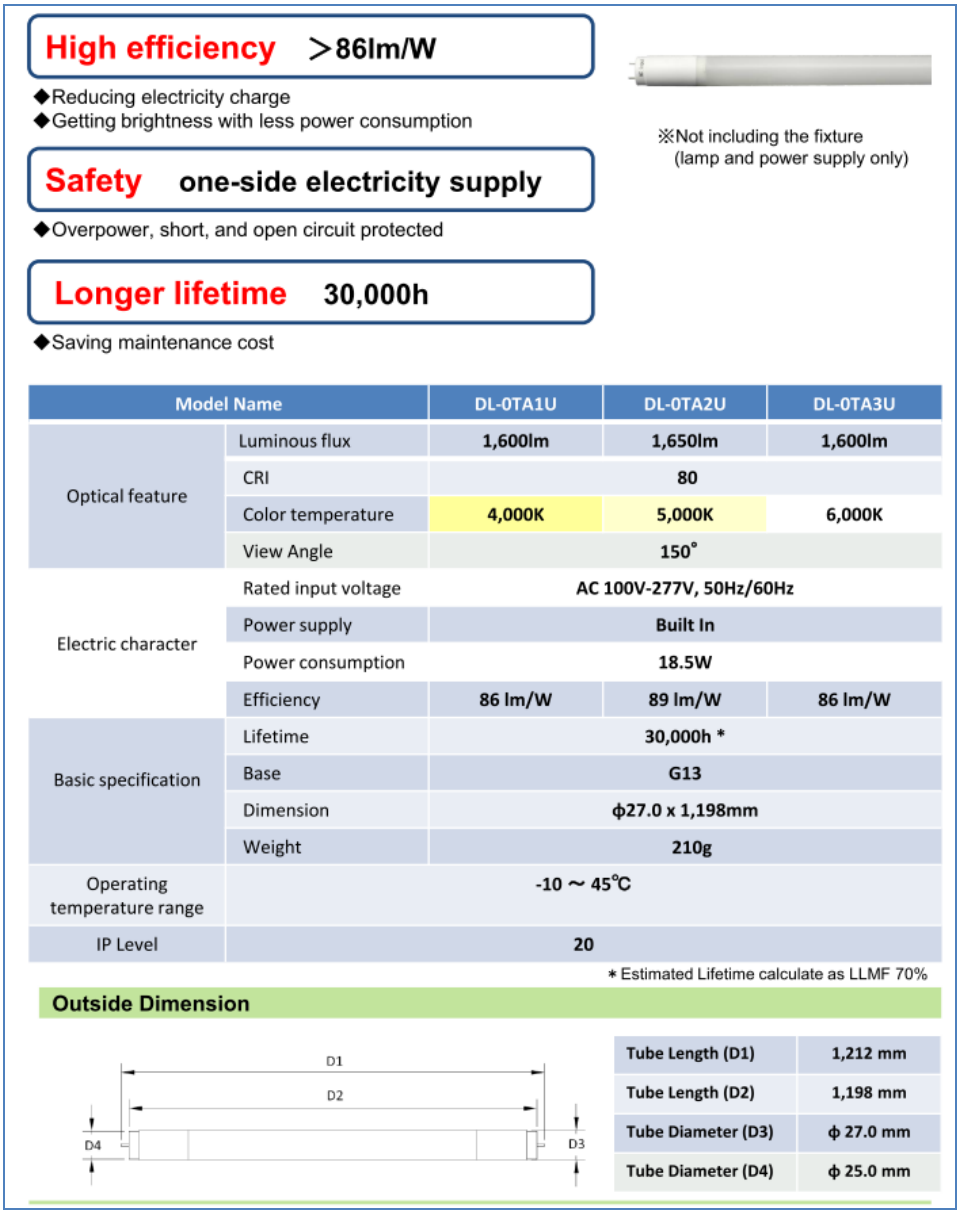


Figure 4.3.2-42: Procedure for the renewal of lighting

The specifications of an LED lamp are listed below for the consideration of renewal.



High efficiency >86lm/W

◆Reducing electricity charge
◆Getting brightness with less power consumption

※Not including the fixture
(lamp and power supply only)

Safety one-side electricity supply

◆Overpower, short, and open circuit protected

Longer lifetime 30,000h

◆Saving maintenance cost

Model Name		DL-0TA1U	DL-0TA2U	DL-0TA3U
Optical feature	Luminous flux	1,600lm	1,650lm	1,600lm
	CRI	80		
	Color temperature	4,000K	5,000K	6,000K
	View Angle	150°		
Electric character	Rated input voltage	AC 100V-277V, 50Hz/60Hz		
	Power supply	Built In		
	Power consumption	18.5W		
	Efficiency	86 lm/W	89 lm/W	86 lm/W
Basic specification	Lifetime	30,000h *		
	Base	G13		
	Dimension	ϕ27.0 x 1,198mm		
	Weight	210g		
Operating temperature range		-10 ~ 45℃		
IP Level		20		

* Estimated Lifetime calculate as LLMF 70%

Outside Dimension

Tube Length (D1)	1,212 mm
Tube Length (D2)	1,198 mm
Tube Diameter (D3)	ϕ 27.0 mm
Tube Diameter (D4)	ϕ 25.0 mm

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.

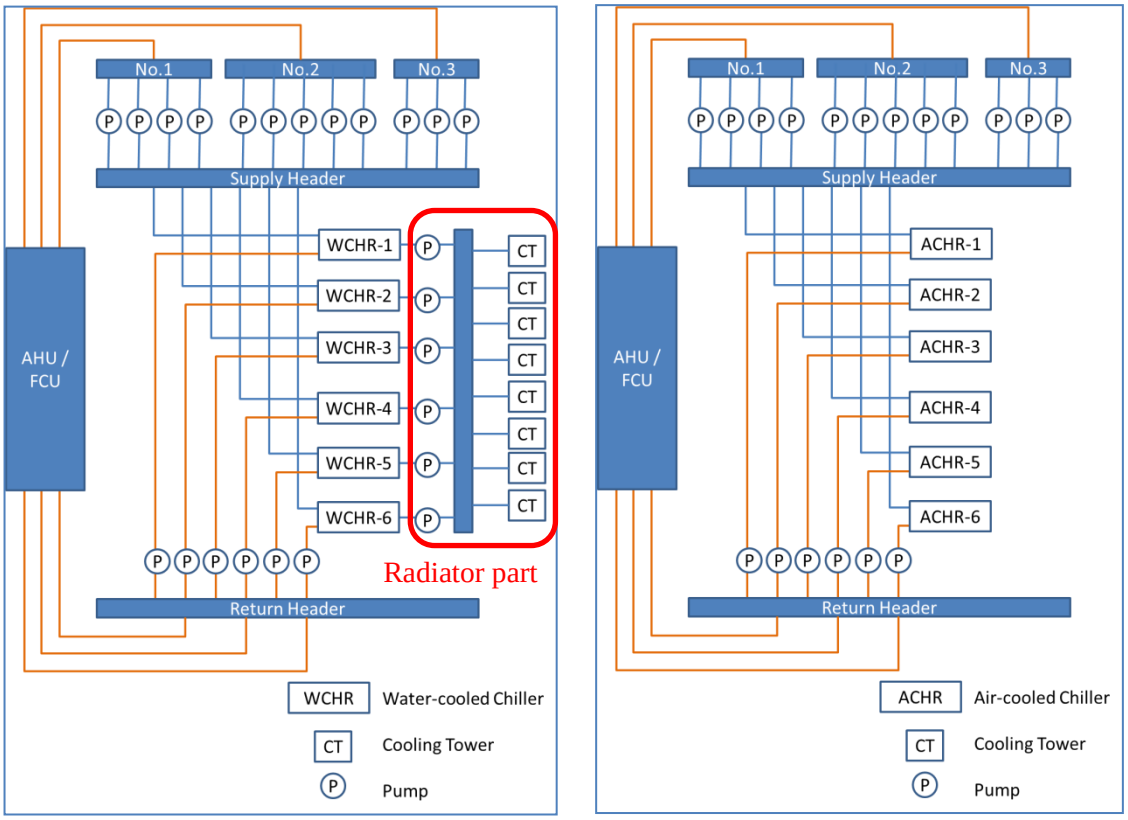
4.3.3 Case study 3 Energy conservation in buildings (Trans Studio Mall)

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_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.



Example of water-cooled chiller configuration

Example of air-cooled chiller configuration

Figure 4.3.3-1: Example configuration comparison between the water-cooled chiller and the air-cooled chiller

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.

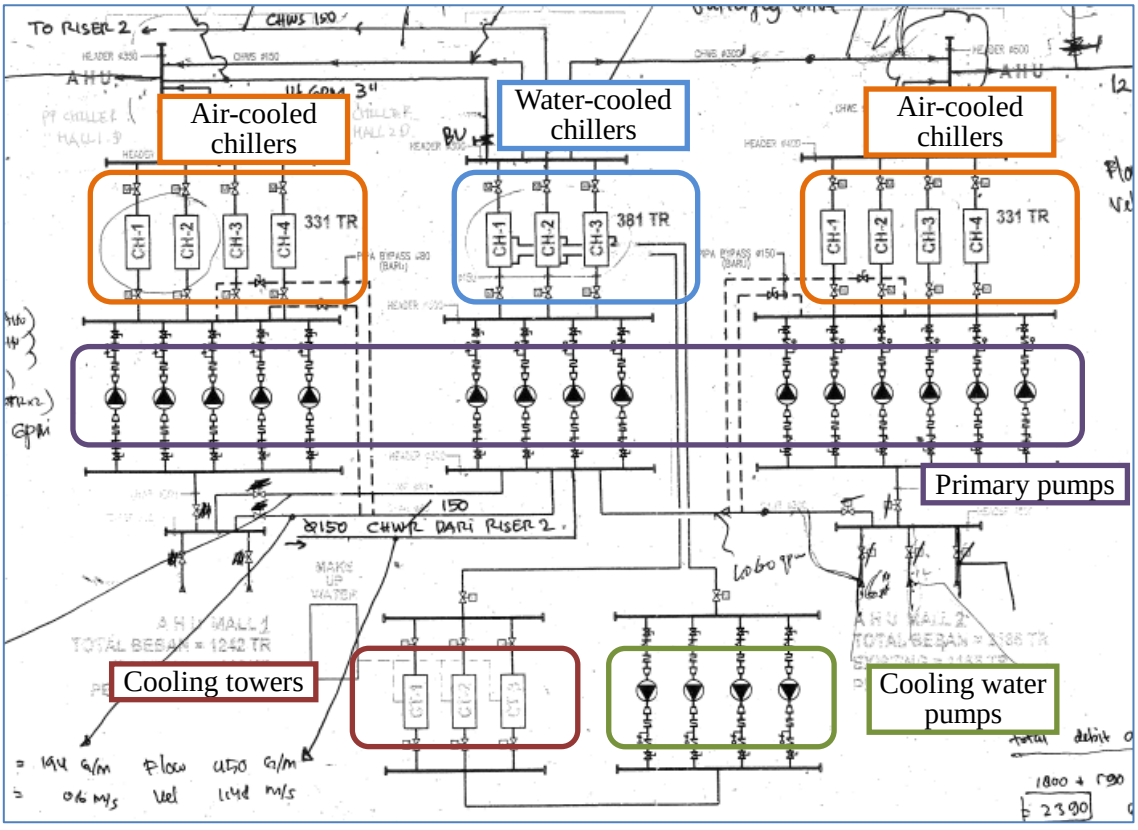


Figure 4.3.3-2: The heat source system

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 4.4.1-1: Indices for renewal to LED lighting
(table reproduced)

Lamp type (Before renewal)	Power consumption (W)	Power consumption after renewing to LED (W)
Sodium lamp (SON)	70	60-70
Sodium lamp (SON)	150	80-100
Sodium lamp (SON)	250	100-120
Mercury lamp (HPL)	250	80-100
Mercury lamp (HPL)	125	80-100
Mercury lamp (HPL)	70	60-70
Fluorescent lamp (LHE)	45	60-70
Fluorescent lamp (LHE)	85	60-70

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

Before conversion								
Lamp type	Power consumption (W)	Quantity *1	Operating hours (h/day)	Number of operating days (day/year)	Operation efficiency (-)	Amount of electricity used (kWh/year)		
Sodium lamp	150	2,087	11	365	1.00	1,256,896		
	250	863	11	365	1.00	866,236		
Mercury lamp	250	1,112	11	365	1.00	1,116,170		
	125	2,346	11	365	1.00	1,177,399		
After conversion								
Lamp type	Power consumption (W)*2	Quantity *1	Operating hours (h/day)	Number of operating days (day/year)	Operation efficiency (-)	Amount of electricity used (kWh/year)	Investment in equipment (million yen)	
							Installation of lamp	Removal and installation of pole
LED	100	2,087	11	365	1.00	837,931	153	284
LED	100	863	11	365	1.00	346,495	63	118
LED	100	1,112	11	365	1.00	446,468	81	151
LED	100	2,346	11	365	1.00	941,919	172	319
							469	872
				Amount of electricity reduction			1,843,889	kWh/year
				Amount of CO_2 emissions reduction			1,501	t-CO_2/year
				Cost effectiveness (Estimated based on the assumption that only lamp is installed and the service life is 7 years)			44,597	yen/t-CO_2

*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 -

<Before conversion>								
Place of installation	Lamp type	Quantity	Power consumption (W)	Operating hours (h/day)	Number of operating days (day/year)	Operation efficiency (-)	Amount of power consumption (kWh/year)	
Parking lot	FL36W×2	113	80	14	365	1.00	46,194	
Parking lot	FL36W×1	371	40	14	365	1.00	75,832	
							122,027	
<After conversion>								
Place of installation	Lamp type	Quantity	Power consumption (W)	Operating hours (h/day)	Number of operating days (day/year)	Operation efficiency (-)	Amount of power consumption (kWh/year)	Investment in equipment (yen)
Parking lot	LED18.5W×2	113	37	14	365	1.00	21,365	740,000
Parking lot	LED18.5W×1	371	18.5	14	365	1.00	35,072	1,210,000
							56,437	1,950,000
					Amount of electricity reduction		65,589	kWh/year
					Amount of CO_2 emissions reduction		53.4	t-CO_2/year
					Cost effectiveness (Estimated based on a service life of 6 years)		6,086	yen/t-CO_2

* 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

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

Item	Value
Power consumption of the existing chiller	8,262 MWh/year
Power consumption of the replaced chiller (including ancillary equipment)	4,423 MWh/year
Reduction of power consumption (reduction from the existing chiller)	3,839 MWh/year
Amount of CO_2 emission reduction (as per JCM_ID_AM002 Ver1.0)	475 t-CO_2/year
Investment in equipment	314 (million yen)
Cost-effectiveness (estimated based on a service life of 15 years)	44,070 yen/t-CO_2

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_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_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_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 4.5.1-1: Trend of electricity sale for different customers

Unit: GWh

Sector	2005	2006	2007	2008	2009	2010	2011	2012
Household	41,182	43,754	47,324	50,184	54,945	59,825	65,110	72,132
Commerce	15,980	18,415	20,608	22,926	24,825	27,157	28,309	30,989
Industry	42,453	43,615	45,802	47,969	46,204	50,985	54,725	60,176
Public	7,417	6,825	7,510	7,940	8,607	9,330	9,848	10,694
Total	107,032	112,609	121,246	129,019	134,581	147,297	157,992	173,991

Source: PLN Annual Report 2009, PLN Annual report 2012 (PLN, 2009, 2012)

Taking 2012 as a base and assuming the energy-derived CO_2 per unit in the commerce sector is 0.814 (t-CO_2/MWh), the total emission would be 25,225,046 (t-CO_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_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

Number	Requirement (ID_PM004)	Proposed modification of requirement
Requirement 1	New installation or conversion of fluorescent lamp at a grocery shop (400 m^2 or less)	Outdoor street lamps & road lighting
Requirement 2	Color temperature of LED: 5,000K - 6,500 K Length: 602.5 mm - 1,513.0 mm Efficiency: 120 lm/W or more	Color temperature of LED: 3,000 K - 6,000 K Length: 422 mm or more 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 conforms to Indonesian National Standard（SNI 7391:2008）

Street type	E (lux)
Sidewalk	1-4
Local road Primary secondary	2-5 2-5
Feeder road Primary Secondary	3-7 3-7
Main road Primary secondary	11-20 11-20
Main roads with access control, freeways	15-20
Tunnels, overpasses, highways	20-25

(2) Formula to calculate the emissions reduction
Emissions reduction is calculated using the formula below
$ER_p = RE_p - PE_p$
ER_p: Emissions reduction for the period 'p' (tCO_2/p)
RE_p: Reference emission for the period 'p' (tCO_2/p)
PE_p: Project emission for the period 'p' (tCO_2/p)

(3) Formula to calculate the project emission
$PE_p = EC_{PJ,p} \times EF_{elec}$
PE_p: Project emission for the period 'p' (tCO_2/p)

$EC_{PJ,p}$: Total power consumption of project lighting for the period 'p' (MWh/p)
EF_{elec}: CO_2 emission factor of the power consumption (tCO_2/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' (tCO_2/p)
$EC_{PJ,p}$: Total power consumption of the project lighting for the period 'p' (MWh/p)
η_{PJ}: Luminous efficiency of the project lighting (lm/W)
η_{RE}: Luminous efficiency of the reference lighting (lm/W)
EF_{elec}: CO_2 emission factor of the power consumption (tCO_2/MWh)

(5) Setting parameter values

EF_{elec}: The most recent CO_2 emission factor must be used.
η_{PJ}: With respect to the luminous efficiency of the project lighting, if multiple products are to be introduced, the lowest one shall be used.
η_{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)

Type	Model number	Electricity Consumption (W)	Efficiency (lm/W)
Sodium lamp	LAMP SON I 70W/220V	70	80
	LAMP SON T 150W/220V	150	98
	LAMP SON T 250W/220V	250	110
Mercury lamp	LAMP HPL 80W/220V	80	44.5
	LAMP HPL 125W/220V	125	-
	LAMP HPL 250W/220V	250	51

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>
<tr><th>Number</th><th>Requirement (ID_PM004)</th><th>Proposed modification of requirement</th></tr>
<tr><td>Requirement 1</td><td>New installation or conversion of fluorescent lamp at a grocery shop (400 m^2 or less)</td><td>Indoor lighting & indoor parking lot</td></tr>
<tr><td>Requirement 2</td><td>Color temperature of LED: 5,000 K - 6,500 K
Length: 602.5 mm - 1,513.0 mm
Efficiency: 120 lm/W or more</td><td>Color temperature of LED: 4,000 K - 6,000 K
Length: 602.5 mm - 1,513.0 mm
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>—</td><td>LUX should conform to Indonesia National Standards (SNI 7391:2008）
<table><tr><th colspan="3">Lighting for Indoor parking lot</th></tr><tr><th></th><th>Day time (lux)</th><th>Night tim (lux)</th></tr><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></table></td></tr>
<tr><td>Requirement 5</td><td>—</td><td>Renovate the electric wiring and utilize existing light fixtures</td></tr>
</table>

(2) Formula to calculate the emissions reduction
Emissions reduction is calculated using the formula below.

$ER_p = RE_p - PE_p$
ER_p: Emissions reduction for the period 'p' (tCO_2/p)
RE_p: Reference emission for the period 'p' (tCO_2/p)
PE_p: Project emission for the period 'p' (tCO_2/p)

(3) Formula to calculate the project emission
$PE_p = EC_{PJ,p} \times EF_{elec}$
PE_p: Project emission for the period 'p' (tCO_2/p)
$EC_{PJ,p}$: Total power consumption of project lighting for the period 'p' (MWh/p)
EF_{elec}: CO_2 emission factor of the power consumption (tCO_2/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' (tCO_2/p)
$EC_{PJ,p}$: Total power consumption of the project lighting for the period 'p' (MWh/p)
η_{PJ}: Luminous efficiency of the project lighting (lm/W)
η_{RE}: Luminous efficiency of the reference lighting (lm/W)
EF_{elec}: CO_2 emission factor of the power consumption (tCO_2/MWh)

(5) Setting parameter values
EF_{elec}: The most recent CO_2 emission factor must be used.
η_{PJ}: With respect to the luminous efficiency of the project lighting, if multiple products are to be introduced, the lowest one shall be used.
η_{RE}: 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 lm/W). *

*1 : According to the additional information of JCM_ID_PM004, Manufacturer A's No1 to No.3 considered for installment. 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

No.	Category	Model Number	Type	Length (mm)	Color Temperature (K)	Luminous Flux (lm)	Rated Power Consumption (W)	Luminous Efficacy (lm/W)
1	MASTER LEDtube SA1 Gen2	MASTER LEDtube SA1 1200mm 1600lm 856 G13	(n/a)	1,212.0	5,600	1,600	19	84.2
2	MASTER LEDtube SA1 Gen2	MASTER LEDtube SA1 900mm 1150lm 856 G13	(n/a)	907.5	5,600	1,150	15	76.7
3	MASTER LEDtube SA1 Gen2	MASTER LEDtube SA1 600mm 800lm 856 G13	(n/a)	602.5	5,600	800	10	80.0
4	Essential LEDtube	ESSENTIAL LEDtube 1200mm 20W865 T8 AP I	T8	1,212.0	6,500	1,600	20	80.0
5	Essential LEDtube	ESSENTIAL LEDtube 600mm 10W865 T8 AP I	T8	602.5	6,500	800	10	80.0

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

Requirement 1	The project chiller is a centrifugal (turbo) chiller unit and its cooling capacity is 1250 USRT or less * 1 USRt = 3.52 kW
Requirement 2	• COP of the project chiller 'i' under standard temperature conditions must be 6.0 or more. • $COP_{pj,tc,i}$ is worked out by converting COP of the project chiller under project conditions to COP under standard conditions. • $COP_{pj,i}$ is worked out on the basis of a quote from the manufacturer and factory test data. (Formula to calculate $COP_{pj,tc,i}$) $\mathbf{COP_{PJ,tc,i} = COP_{PJ,i} \times [(T_{cooling-out,i} - T_{chilled-out,i} + TD_{chilled} + TD_{cooling}) \div (37 - 7 + TD_{chilled} + TD_{cooling})]}$ $COP_{pj,tc,i}$: COP of the project chiller ''calculated under standard temperature conditions (-) $COP_{pj,i}$: COP of the project chiller 'i' calculated under project specific conditions (-) $T_{cooling-out,i}$: Outlet temperature of the cooling water of the project chiller 'i' under project specific conditions (°C) $T_{chilled-out,i}$: Outlet temperature of the chilled water of the project chiller 'i' under project specific conditions (°C) $TD_{cooling}$: Difference between condensation temperature of the refrigerant and outlet temperature of the cooling water; the default value is 1.5 (°C) $TD_{chilled}$: 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 $COP_{pj,tc,i}$ • 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)
Requirement 3	Periodical inspection at least four times a year must be planned.
Requirement 4	Refrigerant whose ozone depletion potential is zero must be used for the project chiller.
Requirement 5	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.

(2) Formula to calculate the amount of emissions reduction
The amount of emissions reduction is calculated using the formula below.

$$\mathbf{RE_p} = \sum_{\mathbf{i}} \left\{ \mathbf{EC_{PJ,i,p}} \times \left(\mathbf{COP_{PJ,tc,i}} \div \mathbf{COP_{RE,i}} \right) \times \mathbf{EF_{elec}} \right\}$$

RE_p: Emissions reduction for the period 'p' (tCO_2/p)
$EC_{pj,i,p}$: Power consumption of project chiller 'i' for the period 'p' (MWh/p)
$COP_{pj,tc,i}$: COP of the project chiller 'i' calculated under standard temperature conditions (-)
$COP_{RE,i}$: COP of the reference chiller 'i' calculated under standard temperature conditions (-)
EF_{elec}: CO_2 emission factor associated with the power consumption (tCO_2/MWh)

(3) Formula to calculate the amount of project emissions

$$\mathbf{PE_p} = \sum_{\mathbf{i}} \left(\mathbf{EC_{PJ,i,p}} \times \mathbf{EF_{elec}} \right)$$

PE_p: Project emissions for the period 'p' (tCO_2/p)
$EC_{pj,i,p}$: Power consumption of project chiller 'i' for the period 'p' (MWh/p)
EF_{elec}: CO_2 emission factor associated with the power consumption (tCO_2/MWh)

(4) Formula to calculate the amount of reference emissions

$$\mathbf{ER_p} = \mathbf{RE_p} - \mathbf{PE_p}$$

ER_p: Emissions for the period 'p' (tCO_2/p)
RE_p: Reference emissions for the period 'p' (tCO_2/p)
PE_p: Project emissions for the period 'p' (tCO_2/p)

(5) Setting parameter values

Parameter	Explanation on data	Information source
EF_{elec}	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_2 emission factor. When the project chiller consumes both grid electricity and dedicated power supply, apply CO_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 ($EI_{grid,p}$) and dedicated power supply ($EG_{gen.p}$)*. *: 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). (CO_2 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) *: The most recent value at the time verification is approved should	(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

<table>
<tr><td></td><td>be the one in accordance with CDM-approved small-scales methodology AMS-I.A.</td><td></td></tr>
<tr><td>$COP_{RE,i}$</td><td>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><tr><td>Cooling capacity (USRt)</td><td>x<300</td><td>300≤ x<450</td><td>450≤ x<500</td><td>500≤ x<700</td><td>700≤ x<1250</td></tr><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></table></td><td>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.</td></tr>
<tr><td>$COP_{pj,i}$</td><td>COP of the project chiller ‘i’ under project specific conditions</td><td>Specifications of the project chiller ‘i’ is based on the quotation from the manufacturer and factory test data.</td></tr>
<tr><td>$T_{cooling\text{-}out,i}$</td><td>Outlet temperature of the cooling water of the project chiller ‘i’ under project specific conditions</td><td>Specifications of the project chiller ‘i’ are based on the quotation from the manufacturer and factory test data.</td></tr>
<tr><td>$T_{chilled\text{-}out,i}$</td><td>Outlet temperature of the chilled water of the project chiller ‘i’ under project specific conditions</td><td>Specifications of the project chiller ‘i’ are based on the quotation from the manufacturer and factory test data.</td></tr>
<tr><td>RC_{gen}</td><td>Rated capacity of the generator</td><td>Specifications of the dedicated power supply generator</td></tr>
</table>

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 CO_2 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 CO_2 emissions reduction performance; therefore, this mechanism brings about a Win-Win situation for both countries.

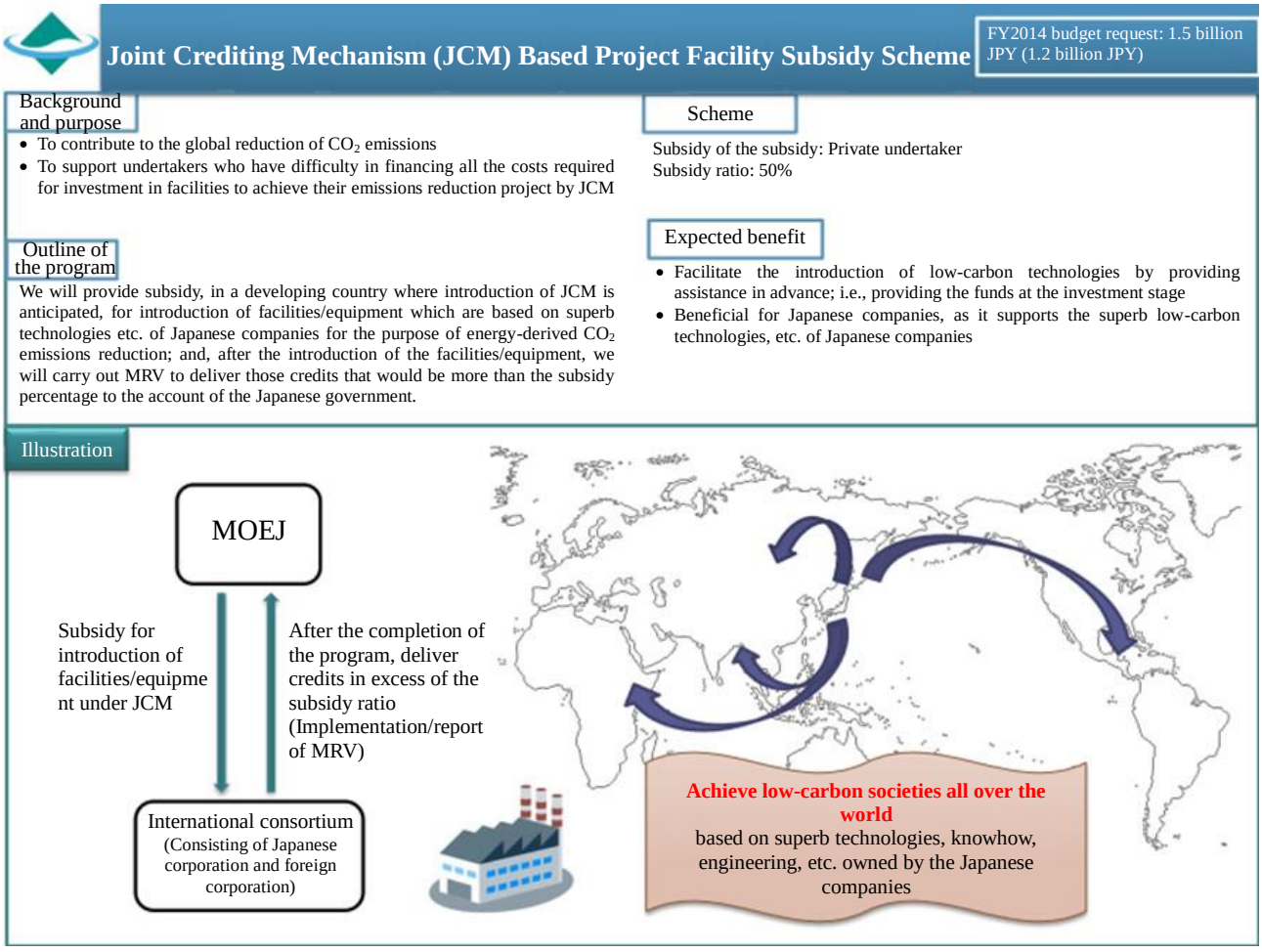


Figure 4.7.1-1: Outline of JCM Based Project Facility Subsidy Scheme

(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:

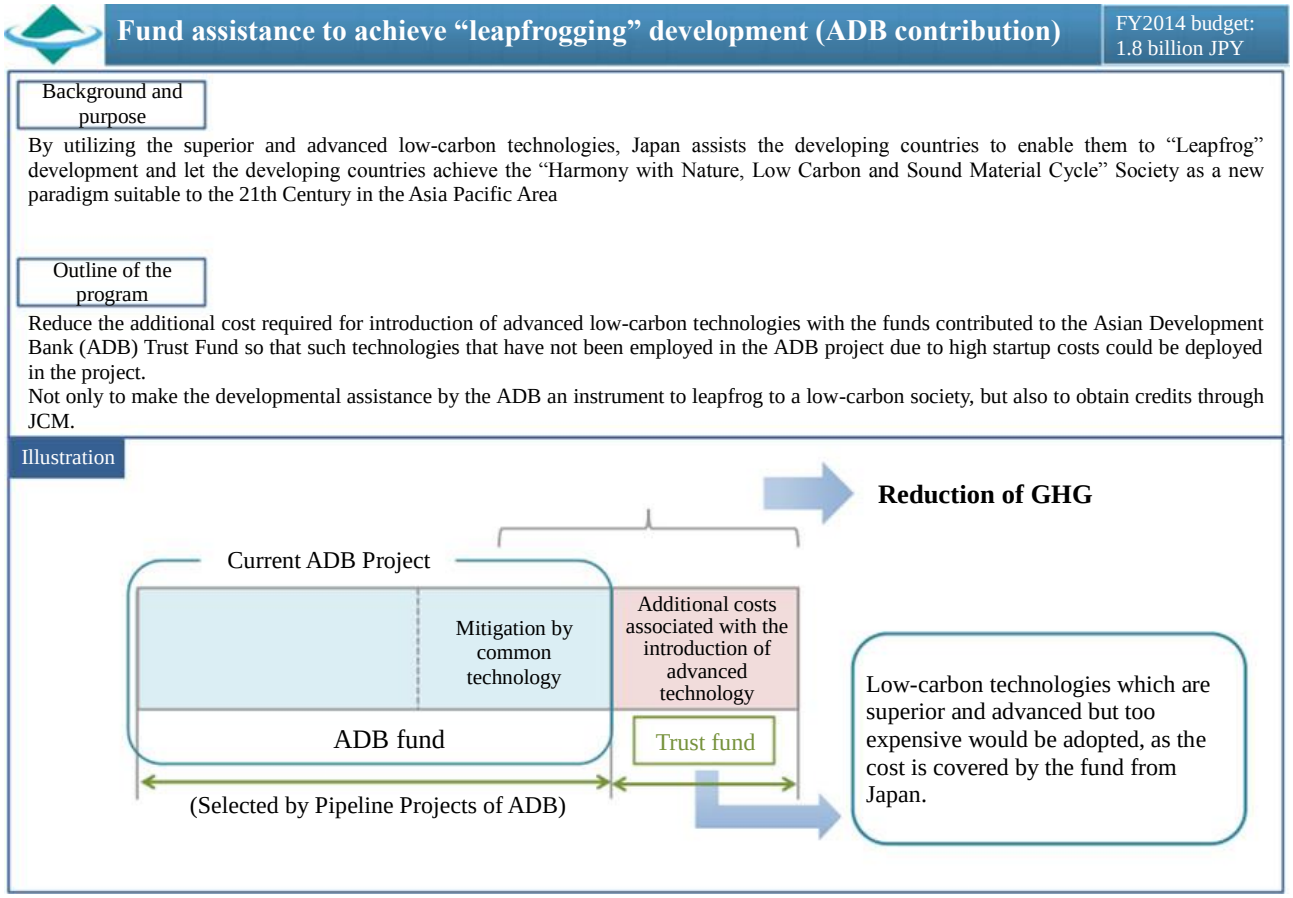


Figure 4.7.1-2: The outline of ADB contribution

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 CO_2 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.

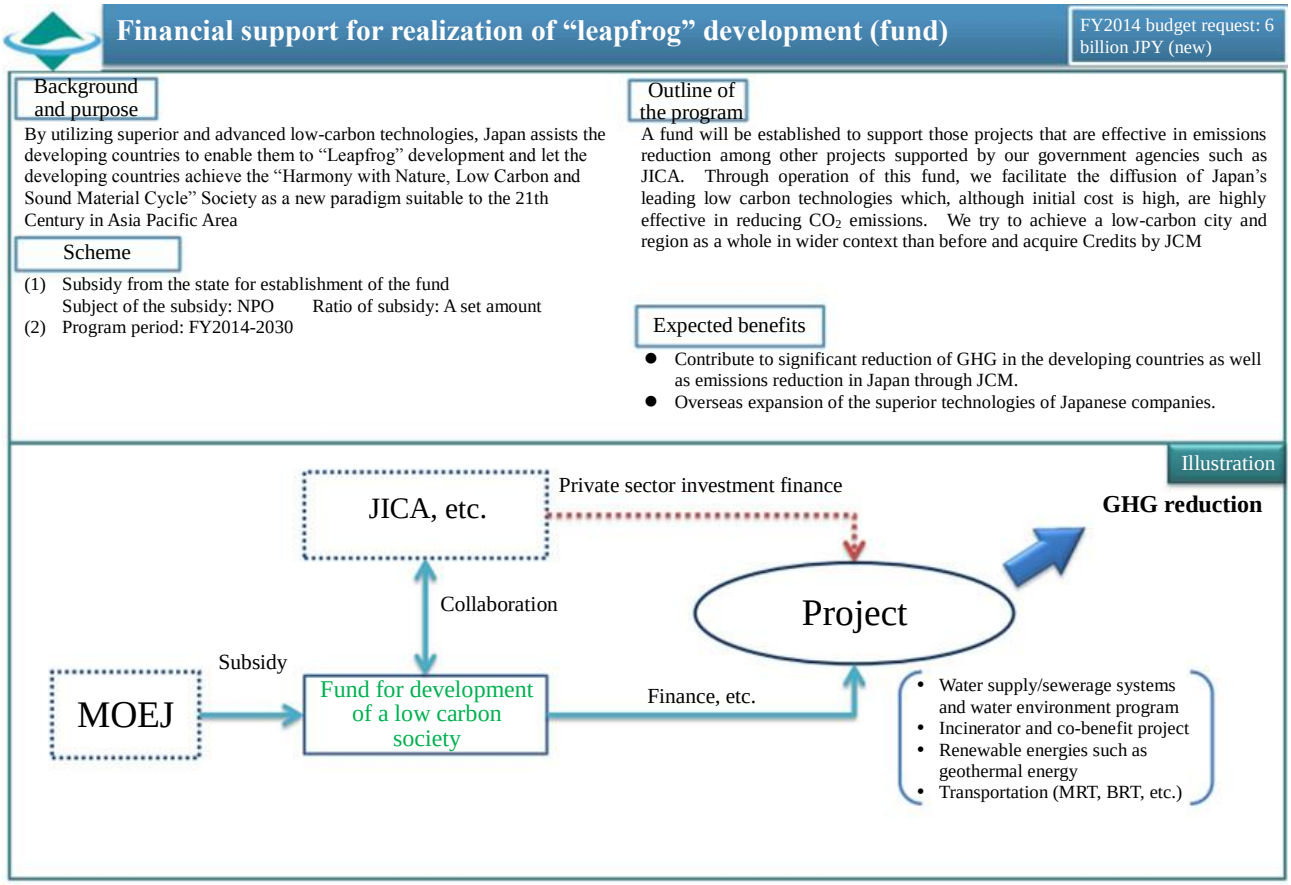


Figure 4.7.1-3: Outline of the fund for promotion of low-carbon technologies by JICA

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.

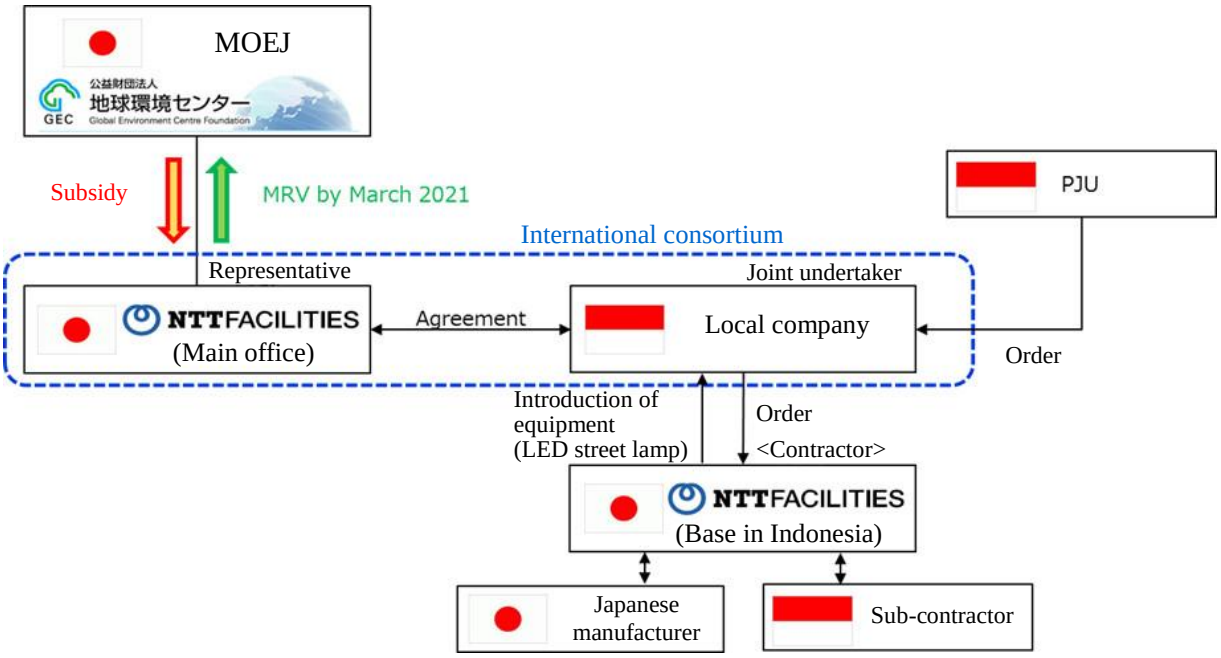


Figure 4.9.1-1: Proposed implementation framework (LED street lamps)

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

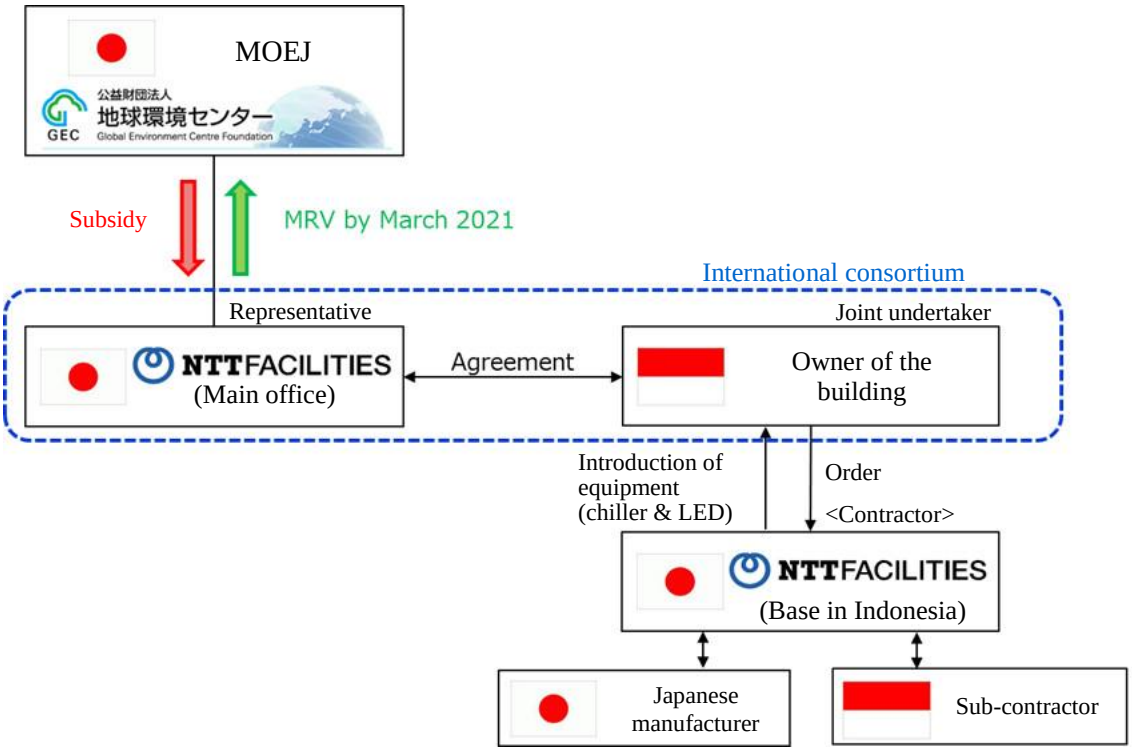


Figure 4.9.1-2: Proposed implementation framework (energy savings of the building)

■ Schedule

	2015									2016			
(Month)	4	5	6	7	8	9	10	11	12	1	2	3	4
Introduction of energy-saving facilities for the building	Public offer of facility subsidy		Approval • Order construction work • Production and procurement of equipment			• Preparation for local construction work • Installation of equipment • Implementation of construction work					• Trial operation and adjustment • Final inspection		• Start monitoring

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.

	Long-term plan (2005-2025)	Medium-term plan (2014-2018)
3R	40%	30%
W to E	30%	35%
Sanitary landfill	20%	25%

(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.

NO	Service type	Charge
1	Household	3,000－20,000 Rp/month
2	Commerce	60,000 Rp/M3
3	Other than commerce	50,000 Rp/M3
4	Society	45,000 Rp/M3
5	Broadcasting	1,000 Rp/M3
6	Public transportation	1,000-10,000 Rp/M3

(4) 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.

(Reference) Breakdown by generation source

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

(5) 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.

(6) 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/m^3 (for transportation) within the sewage area or 10,000 RP (for cleaning) plus 75,000 RP/m^3 (for transportation) out of the sewage area.

5.2 Feasibility study on the biodigester to be introduced in Bandung

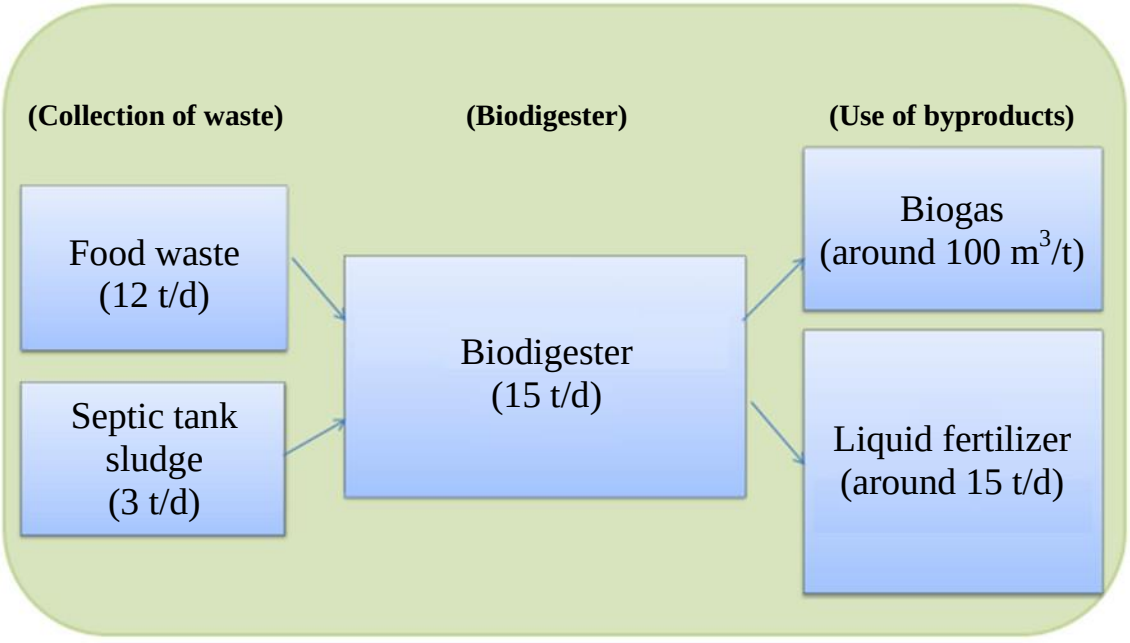
The purpose of this feasibility study is to study the feasibility of "the project to reduce greenhouse gas through the disposal of organic waste by the biodigester and by the use of the byproducts (biogas and liquid fertilizer) gained during the process of disposal."

(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

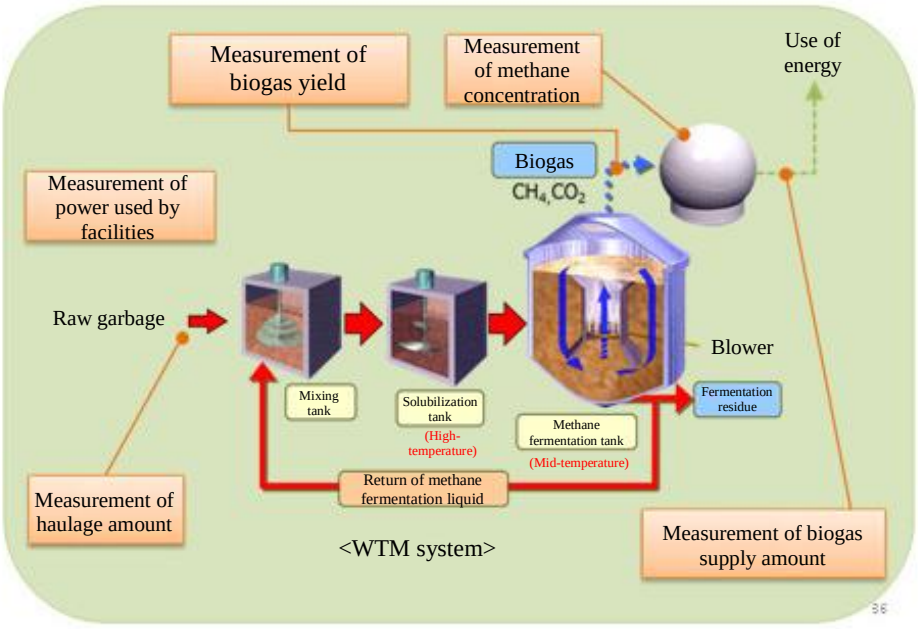
(3) Main items covered by the feasibility study

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.



<WTM system>

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:

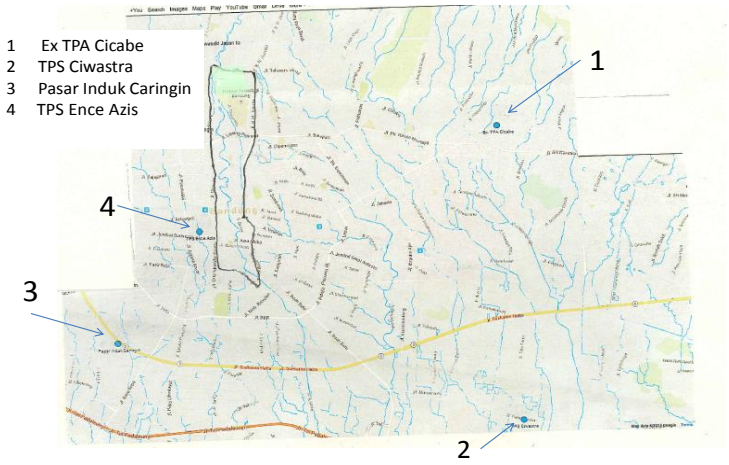
(Results of study examination)

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 Ciswastra, 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 m^3/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

No	Location	volum m³/day (mix domestic waste)	Service area	disposal to TPA Sarimukti Schedule
A	**TPS are :**			
1	TPS at bottom of pasopati bridge	12 m3	Kelurahan tamansari RW 09, RW 15 dan RW 10, Kel. cipaganti RW 07, sapuan jalan Cipaganti, Pasteur, Cihampelas dan dari trida – trida Bandung Utara	1 trip/day
2	TPS Flower market at Jl. Wastukencana	3 m^3	Flower Market at Jl Wastu Kencana	2 trip/week
3	TPS Tamansari (near the zoo)	16 m^3	Kelurahan Lebak Gede 8 RW, Kelurahan Sekeloa 9 RW,Kelurahan Dago 2 RW, Kelurahan Lebak Siliwangi 6 RW	1 trip/day
4	TPS Babakan Siliwangi (at city forres area)	6 m^3	Kel. Cipaganti RW1, Kel. Hegarmanah RW 10	1 trip/day
5	TPS Sabuga at ITB area	6 m^3	komplek ITB + sabuga area	1 trip/day
6	transported direct at Jl. cihampelas	10 m^3	kelurahn Tamansari RW 07,RW 10, dan RW 15 dan Kelurahan Cipaganti RW 04 dan RW 05	1 trip/day
B	**waste collection be sides general TPS**			
1	TPS at BALTOS MALL (include tradisional market)	10 m^3	Komplek Pusat Perbelanjaan Balubur (Mall)	3-4 trip/week
2	TPS PT Lion Super Indo Bandung Jln Ir.H. Djuanda No 40 (Mall)	10 m^3	Komplek Superindo	1 trip/day
3	Universitas Pasundan Jln Tamansari No 6-8 (college)		Kompleks Kampus UNPAS	rute tiap hari
4	PT Multi Nusantara Karya (Pengelola Kebersihan BIP) Jln Merdeka no 56 (Mall)	6 m^3	Pusat Perbelanjaan BIP/Mall BIP	Buang langsung ke TPA tiap hari
5	RS St Borromeus Jln Ir H. Djuanda No 40-44 (Hospital)	10 m^3	Komplek RS St Borromeus	2 trip/week
6	Pusat Penelitian Tenaga Listrik LIPI Jln Cisitu No 21 (office)	6 m^3	komplek perkantoran LIPI	every day
7	PT Kacida Sukses (Hotel Geulis) Jln Ir. H. Djuanda No 129 (Hotel)	6 m^3	komplek Hotel Geulis	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:

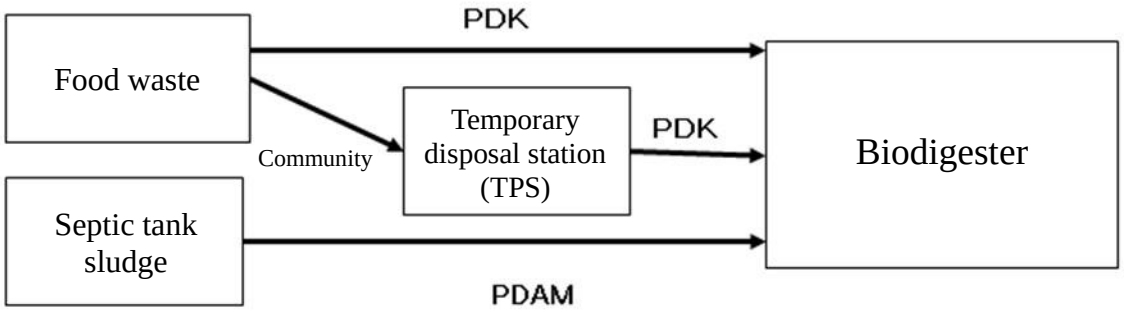
6)-1 Process of bringing in waste
(Food waste)
a. Sorted discharge
In principle, both enterprises and households sort and discharge waste. Neither sectors conduct sorting at this point. Kawasaki City has offered their experience on both enterprise and household waste in detail this year.

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



(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

Photo 2: Collection service of valuables

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

Photo 4: Unsorted waste

(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.

Content		Ratio (%)	Content		Ratio (%)
Non-organic waste	Sandbags	2.6	Organic waste	Vegetables	12.3
	Paper	22.8		Meat (chicken, bone-in)	7.0
	Plastic waste	1.4		Fish & shellfish (bony parts, liver)	5.0

	Vinyl waste (bags, cords)	15.0		Rice & vegetables (leftover rice)	23.9
	Other	0.4			
	Bones (chicken, fish)	5.6			
	Eggshells	4.0			
	Subtotal	51.8		Subtotal	48.2
Total					100.0

Table 1: Composition of business waste

Photo 7: Household waste

Photo 8: Business waste

(3) Analysis of waste components at each place of discharge

Analysis was carried out in relation to the components of the sampled organic waste. The analysis items were moisture content, ash content, total solids (TS), volatile total solids (VTS), n-hexane extract, COD, and elements (C, H, N, O, Ca, Mg, K, Na).

The analysis results are as shown in Table 2 below.

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

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.

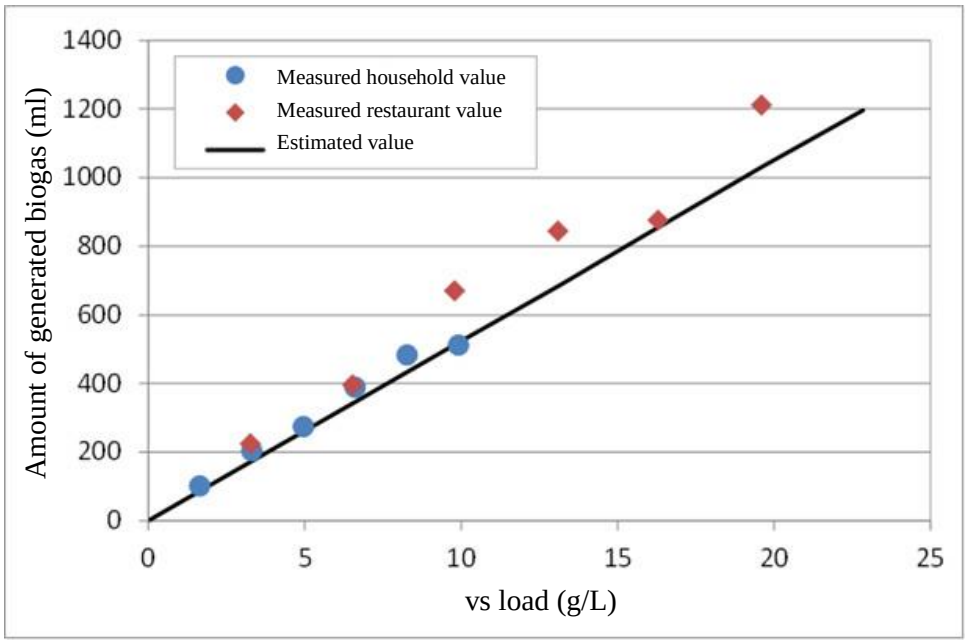


Figure 1: Amount of generated biogas per input load

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 CO_2 conversion).

Calculation formula:
2,900 CO_2 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 CO_2 conversion). (This is equivalent to 2,900 tons CO_2/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 CO_2 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

Term	Definition
Airtight test	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)
Continuous anaerobic digestion system	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.
Biogas	Biogas collected from the anaerobic digestion tank and desulfurized.
Desulfurization equipment	H_2S 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.

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

Requirement 1	The continuous anaerobic digestion system should be introduced to supply biogas for fuel replacement.
Requirement 2	The equipment's scale of disposal should be 15 tons/day or more.

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 3: Target greenhouse effects

Target greenhouse effect	Emission source	Grounds for setting the target
CH_4	The amount of CH_4 emissions from organic waste buried in landfills if this project were not carried out	Main greenhouse effect to be reduced by this project
CO_2	The amount of CO_2 emissions from fossil fuel consumed if this project were not carried out	Same as above
CO_2	The amount of CO_2 emissions from system power consumed by methane fermentation equipment	Main greenhouse gas emitted through project activities

• 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 4: Information for calculation

	Information/data	Monitoring needed?	D/S
1	Weight of waste input into methane fermentation equipment (tons)	Yes	--
2	CO_2 emission coefficient of system power (tCO_2/MWh)	No	D
3	CO_2 emission coefficient of diesel (tCO_2/TJ)	No	D
4	Adjustment factor for uncertainty	No	D
5	Ratio of methane to be flared/burned/used in recovered methane	No	D
6	Global warming potential of methane	No	D
7	Oxidation ratio	No	D
8	Ratio of methane in waste disposal site gas	No	D
9	Ratio of carbon to be decomposed in decomposable organic carbon	No	D

10	Methane correction factor	No	D
11	Ratio of decomposable organic carbon in waste *j*	No	D
12	Decomposition speed of waste *j* (1/year)	No	D
13	Composition ratios of waste *j*	No	S

5.6.1.6 Setting of default values

The following are default values under this methodology:

Table 4: default values

No.	Data		Value
1	$EF_{e,y}$	CO_2 emission coefficient of system power (tCO_2/MWh)	0.814
2	$EF_{FF,CO2}$	CO_2 emission coefficient of diesel (tCO_2/TJ)	72.6
3	$\eta_{thermal}$	Efficiency of fossil fuel-consuming equipment that would be used if the project did not exist	1
4	Φ	Adjustment factor for uncertainty	0.90
5	GWP_{CH4}	Global warming potential of methane	25
6	OX	Oxidation ratio	0.1
7	F	Ratio of methane in waste disposal site gas	0.5
8	DOC_f	Ratio of carbon to be decomposed in decomposable organic carbon	0.5
9	MCF	Methane correction factor	1.0
10	DOC_j	Ratio of decomposable organic carbon in waste *j*	15%
11	k_j	Decomposition speed of waste *j* (1/year)	0.17
12	*J*	Composition ratios of waste *j* (on weight basis)	Organic waste 100%

The following are grounds for setting each default value:

1. $EF_{e,y}$ (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. $EF_{FF,CO2}$ (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. $\eta_{thermal}$ (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. Φ (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_{CH4} (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_f (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_j (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_j (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

No.	Data		Value
10	DOC_j	Ratio of decomposable organic carbon in waste *j*	Wood & wood products 43% Paper 40% Raw garbage 15% Cloth 24% Garden, park refuse 20% Glass, plastic, other inorganic matters 0%
			IPCC

11	k_j	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)
12	*J*	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

Year	BaU emissions (tCO_2)	Reference emissions (tCO_2)
1	1,042	693
2	1,791	1,278
3	2,342	1,772
4	2,756	2,188
5	3,075	2,539
6	3,328	2,836
7	3,534	3,086
8	3,706	3,297
9	3,854	3,474
10	3,982	3,625
Total	29,410	24,787

5.6.1.11 Method to calculate reference emissions

The following is the method to calculate reference emissions:

$RE_y = RE_{CH4,SWDS,y} + (EG_{thermal,y}/\eta_{thermal}) * EF_{FF,CO2}$

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

$_{H4,SWDS,y}$	Reference emissions from waste landfill disposal sites	693 tCO_2
$EG_{thermal,y}$	Net amount of heat generation from steam/heat supplied through the project activities	8.95 TJ
$\eta_{thermal}$	Heat efficiency under the reference scenario	100%

$RE_{CH4,SWDS,y} = \Phi_y*(1-f_y)*GWP_{CH4}*(1-OX)*16/12*F*DOC_{f,y}*MCF_y*\Sigma\Sigma W_{j,x}*DOC_j*(1-e^{-kj})*e^{-kj(y-x)}$

$693 = 0.90*(1-0)*25*(1-0.1)*16/12*0.5*0.5*1.0*\Sigma\Sigma W_{j,x}*DOC_j*(1-e^{-kj})*e^{-kj(y-x)}$

2) $RE_{CH4,SWDS,y}$ in the decade

Amount of waste disposal (t)	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380
Year	1	2	3	4	5	6	7	8	9	10
1	693	585	493	416	351	296	250	211	178	150
2	0	693	585	493	416	351	296	250	211	178
3	0	0	693	585	493	416	351	296	250	211
4	0	0	0	693	585	493	416	351	296	250
5	0	0	0	0	693	585	493	416	351	296
6	0	0	0	0	0	693	585	493	416	351
7	0	0	0	0	0	0	693	585	493	416
8	0	0	0	0	0	0	0	693	585	493
9	0	0	0	0	0	0	0	0	693	585
10	0	0	0	0	0	0	0	0	0	693
$RE_{CH4,SWDS,y}$ (CO_2)	**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:

$PE_y = PEC_y * EF_{e,y} + \Sigma (PEC_{i,y} * NCV_y * EF_{CO2,i,y})$

$208 = 256 * 0.814$

PEC_y	Power consumption of project equipment	256 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:

P	Item	Target	Method
P1	Weight of waste inputted into methane fermentation equipment	Truck scale	Estimate record
P2	Supply of gas	Exit of methane fermentation equipment	Constant monitoring by gas flow meter
P3	Methane gas concentration	Exit of methane fermentation equipment	Constant monitoring by gas concentration meter

P4	System power consumption of project equipment	Electricity inlet	Constant monitoring by electricity meter
P5	Fossil fuel consumption of project equipment	--	Bill, purchase slip
P6	Ratio of methane to be flared/burned/used in methane recovered at landfill disposal sites	--	Interviews with enterprises & administrative agencies

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 (Reduction in emissions in the first year)

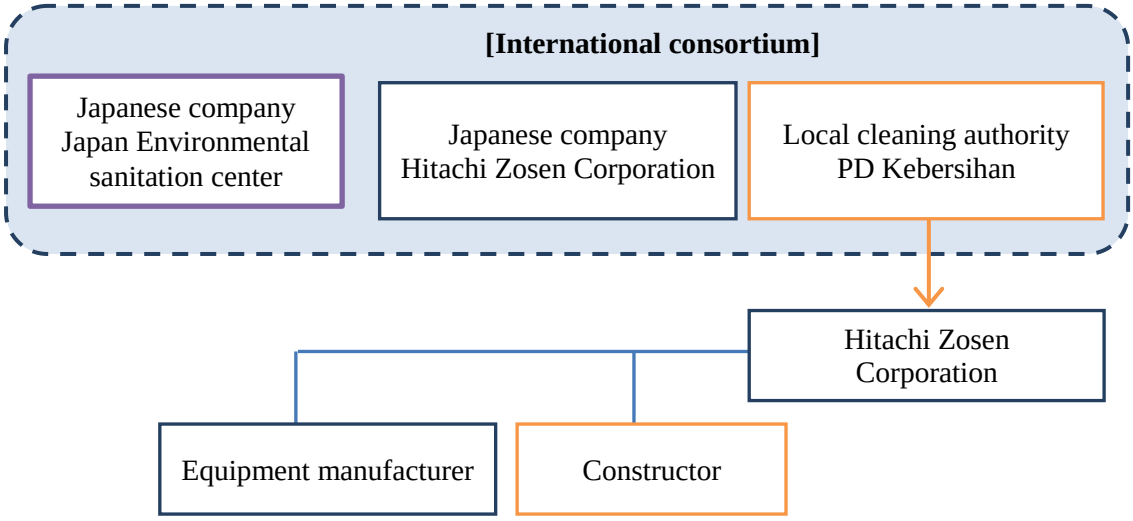
Changes in reduction in emissions in the decade (tCO_2)

Year	RE_y	PE_y	ER_y
1	1,342	208	1,134
2	1,927	208	1,719
3	2,421	208	2,213
4	2,837	208	2,629
5	3,188	208	2,980
6	3,485	208	3,277
7	3,735	208	3,527
8	3,946	208	3,738
9	4,123	208	3,915
10	4,274	208	4,066
Total	31,278	2,080	29,198

5.6.2 Study for preparation of PDD

5.6.2.1 Project implementation system and project participants

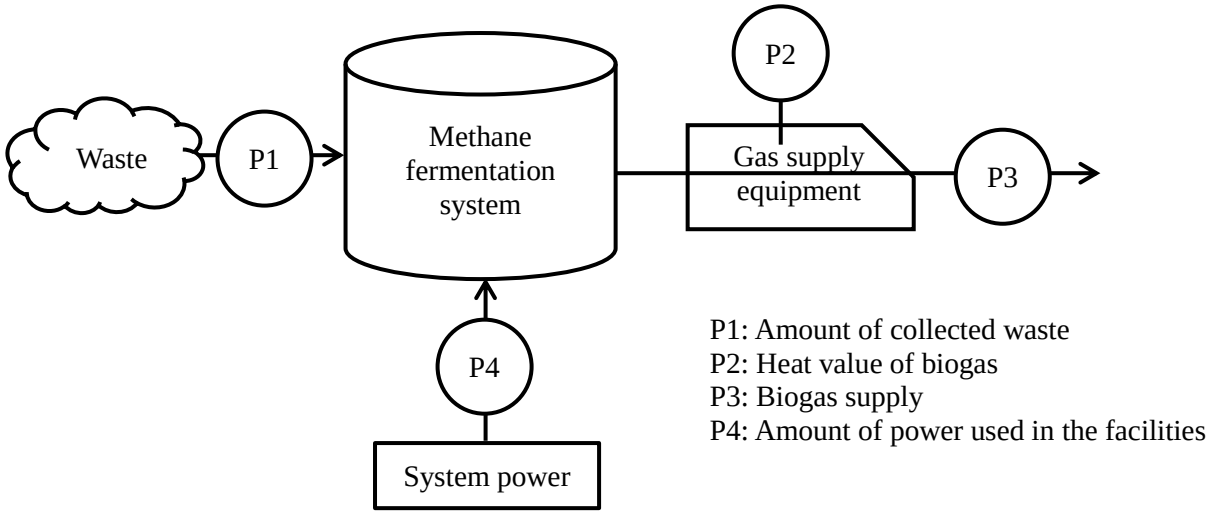
The following is the implementation system under consideration in this project:



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:



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

Annual revenue (10,000 yen)		Annual expenditure (10,000 yen)	
Waste disposal charges	240	Operation/management cost	800
Sales of biogas (electricity)	560		
Sales of liquid fertilizer	0		
Total	800	800	

(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.

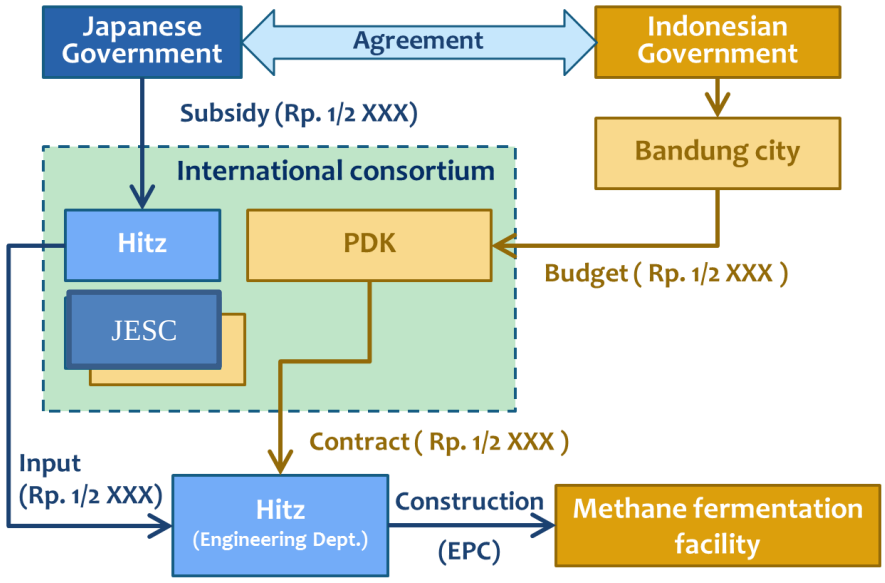


Figure 2: If PDK secures a budget by itself

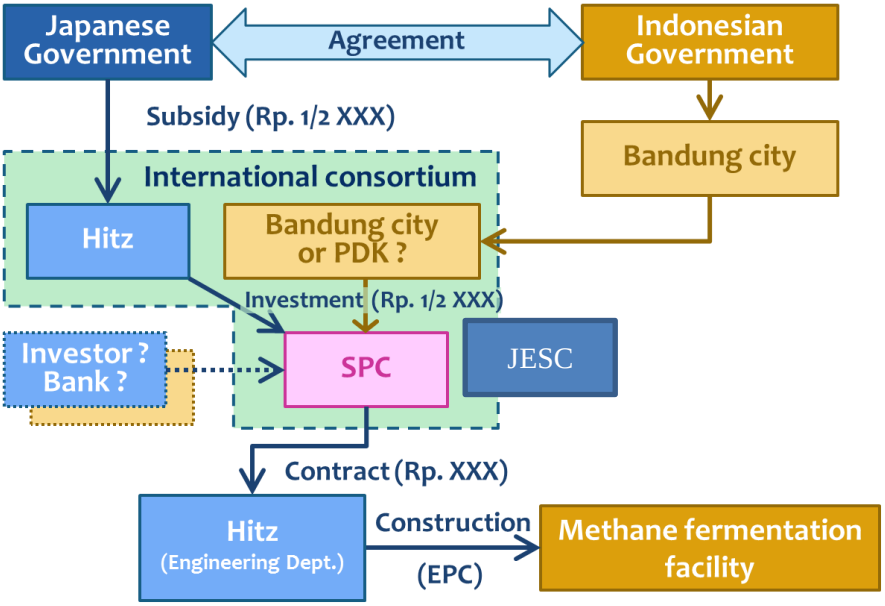


Figure 3: If PDK makes a joint investment with other enterprises

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 to 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

Ver. Aug 22th, 2014

Inception meeting of
Project for Developing a Low Carbon Society under
collaboration between Bandung city and Kawasaki city in Bandung, Indonesia
バンドン市・川崎市の都市間連携による
低炭素都市形成支援事業キックオフ会合
Agenda　**アジェンダ**

Date: August 25th 2014 9:00-16:30　　Venue：Unamuno-Lautze Room, Novotel Hotel Bandung
日時：2014 年 8 月 25 日 9:00-16:30　　会場：ノボテルホテル内　Unamuno-Lautze

Purpose 目的	Information exchange among FS stakeholders 関係者のキックオフ会合-JCM を進める上で必要な情報共有。
Participants 参加者	【Indonesia】Bandung city government, Bandung Institute of Technology (ITB), Indonesia JCM secretariat and others 【Japan】Kawasaki City , NTT Facilities Inc. , Japan Environmental Sanitation Center , Hitachi Zosen Corporation,　Japan International Agency (JICA) and Institute for Global Environmental Strategies (IGES) 【インドネシア】バンドン市政府、バンドン工科大学、インドネシア JCM 事務局他 【日本】川崎市、NTT ファシリティーズ（株）、（一財）日本環境衛生センター、日立造船（株）、（独）国際協力機構、（公財）地球環境戦略研究機関
Moderator モデレーター	Ms. Ayu Sukenjah, Head of Division for Environmental Rehabilitation, Bandung City アユ・スケンジャ　環境改善部リーダー、バンドン市
Language 言語	Translation will be provided for Bahasa <-> English,　Bahasa <-> Japanese バハサ語⇔英語、　バハサ語⇔日本語　の通訳有り

9:00-　Opening Remarks　開会の挨拶
- ✓ Mayor Ridwan Kamil, Bandung City Government (TBD) <language: English>
  リドワン・カミル、バンドン市長
- ✓ Satoru Yokota, Executive Director, Kawasaki Environmental Research Institute
  横田覚、所長、川崎市環境総合研究所 <language: Japanese>
- ✓ Mr. Akio Okumura, Chairman, Japan Environmental Sanitation Center
  奥村昭雄、会長、（一財）日本環境衛生センター <language: Japanese>

9:15-9:45　Overview of the Joint Crediting Mechanism (JCM) and Climate Change
<language: English>
二国間クレジット制度および気候変動の概要説明
- ✓ Mr. Dicky Edwin Hindarto (Head of Indonesia JCM Secretariat)
  ディッキー・エドウィン・ヒンダルト、事務局長、インドネシアＪＣM事務局

9:45-10:00　Recess 休憩

10:00-10:15　Overview of JCM Feasibility Studies <language: English>
- ✓ Ms. Ratu Keni Atika (Monitoring, Evaluation and Dissemination Specialist. Indonesia Joint Crediting Mechanism (JCM) Secretariat)
  ラトゥ・ケニ・アティカ、スペシャリスト、インドネシアＪＣM事務局

10:15-10:55　Introduction to Feasibility Study (1): Waste to Energy <language: Japanese>
FS のご紹介（1）
Topic: Descriptions of the technologies and data required for MRV
テーマ：技術概要と MRV が必要とするデータ
- ✓ Mr. Shigenobu Ohbayashi, Japan Environmental Sanitation Center
  大林重信、国際事業部長、（一財）日本環境衛生センター
- ✓ Mr. Hidemasa Kobayashi, Hitachi Zosen
  小林英正、水環境第一設計部長、日立造船株式会社

10:55-11:05　Q & A　質疑応答
- ✓ Dr. Priana Sudjono, Bandung Institute of Technology to moderate
  プリアナ教授、バンドン工科大学が進行

11:05-11:25　Introduction to Feasibility Study (2): Energy efficiency for streetlamps and buildings
<language: English>
FS のご紹介（2）　街灯および建物内省エネ
Topic: Descriptions of the technologies and data required for MRV
テーマ：技術詳細と MRV が必要とするデータ
- ✓ Mr. Naoki Ishitani, Director, NTT GP-Eco communication, Inc.
  石谷　直樹、ＮＴＴジー・ピー・エコ　株式会社　環境エネルギー部　課長

11:25-11:35　Q & A　質疑応答
- ✓ Ms. Ayu Sukenjah to moderate
  アユ・スケンジャ、環境改善部リーダーが進行

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

13:00-13:20　Sharing and scaling of low carbon development <language: English>
低炭素開発の都市間連携から望まれる知見の共有
- ✓ Dr. Eric Zusman, Principal Policy Researcher, Institute for Global Environmental Strategies
  エリック・ザスマン、上席研究員、（公財）地球環境戦略研究機関

13:20-14:05 Sharing of current status - Bandung City　バンドン市の近況報告 <language: Bahasa>

- ✓ City master plan, energy master plan, GHG emissions inventories, building energy efficiency,: Mr. Eric Mohamad Atthauriq, Head of Environment Management Board, Bandung City Government
  マスタープラン、エネルギーマスタープラン、温室効果ガスインベントリ、建物内省エネ：
  エリック・モハメド　アタウリク、環境運営委員会リーダー、バンドン市

- ✓ Street lightings plan : Dr. Bona Frazila Russ, Institute of Technology Bandung
  街路灯：　ボナ・フラジラ・ラス教授、バンドン工科大学

- ✓ Waste management plan: Mr. Cece Iskandar, Head of PD Kebersihan
  廃棄物管理計画：チェチェ・イスカンダル、バンドン市清掃公社　責任者

14:05-14:35 Green innovations for sustainable and low carbon society : from Kawasaki city to the world <language: Japanese>
低炭素で、持続可能な社会の構築のためのグリーンイノベーション：　川崎市の経験を世界へ

- ✓ Akira Ogihara,　Head of project and research section, Kawasaki Environmental Research Institute
  荻原朗、都市環境課　課長、川崎市環境総合研究所

14:35-14:45 Q&A　質疑応答

- ✓ Ms. Ayu Sukenjah to moderate
  アユ・スケンジャ、環境改善部リーダーが進行

14:45-15:00 Recess　休憩

15:00-16:15 Overall discussions and small group discussions 全体討議と小グループ討議
<language: English>

- ✓ Dr. Eric Zusman, Principal Policy Researcher, Institute for Global Environmental Strategies to moderate
  エリック・ザスマン、上席研究員、（公財）地球環境戦略研究機関が進行

16:15-16:30 Closing Remarks 閉会の挨拶 <language: Bahasa>

- ✓ Dean of Bandung Institute for Technology　バンドン工科大学　学長

Reception for Workshop Participants 懇親会
Date and time:　August 25th 18:30 – 20:00
日時：8 月 25 日 18:30～20:00
Venue: Novotel Hotel
場所：ノボテルホテル

Site visit and courtesy call 現地視察及び表敬訪問
Agenda アジェンダ

Date and time: August 26th 8:30-16:00　８月２６日 8:30-16:00
August 27th 9:30-12:00　８月２７日 9:30-12:00

Aug 26th 2014　8 月 26 日
To be divided into two teams – energy and waste　二チームに分かれて終日行動

Waste Team 廃棄物チーム

8:30- Depart hotel lobby ホテル・ロビーを出発

8:30-12:30 Waste to energy (biodigester) FS site survey
メタン発酵エネルギー技術（バイオダイジェスタ）の候補地視察
Thamansali Chihanpelas, near the zoo
タマンサリ・チハンペラス地区内の動物園横
Participants　参加者

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

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

14:00 - Discussions at ITB　ITB で打合せ

Energy Team　エネルギーチーム

8:30- Depart hotel　ホテル・ロビーを出発

8:30-12:30 Energy FS site survey (1)
エネルギー関連 FS の候補地視察　(1)

※ *To visit Bandung Indah Plaza, Hospital Borromeus, and the Nuclear Research Institute, BATAN*
バンドン・インダ・プラザ (ショッピング・モール)、ボロミウス病院、そしてバタン核研究施設を午前と午後に分けて視察

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)
IGES	Ms. Ryoko Nakano

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

13:45-15:45　Energy FS site survey (2)
エネルギー関連 FS の候補地視察　(2)
※ *To visit the remaining locations and also the LED streetlight panel board*
残りの候補地を訪問。

Aug 27th 2014　8 月 27 日

Japanese participants departing Bandung should check-out from the hotel in the morning.
当日出国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・イスカンダル　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

※ Return to hotel and after lunch some participants to depart for Sukarno Intl Airport
※ ホテルに戻り昼食後、当日出国される方々は空港へ向かう

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. Ogihara
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)
IGES	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、空港或いはジャカルタ市内へ向かう

Contact mobile phones　連絡先電話番号

Name 氏名	Cellphone 携帯電話	Notes 備考
Ms. Ryoko Nakano（中野）　IGES	+81-80-5898-7387	(Japan & Indonesia 日本及びインドネシアにおいて)
Dr. Sudarmanto Nugroho (トト氏), IGES	+62-0819-3222-2658	(Indonesia, インドネシア国内のみ)
Ms. Yoriko Itakura　(板倉) IGES	+ 81-46-855-3830	(Japan　日本)
Dr. Widyarini Weningtyas　(リニ氏) ITB	+62-817-9250225	(Indonesia, インドネシア国内のみ)
Mr. Jongga Jihann（ジョンガ氏）ITB　(	+628153809266	(Indonesia, インドネシア国内のみ)

Ver. Oct 23rd, 2014

「バンドン市・川崎市の都市間連携による低炭素都市形成支援事業」
国内視察　アジェンダ案

日時：10 月 27 日（月）15：00-17：00

14:00- 14:40-16:00 15:00-16:00 (16:00-16:30)	**NTT ファシリティーズ研究開発本部ビル　視察** ➢　パシフィコ横浜出発　（IGES が視察先まで同行） ➢　東京駅八重洲口タクシー乗り場にて集合　（移動） ➢　視察　（住所：東京都江東区新大橋 1-1-8） 　　質疑応答 【参加者】 　　アユ・スケンジャ　バンドン市環境局環境改善課長 　　荻原朗　　川崎市環境総合研究所　川崎市環境局都市環境課課長 　　田中将之　　NTT ファシリティーズ プロジェクト開発部　主査 　　石谷直樹　　NTT ジーピー・エコ 環境エネルギー部課長 　　スダルマント・ヌグロッホ（トト）地球環境戦略研究機関　研究員 　　中野綾子　地球環境戦略研究機関　主任研究員 【連絡先窓口】 　　NTT ファシリティーズ　田中将之 090-3131-1270 【緊急連絡先】 　　中野（携帯電話 080-5898-7387）トト（携帯電話 090-2803-5212）
16:30-	➢　パシフィコ横浜に向けて出発

アジアにおける低炭素都市形成セミナー（案）（公開）

主催：日本国環境省、共催：公益財団法人地球環境戦略研究機関（IGES）
日時：10 月 29 日（水）、会場：パシフィコ横浜 301
日英同通、席配置：スクール形式

13:00-13:30	登録
13:30-13:35 （5 分）	**開会** ➢　開会の挨拶：環境省地球環境局国際連携課国際協力室長　木野修宏氏（5 分）
13:35-15:25 （110 分）	**全体セッション１：　都市間連携を通じてアジアを低炭素化（パネルディスカッション）** ➢　発表： 　✓　都市間連携による幅広の支援について：アジア 8 都市の事例紹介（60 分） 　　✧　横浜市（バンコク都）（7 分）－ *横浜市温暖化対策統括本部 環境未来都市推進担当部長 吉野 議章 氏* 　　✧　川崎市（バンドン市）（7 分）－ *川崎市環境総合研究所 都市環境課プロジェクト研究担当 荻原 朗 氏* 　　✧　京都市（ビエンチャン特別市）（7 分）－ *京都市環境政策局環境企画部環境総務課・庶務係長 松本　純二氏* 　　✧　大阪市（ホーチミン市）（7 分）－ *大阪市環境局環境施策部都市間協力担当課長　泉 憲 氏* 　　✧　神戸市（キエンザン省フーコック島）（7 分）－ *神戸市環境局資源循環部環境貢献都市室 エネルギー利活用担当課長　金子 信一 氏* 　　✧　北九州市（ハイフォン市、パシグダン市、スラバヤ市）（15 分）－ *北九州市環境局環境国際戦略室 低炭素化センター担当部長 石田 謙悟 氏* ➢　討議（40 分） 　✓　大規模案件形成可能性調査を通じて見えてきた都市間連携の利点あるいは課題とは 　✓　海外自治体からのコメント（都市間連携の利点、課題、今後の展望） 　　【パネリスト】北九州市、ハイフォン市、大阪市、ホーチミン市、シェムリアップ市（アプサラ機構）、環境省、JICA、ファシリテーター（IGES 大塚） ➢　質疑応答（10 分）
15:25-15:55	休憩、写真撮影
15:55-16:55 （60 分）	**全体セッション２：　自治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排出量の定量化～（パネルディスカッション）** ➢　発表： 　✓　日本の自治体の低炭素行動計画の策定状況と排出量の定量化（環境省総合環境政策局）（10 分）－ *環境省総合環境政策局環境計画課課長補佐　浜島 直子氏* 　✓　大阪市―ホーチミン市の都市間連携の下で進められる都市版 AIM モデル（10 分）－ *国立環境研究所 社会環境システム研究センター 主任研究員 藤野 純一 氏* 　✓　自治体による排出量算定のための国際ガイドライン、自主的報告制度、自治体プラットフォーム（10 分）－ *一般社団法人 イクレイ日本 事務局長 岸上 みち枝 氏* ➢　討議（20 分） 　✓　低炭素化に向けて海外の自治体がすべきこととは（データ管理体制の構築等） 　✓　海外の自治体が低炭素化に向けた活動を行う上で期待する日本からの支援とは 　✓　JCM の枠組で行える支援、それ以外のスキームで行える支援 　【パネリスト】環境省、JICA、ICLEI、NIES、キエンザン省、バンドン市、ファシリテーター（IGES 塚本） ➢　質疑応答（10 分）
16:55-17:00 （5 分）	**閉会** ➢　閉会の挨拶：IGES 事務局長 塚本 直也 氏（5 分）

※パネル展示あり（@ホワイエ）　※写真撮影は JCM 関係者のみ

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“バンドン市・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バンドン市の政府職員を招聘し、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視察、および廃棄物管理に関する研修を実施し知見を高めていただいた。

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貰った。
- メタン発酵処理の結果、醸成されるメタンガス及び液肥の用途そして有望な販売先、販売方法を理解した。
- 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バンドン市においても日本同様分別回収する必要から川崎市の担当者から計画策定方法、関連する法令、市民の啓蒙活動の事例について学んだ。
- 日インドネシアの関係者が来年度の事業化に向けて議論し、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、し尿と浄化槽汚泥の処理を進める施設。加えて生ごみを受け入れ、し尿汚泥と合わせて発酵を行い、発生したメタンガスはボイラー燃料として場内や隣接する附属休憩所へ給湯し、発酵後の汚泥は「たい肥としてリサイクル」を行っています。地元に密着した小規模な施設で、バンドン市における日立造船の取組みに沿うものと期待された。

12月2日　新瀬波バイオマスエネルギープラントの視察

新瀬波バイオマスエネルギープラントでは今までは廃棄物処理されていた生ゴミや下水汚泥をバイオマスプラントにてメタンガスを作り出し「発電と温熱に利用」しています。バンドンにおいてもゴミ発電による収入が今回の事業のバ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た。

12月3日　関係者会合　議題

・「メタン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」

・「施設の管理運営主体に関すること」

12月4日　川崎市・IGESの一般廃棄物分別回収、市民啓蒙活動の研修

日付		行動予定	宿泊予定先
30-Nov	日	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	品川プリンスホテル Tel: 03-3507-0606
1-Dec	月	新潟市　廃棄物処理施設　視察 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	新潟第一ホテル Tel: 025-243-1111
2-Dec	火	新潟市　廃棄物処理施設　視察 9:30-11:30　新瀬波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	品川プリンスホテル Tel: 03-3507-0606
3-Dec	水	バンドン市のバイオダイジェスタ事業の協議 （場所：ＴＢＤ）	品川プリンスホテル Tel: 03-3507-0606
4-Dec	木	9:30-16:30　廃棄物関連業務の研修 （川崎市市庁舎　ＴＢＤ）	品川プリンスホテル Tel: 03-3507-0606
5-Dec	金	12/5　NH 836　30NOV　ジャカルタ 06:25-成田 15:45 (予定)	-

Kawasaki City's Efforts in Creating a Recycling Society

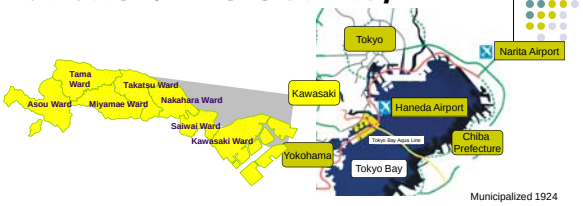
Kawasaki 3 R Promotion Character
"Kawarun"

December 4,2014

Waste Policy Section, Environment Bureau, Kawasaki City

1

Overview of Kawasaki City



Municipalized 1924

	Kawasaki City	Japan	Remarks
Population (April 2013)	1,440,474	126.66 million	Eighth among government decreed cities
Land area	144.35 km²	377,955 km²	Smallest among government decreed cities
Population growth rate (2000 to 2010)	14.05%	0.89%	Highest among government decreed cities
Average age (2011)	41.8	44.9	Youngest among government decreed cities

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.**

3

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

4

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)

Load packer
1960 - Today

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

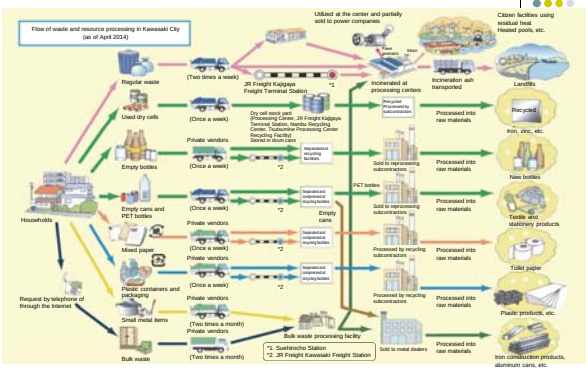
5

Changes in waste collection and disposal treatment by Kawasaki City (1970's ～ resent)

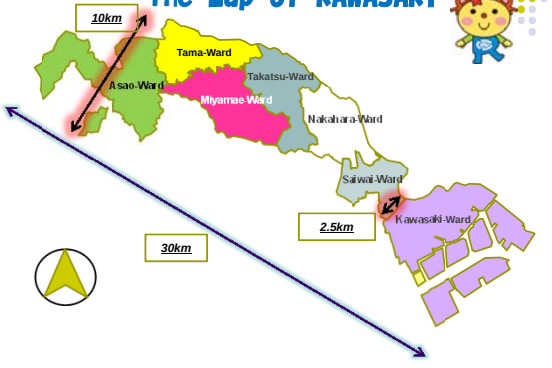
- Started empty can collection (1977- , started city-wide collection in 1998)
- Started used dry cell collection (1984～)
- Started empty bottle collection (1991 - , started city-wide collection in 1999)
- Started railway transportation of garbage (1995-)
- Started small metal collection (1997-)
- Started plastic bottle collection (1999- , started city-wide collection in 2003)
- 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 in2013)
- 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

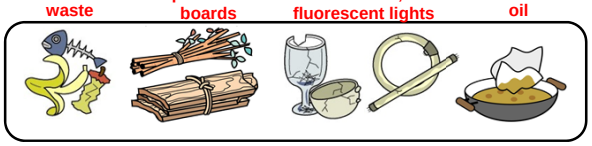


The map of KAWASAKI



Regular Waste (Combustible Waste)

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



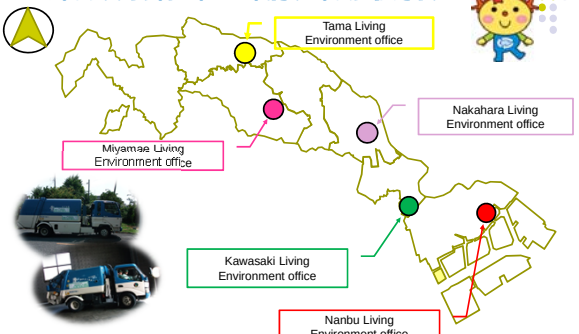
Twice a Week

9

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

10

Collection of household waste

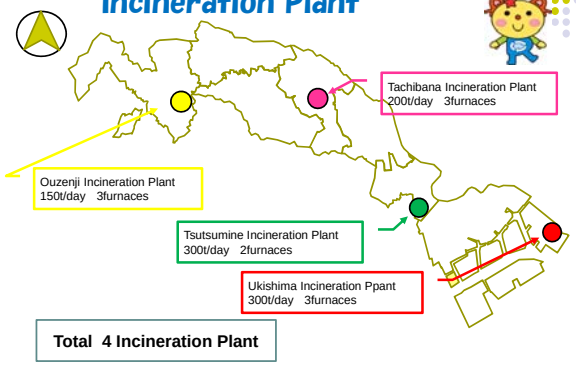


Total 5 Environment office

Garbage truck (packer vehicle)

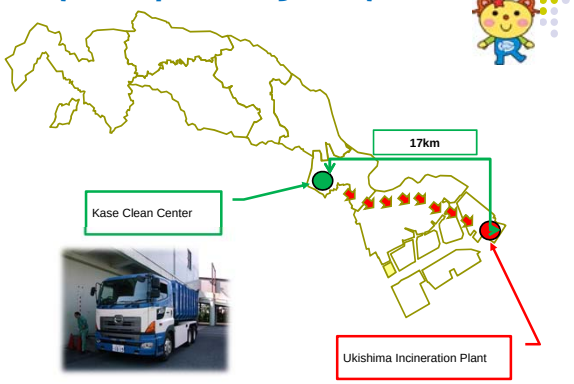
12

Incineration Plant



Total 4 Incineration Plant

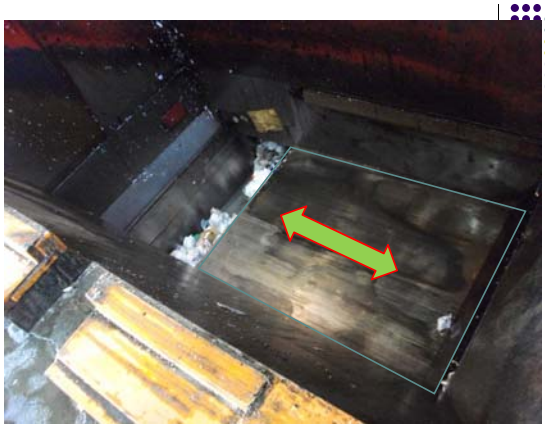
Relay Transport Using Heavy Trucks



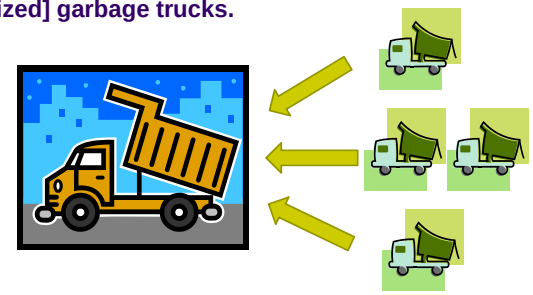
Kase Clean Center

- **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**

15



One container truck has a capacity equivalent to three to four [medium-sized] garbage trucks.



20

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

2

Transport Using Railroads
Freight Train [Clean Kawasaki]

Transportation by a Dedicated Train of 21 Cars Carrying 83 Containers

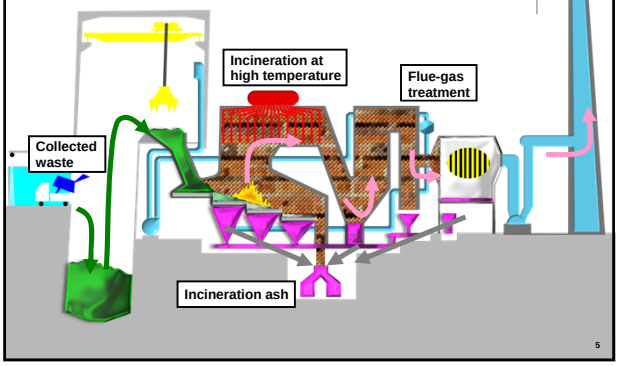
The train transports regular waste, incineration ash, and recyclables, and discharges them at two stations.
From there, they are transported by land using trucks for a short distance, and brought to incineration facilities, landfill sites, and recycling facilities, respectively.

3

The Subject of KAWASAKI

4

Flow of waste incineration in the waste incineration plant



5

Thermal disposal and Power generation

- As much as possible, it recycles, thermal disposal of what remained is carried out, and recyclables are reclamation.

Waste disposal track record

unit：t

Decreases to 1/8 by incineration

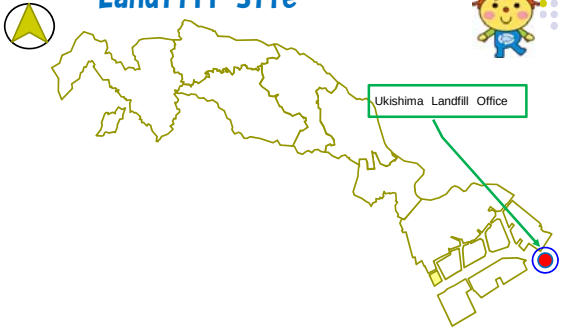
	Total amount of discharge	Recycled Quantity	Incinerated Quantity	Reclamation Quantity	Storage Quantity
2013	531,949	154,299	377,363	47,671	4,508

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

	Combustion capacity	Combustion furnace	Power generation equipment Maximum output
Ukishima Incineration Plant	900t／24h	3furnaces（300t／24h）	12,500kw
Tsutsumine Incineration Plant	600t／24h	2furnaces（300t／24h）	2,000kw
Tachibana Incineration Plant	600t／24h	3furnaces（200t／24h）	2,200kw
Ouzenji Incineration Plant	450t／24h	3furnaces（150t／24h）	7500kw

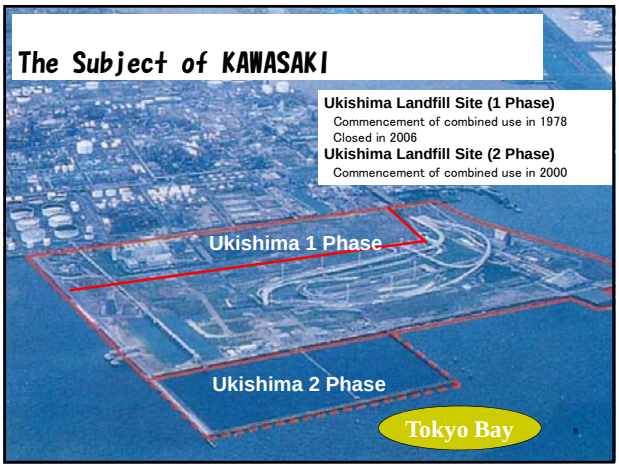
2013	Power Generation Quantity	Power Generation Quantity per ton	Electricity-sales-to-utilities efficiency	Electricity sales to utilities — quantity	Electricity-sales-to-utilities amount of money
	(kwh)	(kwh/t)	(%)	(kwh)	(X1,000yen)
Ukishima	36,953,144	211	7	26,145,468	366,934
Tsutsumine	4,997,890	111	3	—	—
Tachibana	7,222,320	124	4	517,450	6,835
Ouzenji	50,801,520	552	19	39,203,712	714,170
Total	99,974,874	(average) 249		65,866,630	**1,087,939**

Landfill Site



The Subject of KAWASAKI

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



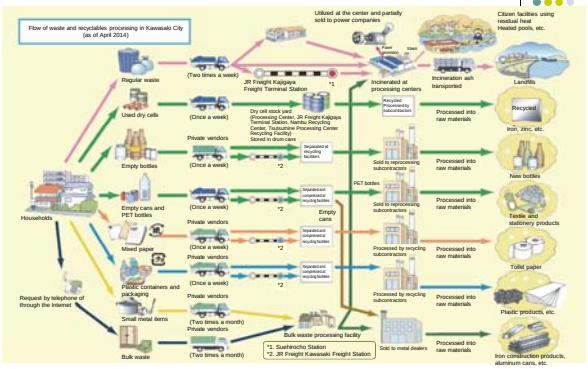
8

Activities concerning Recyclables

Once a Week

9

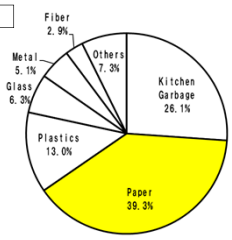
Waste and Recyclables Processing Flow



Citizen Waste Output Survey

2012 – Citizen Waste Output Survey

Household Waste



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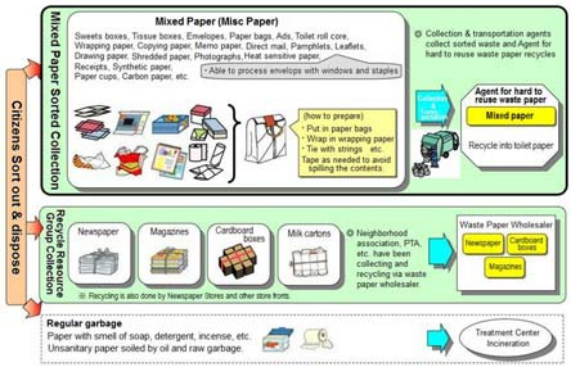
Flow of "Paper" Recycling Process



Scenery of "Mixed paper" collection

① Citizens judge and it takes out waste.

② Collection work（Privatization）

"Mixed paper" intermediate treatment

③ It carries in to an Resource Recycling Facility

④ It puts in a receiving conveyor

⑤ Foreign substance is removed by hand-sorting（Privatization）

⑥ Compression (baling)

"Mixed Paper Recycling"

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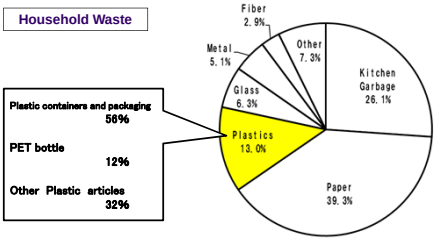
Citizen Waste Output Survey

2012 – Citizen Waste Output Survey



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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 Containers 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).

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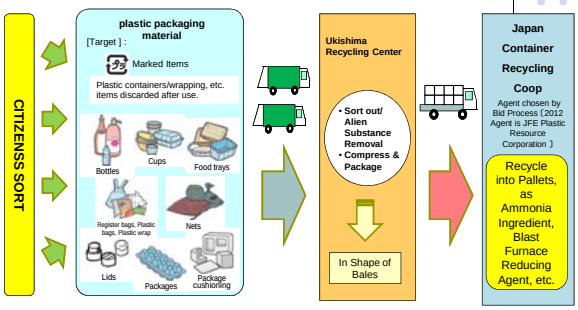
Flow of "Plastic containers and packaging" Recycling Process



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Scenery of "Plastic containers and packaging" collection

① Citizens judge and it takes out waste.

② Collection work（Privatization）

"Plastic containers and packaging" Intermediate treatment

③ It carries in to an Resource Recycling Facility

④ Foreign substance is removed by hand-sorting（Privatization）

⑤ Compression (baling)

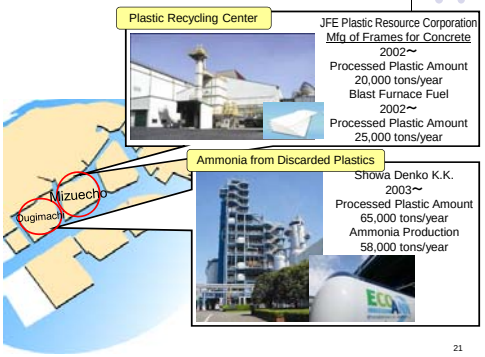
⑥ It Carries out to an Recycling Companies

"Plastic container and packaging" Recycling

The Japan Containers and Packaging Recycling Association:

Through bidding process to Recycling companies

Recycle into Pallets, Ammonia Ingredient, Blast Furnace Fuel, etc



Plastic Recycling Center

JFE Plastic Resource Corporation
Mfg of Frames for Concrete
2002～
Processed Plastic Amount
20,000 tons/year
Blast Furnace Fuel
2002～
Processed Plastic Amount
25,000 tons/year

Ammonia from Discarded Plastics

Showa Denko K.K.
2003～
Processed Plastic Amount
65,000 tons/year
Ammonia Production
58,000 tons/year

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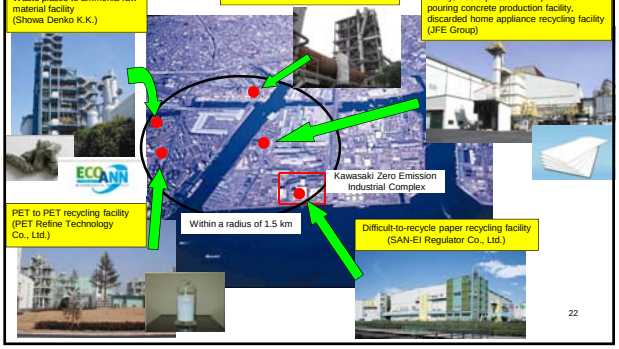
Kawasaki Ecotown Collection of Advanced Resource Recycling Facilities

Waste plastic to ammonia raw material facility (Showa Denko K.K.)

Recycled cement production facility (D.C. Co., Ltd.)

Waste plastic blast furnace recycling facility, waste plastic frame panels for pouring concrete production facility, discarded home appliance recycling facility (JFE Group)



PET to PET recycling facility (PET Refine Technology Co., Ltd.)

Difficult-to-recycle paper recycling facility (SAN-EI Regulator Co., Ltd.)

22

Kawasaki City's Plan for Processing Waste

23

The Subject of KAWASAKI
①The Superannuated Incineration Plant

Combustion capacity
600t／day
since A.D.1974

Combustion capacity
900t／day
since A.D.1995

Combustion capacity
450t／day
since A.D.2012

Combustion capacity
600t／day
since A.D.1979

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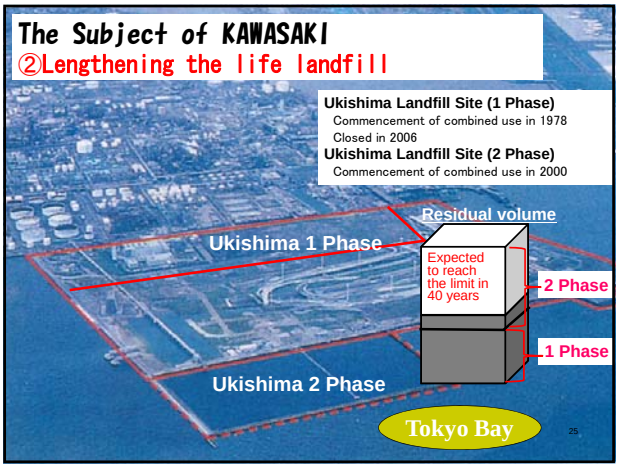
The Subject of KAWASAKI
②Lengthening the life landfill



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**
  - ① **Promoting efforts to reduce waste:** **Reduce waste produced by 180 grams per citizen per day.**
  - ② **Promoting recycling:** **200,000 tons of recycling for the entire city (35% recycling rate)**
  - ③ **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)

Understanding the Current Situation of the City

◆ Preparation of annual reports and outlines of activities (every year)

・Survey on waste composition
Composition of waste brought into incineration facilities is examined.

・Calculation of waste processing costs
Costs for processing waste and recyclables are calculated respectively.

◆ Citizen Waste Output Survey (Approximately every five years)
Composition of waste generated in households over one week is examined, with the cooperation of citizens who are selected randomly.

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

Information and Data for Preparing the Plan (2)

Understanding the Situations of the Country and Other Cities

◆ Developments concerning amendments of laws and enforcement of new laws

◆ Situation of other cities

◆ Trends in recycling technologies

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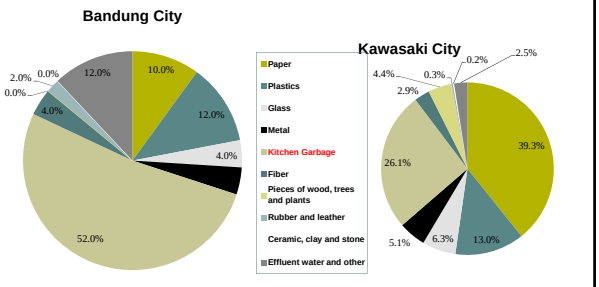
Comparison of Waste Composition



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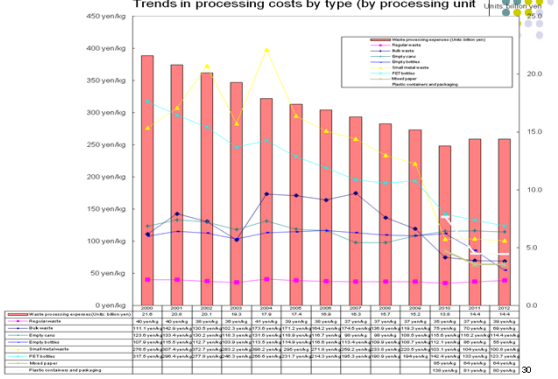
Trends in Waste Processing Costs



30

Main Efforts Based on the Plan

① **Starting a new separated waste collection system**

- Mixed paper
- Plastic containers and packaging

② **Changing the number of times regular waste is collected**

Changing from four times a week to two times in stages.

③ **Subcontracting work to private vendors**

Subcontracting the collection and transport of recyclables.

④ **Improving publicity**

Using characters, idol groups, lectures (over 1,000), and idea contests.

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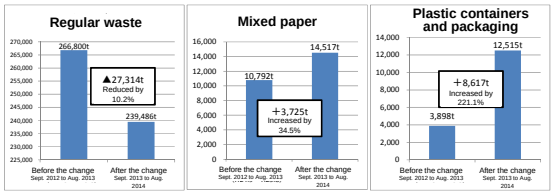
The Situation Before and After the Change in the Collection System in September 2013

Comparison of figures with the previous year, between the period after the change (Sept. 2013 to Aug. 2014) and before the change (Sept. 2012 to Aug. 2013)

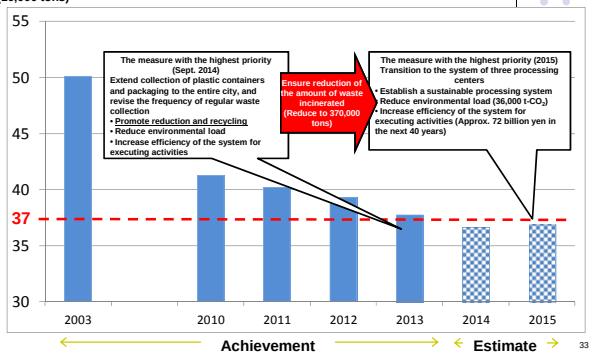
- **After the change in the collection system, the amount of regular waste was reduced by 27,314 tons, or approximately 10.2%, compared to the period before the change.**
- **In addition to plastic containers and packaging, for which collection was implemented in the entire city, the amount of mixed 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 and packaging collected. In total, there was an effect of reducing waste by 14,972 tons or by approximately 5.6%.**



32

The System of Three Processing Centers Has Been Enabled!!

Amount of waste incinerated (Waste from households and businesses) (10,000 tons)



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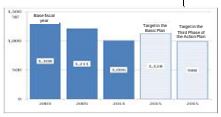
Results of the Plan (1) Status of Achieving the Goals

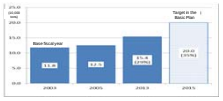
Goal 1 Promote reduction of waste generated

Base fiscal year FY2003 1,308 g
FY2013 1,006 g



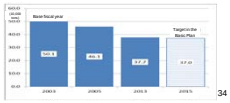
Goal 2 Promote recycling

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



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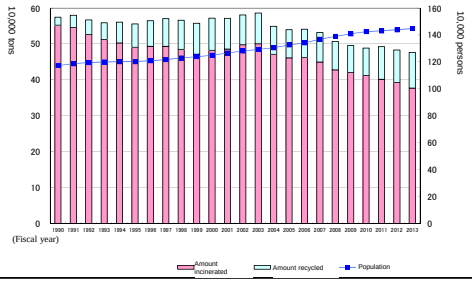
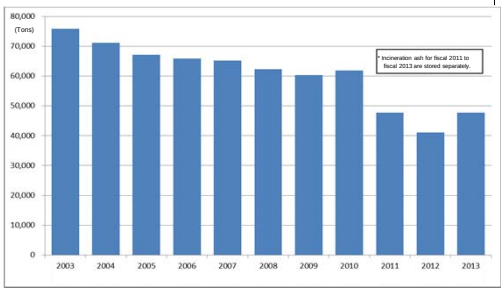
Results of the Plan (2) Trends in the Amount of Waste Discharged



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

35

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



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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.**

37

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!!

38

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

Thank you for your attention.

39

Public Information Activities for Promoting Waste Reduction and Recycling

Toward creating a sustainable recycling city that is easy on the global environment!

December 4, 2014

Waste Reduction Section, Environment Bureau, Kawasaki City

1

Introduction

● **The Transition in Separated Waste Collection**

Year	Activities Implemented
1938	The City started waste collection
1977	Started separated waste collection of empty cans
1984	Started separated waste collection of used batteries
1990	"Waste Emergency" declared
1991	Started separated waste collection of empty bottles
1999	Started separated waste collection of PET bottles
2004	Started charging for oversized waste

Year	Activities Implemented
2006	Started a pilot project for separated waste collection of mixed paper
2007	Frequency of ordinary waste collection changed from four days a week to three days a week
2011	Started city-wide separated waste collection of mixed paper Started separated waste collection of plastic containers and packaging (Kawasaki Ward, Saiwai Ward, and Nakahara Ward)
2013	Started city-wide separated waste collection of plastic containers and packaging Frequency of ordinary waste collection changed from three days a week to two days a week

3

Separated Waste Collection in Kawasaki City

Nine items and eight separation categories	Frequency of collection	Remarks
Ordinary waste	Twice a week	
Empty cans and PET bottles	Once a week	~ Recyclables ~ **Recycled as resources**
Empty bottles	Once a week	
Mixed paper	Once a week	
Plastic containers and packaging	Once a week	
Used batteries	Once a week	
Oversized waste	Twice a month	Metal goods that are not less than 30 cm and furniture not less than 50 cm in size, etc.
Small metal articles	Twice a month	Metal goods less than 30 cm in size, umbrellas, and coat hangers made of wire

* The City does not collect waste from businesses.

4

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.

Ward	Name of town	Mon.	Tue.	Wed.	Thurs.	Fri.	Sat.
Nakahara Ward	Kamishinjo, Shimokodanaka, Shimoshinjo, Shinjo, Shinjonaka-cho	Ordinary waste	Cans and PET bottles (Kulin, Aerosol)	Plastic containers and packaging	Ordinary waste	✕	Mixed paper
	Kamikodanaka, Miyauchi	Ordinary waste	Plastic containers and packaging	Cans and PET bottles (Kulin, Aerosol)	Ordinary waste	Mixed paper	✕
	Kamihirama, Kamimarukosanno-cho, Kamimarukohachiman-cho, Kitaya-cho, Shimonumabe, Tajiri-cho, Nakamaruko	Plastic containers and packaging	Ordinary waste	✕	Mixed paper	Ordinary waste	Cans and PET bottles (Kulin, Aerosol)
	Kamimarukotenjin-cho, Kosugigoten-cho, Kosugijinya-cho, Kosugi-machi, Shinmaruko-machi, Shinmarukohigashi, Todoroki, Marukodori	✕	Ordinary waste	Mixed paper	Cans and PET bottles (Kulin, Aerosol)	Ordinary waste	Plastic containers and packaging
	Ichinotsubo, Imaikami-cho, Imainaka-machi, Imainishi-machi, Imaiminami-cho, Kariyado, Kizukiise-cho, Kizukisumiyoshi-cho, Nishikase, Okura-cho	Cans and PET bottles (Kulin, Aerosol)	Mixed paper	Ordinary waste	✕	Plastic containers and packaging	Ordinary waste
	Ida, Idasanmai-cho, Idasugiyama-cho, Idanakano-cho, Kizuki, Kizukio-machi, Kizukigion-cho	Mixed paper	✕	Ordinary waste	Plastic containers and packaging	Cans and PET bottles (Kulin, Aerosol)	Ordinary waste

Public Information to Ensure that Rules of Sorted Disposal Are Followed

- Disposal of waste is an activity in everyday life and is related to all of the 1.46 million citizens.
- The City needs to ensure that citizens are informed of the rules of disposal, which are becoming increasingly complicated.
- The information must spread widely to citizens, although lifestyles are diversifying and also as citizens are diverse.
- Toward this end, multi-faceted public information activities are implemented using information media that citizens feel familiar with.
- In particular, appealing to groups with relatively low awareness, such as one-person households and the younger generation, is a challenge.

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 was selected from applications from the public.
- The name combines "*Kawa*" from Kawasaki and the "3Rs."
- The name incorporates the hope that waste is changed (*kawaru*) to recyclables, lifestyle changes (*kawaru*), and that Kawasaki City changes (*kawaru*) to a resource recycling city.

Kawasaki 3R Promotion Character

"Kawarun"

Introduction of "Kawarun"

- Personality: Very caring, and in particular, it cannot leave alone anyone who is confused about waste separation.
- Favorite phrase: *Mottainai* (Too good to throw away)
- Birthday: March 18
  The 18th letter in the alphabet is "R."
- Special talent: Remaking of secondhand clothing.
- Features: The three "R" shapes of its ears and the body represent the 3Rs.
  The ornament on the head is an azalea, which is Kawasaki City citizens' flower.
- Places where it appears: It shows up in places like flea markets and Kawasaki Eco Gurashi Mirai-kan.

Issuance of "How to Separate and Dispose of Recyclables and Waste"

- The City issues "How to Separate and Dispose of Recyclables and Waste" to inform citizens of the rules of waste separation in Kawasaki City.
- 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 sheet is placed in public facilities such as ward offices, and is given to those moving into the City, in principle.
- 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.

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)

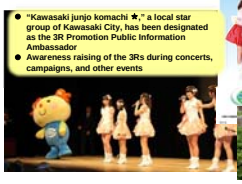
- Implementation of awareness raising activities during events such as the Citizens' Festival.
- Making use of "Kawarun."
- Awareness raising of the 3Rs through quoits, garbage separation game, and other games.

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.

3R 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 1,900 "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 opinions 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 in 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.

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

Thank you for your attention.

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バンドン市・川崎市における廃棄物研修

日時：2014 年 12 月 4 日（木）、9:30-17:00

場所：川崎生命科学センター(LiSE)　1 階大会議室

1. 開会の挨拶　－　横田覚氏（川崎市環境総合研究所長）

2. 国内研修

（1）市民と持続可能な消費行動　－　So-Young Lee 研究員（地球環境戦略研究機関(IGES)）

- アメリカの産業廃棄物は 76 億トン排出されており、家庭ゴミとビジネスゴミは 20 億トン廃棄されている状態にある。こういった中で、食糧と廃棄物は相関関係があると考えている。
- 持続可能ではない人びとの消費は、生産活動の中で問題が生じており、社会の産業化に伴い、廃棄物が増加するという矛盾が生じている。
- 廃棄物と食糧は「同じもの」と捉えている。生産過剰という経済活動の中から生み出されたものである。大量消費により廃棄物が大量に排出され、結果として地球温暖化がもたらされている。CO2 やメタンは地球温暖化をもたらす原因の 1 つである。特にメタンは家庭ゴミから排出され、CO2 を２５トン排出量に相当する有害ガスがメタンから排出され、気候変動をもたらしている。2012 年の日本におけるセクター別の CO2 排出量の割合を見てみると、家庭は直接的な要因として 5%、間接的な要因として 16%を占めている。家庭ゴミは、他の産業が排出する CO2 排出量と比べると多い。
- 世界のエコロジカルフットプリントによると、食糧（29%）や家庭内の消費量（16%）、交通（12%）、物品（12%）による CO2 排出量が多いという結果が出ている。このように、家庭内で消費されることで有害ガスが多く発生しているという事実を受け、市民の中に環境意識の高い人びとが増えている。このような人は「グリーンコンシューマー（グリーン消費者）」であり、環境に優しい、エコラベルがついている商品を購入するという行動をとっている。またこういったグリーン消費や消費者の購入選択を超えた概念として、持続可能なライフスタイルというものがある。
- この持続可能なライフスタイルは、こういった生活様式を好む人が、持続可能なライフスタイルのデザインを再考しながら進めている。たとえば、「エシカル消費」は、農家と消費者、そして生産者と消費者がお互いに便益があるように交易することであり、減農やオーガニックの商品を生産し、それを消費するというライフスタイルである。また「シェアリング」は、共有物をシェアして使うという行為であり、「責任ある廃棄物の排出」は、ゴミの排出量の削減を目指し、例えば肉の摂取を避け、ベジタリアンになるなどの行動を起こすことである。
- このような活動は市民が行うボトムアップのアプローチであるが、グローバルな視点からこういった活動を持ち上げようとする動きがある。例えば、リオの国際会議や持続可能な開発のワールドサミットなどにおいては、持続可能な消費生産ではない方法を変えることについてハイライトされたという事実がある。また、2011 年には UNEP がサステイナブルライフスタイルについて取り上げ、持続可能なライフスタイルにおける効率的な政策（日常生活を送る方法）について提案している。

さらに UNEP は先月、名古屋で開催された ESD の国際会議において、持続可能な消費と生産に関する 10 年と ESD（持続可能な開発のための教育）のスタンスについて提案している。また日本の環境省はプロジェクトとして、市民参加によるプロジェクト（カーボンバジェット）について考案している。このように社会の変革を通じ、自然環境とバランスよく生活できるような「環境」を作ることが求められる。

- Lee 氏は、これまでボトムアップの活動に関わってきた経験から、トップレベルからボトムアップのアプローチを組み込もうとしているところに興味がある。EU がまとめている持続可能なコミュニティの 10 か条の 1 つに「ゼロウェイスト」が挙げられている。これに対応する社会的なイニシアティブはバイオダイジェスターなどが考えられる。
- グローバルな視点からボトムアップな取り組みを展開するためには、政治的なリーダーシップやさまざまなアクターの連携、パートナーシップが重要である。

（2）川崎市の廃棄物政策について：事業系のごみの取り組みについて　－　郡谷武士氏（川崎市環境局生活環境部減量推進課指導係長）

- 日本ではリサイクル社会の創造に向けた法システムがあり、その中に廃棄物処理法などが位置づけられている。
- 日本における廃棄物は、大きく 2 つに区分されている。1 つ目は事業活動によって廃棄されたうち、国で定められた 20 項目を定めている「産業廃棄物」、もう 1 つは事業活動に伴い生じた廃棄物のうち、産業廃棄物意外の「事業系一般廃棄物」と一般家庭の日常生活に伴って生じた廃棄物の「家庭系廃棄物」を備える「一般廃棄物」である。産業廃棄物に区分されているのは、固形不要物、金属、ガラス、コンクリート、プラスチックなどで、廃棄の際は法律によって定められた事業者（営業許可を受けた事業者）に委託する必要がある。不適正な処理を行った場合は、環境負荷が大きいことから、さまざまな罰則規定が生じる。一般廃棄物においては、市町村が一般廃棄物の処理計画を定める必要があり、生活に負担のない状況ですばやく処理する必要がある。市町村ごとにその処理方法は異なる。

表：川崎市における廃棄物の分類

	分類（1）	分類（2）	概要
廃棄物	産業廃棄物	―	・事業活動に伴って生じた廃棄物のうち、法律で定められた 20 種類のもの
	一般廃棄物	事業系一般廃棄物	・事業活動に伴って生じた廃棄物のうち、産業廃棄物以外のもの
		家庭系廃棄物	・一般家庭の日常生活に伴って生じた廃棄物

[発表資料に基づき作成]

- 川崎市における事業系一般廃棄物処理においては、市独自では行っていないため、排出事業者もしくは営業許可を受けた事業者に処理委託の必要がある。委託処理を受けた事業所は、事業系一般廃

棄物を市の施設で焼却処理している。焼却灰は、市内の海面埋立処分場に埋立処分を行い、適正排出、保管場所などについてしっかりと議論し、清潔に保つことに努めている。しかし海面埋立処分場の延命化を考慮し、事業系一般廃棄物の廃棄量の減量をお願いしている。廃棄量の減量は、CO2排出削減にもつながり、持続可能な社会形成に大きな貢献となる。この事業系一般廃棄物の廃棄量減量に向け、川崎市では廃棄物搬入量をデータとして集積し、把握している。データは排出事業や収集運搬受託者から報告を受けているが、受託者が報告義務を違反した場合は、罰則が課せられるため、データの正確性が求められている。

- 一般廃棄物の減量化に向けた取り組みとして、「事業系一般廃棄物減量等計画書」というものがある。ここでは、紙くずや木材、生ゴミ・食品残さなど再利用できるものとそうでないものに区別し、事業系一般廃棄物の減量化に向けた取り組みが行われている。紙にリサイクルできる古紙においては、古紙回収業者や営業許可を受けた事業者に資源化を委託している。木材も営業許可を受けた事業者へ資源化を委託し、燃料チップなどへのリサイクルを可能としている。食品残さも同様に、市が営業許可を出した事業者に資源化を委託し、家畜の飼料や堆肥などへのリサイクルを行っている。ただし、動植物残さは産業廃棄物となるため、一般廃棄物としては処理できない。
- 日本の食品残さ（食品ロス・フードロス）は、年間 500 トンから 800 トン発生（2013 年度の米収穫量と同等な量）している状況にある。食品リサイクル法によって状況改善に努めている。食品リサイクル法では、国において再利用量の目標値が定められている。食品関連事業者の業種別にその目標値が定められており。それを食品関連業者に課している。食品関連業者はその取り組み状況について、国への報告義務がある。2011 年末時点で、食品リサイクルを可能とする再生量事業者数（国への登録ベース）では、208 業者となっている。
- このような廃棄物の状況を広く認識してもらうため、川崎市では事業者を対象とした啓発活動をおこなっている。具体的な取り組み内容としては、(1)事業系一般廃棄物の処理方法や減量化に関する取り組み事例などを市のウェブサイト上に掲載する、(2)事業系一般廃棄物の処理方法や減量化手法、事業系一般廃棄物多量排出事業者制度の概要など事業者向けのマニュアルの作成と配布、(3)事業系一般廃棄物多量排出事業者を対象とした説明会を行い、事業系一般廃棄物の減量化に関わる国レベル・自治体レベルでの取り組み状況や取り組み事例の紹介などを行っている。

質疑応答

- Ayu 氏（バンドン市）：川崎市は公立小学校においてどのように環境教育を実施しているのか。どのように装置を管理し、コントロールしているのか。学校はどこにゴミを収集しているのか。
  - 郡谷氏（川崎市）：このプロジェクトを開始するにあたり、装置の使用方法を学校の先生に教え、その後先生が装置の管理をしている。生徒は給食から出た食品残さを集め、装置で堆肥を作っている。この堆肥は学校の花壇に使用しているため、生徒はすべての工程を学ぶことができている。
- Ayu 氏（バンドン市）：電池などの危険な廃棄物はどのように処理しているのか
  - 木下氏（川崎市）：電池にもいろいろな種類がある。自治会で週 1 回回収し、それを事業者が回収することになっている。リチウムとボタン電池は市では回収できないので、消費者が電気店に持ち寄る必要がある。川崎市では蛍光灯を回収していないが、市民が定期的に持ち寄ることができる回収場所はある。そこに回収された蛍光灯は事業者が回収する
- Piana 氏（バンドン市）：どのようにして産業廃棄物処理を教育したのか、また年間の予算はどのくらいなのか。
  - 郡谷氏（川崎市）：川崎市は企業を対象としたセミナーを開催している。主な内訳は、発表者の謝金と交通費、セミナーの会場費などである。年間予算は 150 万円。
- Lia 氏（バンドン市）:持続可能なライフスタイルについて、廃棄物と食糧の関係性について発表があったが、その他に、衛生や住宅も持続可能な消費に関係するのではないか
  - Lee 研究員（IGES）：フードロスをなくすことで廃棄物の削減につながるという事例を今回発表したが、国によってこの状況は違うと思う。もしインドネシアが大気汚染に対する関心が高いのであれば、それに特化した生活スタイルに変えていく必要があると思う。持続可能な消費へのマインドチェンジが必要だと思う。人間と自然との関係性や人間と地球との関係性についてどうチェンジしていくのかが重要になってくると思う。
- Caca 氏（バンドン市）:質問は 3 点ある。1 点目は、日本では産業廃棄物と一般廃棄物があるが、一般廃棄物における行政の役割と、行政と民間企業との関係性について知りたい。2 点目は、ゴミ処理業者は、事業者としての利益を生み出しているのか。また利益はどの程度上げることが可能なのか。特に産業廃棄物については、行政が公益企業として処理していることがあるのかが知りたい。3 点目は、バンドン市では 3R に関する民間企業はない。処理施設の建設等について川崎市から支援をもらえると助かる。このことは市長から言付かってきている。
  - 郡谷氏（川崎市）：１つ目の質問について、廃棄物の処理を適切に行う必要があることが法律で定められている。一般廃棄物の処理責任は市町村にある。最終的な処理責任を市町村が負うというイメージである。事業ごみは事業者に責任があるが、それ以外のゴミの処理は、行政に責任がある。２つ目の質問である「廃棄物処理業者の利益」については、処理業者がどの程度利益を出しているのかは定かではない。しかし行政が事業者に対して営業許可を出す段階で、財務状況を行政で確認している。そういった意味では経営困難な事業所はいないと思う。
  - 横田氏（川崎市）：補足として、産業廃棄物は排出者に責任があると考えている。法律に定めた方法で処理しない場合、大きな罰則規定がある。ある程度費用がかかったとしても、適切に処理できる委託業者にお願いするため、費用がかかるという点は、排出業者が大きな負担を追うことになる。また処理業者は採算があう状態で処理を進めているため、一定の利益はあると思う。川崎市には収集だけの事業者（許可を受けた事業者）が 120 社くらい存在する。2 点目の「行政で処理できる施設がないのか」という点においては、処理できる施設はある。川崎市の場合、焼却施設では産業廃棄物を受けていない。埋め立て処分場は、零細・中小企業の廃棄物を一部受けている。かつては民間の処理企業を育てるという意味で、市と民間が共同で埋め

立て場を作ったという経験がある。作った当初は大きな民間施設がなかったが、その後大きな民間施設ができてしまい、採算があわなくなり、解散してしまった。3 点目の「バンドン市への建設支援」については、多額の海外援助を市が単独で行うのは難しい。たとえば JCM の事業や JICA の事業をつかって、支援を受けた方が現実的かもしれない。ただし川崎市のノウハウや経験などの知見の共有は、十分できると思う。

- Galih 氏（バンドン市）:川崎市では食物残さを飼料化しているという話があったが、川崎市内に畜産業はあるのか。また飼料化するという意味は、畜産物に食物残さを直接与えるという意味なのか、それともなにか加工をしたものを畜産物に提供しているのか。
  - 郡谷氏（川崎市）：畜産業の数は把握していないが、畜産業は川崎市にもある。飼料化についてはいろいろなアプローチがあるが、その 1 つとして生ゴミを油であげ、乾燥させて、飼料化して活用しているところがある。
- Galih 氏（バンドン市）:食品残さを油で揚げるというのは、廃油で揚げているのか。コスト面からは考えられない
  - 郡谷氏（川崎市）：廃油では揚げていない
- Riela 氏（バンドン市）:公園墓地担当する部署のものであるが、バンドン市でも緑地を 30%引き上げるという目標をたてている。川崎市における木質の廃棄量はどの程度あるのか。
  - 郡谷氏（川崎市）：現在の処理は、ほぼすべて市のごみ焼却場で処理している。なるべく資源化をしようと試みている
- Fiqrina 氏:バンドン市においても多くの剪定ゴミがでる。バンドン市ではそれらを焼却処理するのではなく、ペレット化という形で処理している。ペレットの形にしてその後、再生紙材料にするのか、燃料にするのか、という原料としてのペレット化をしている。川崎市と協力し、ペレット化したものを再資源化して、民間企業に販売して、利益を得るということを行っていきたい

（3）バンドン市の廃棄物処理の現状　－　Cece Husein Iskandar（バンドン市清掃局長）

- バンドン市の中間人口が 300 万人のバンドン市では、ゴミ処理を中期（2014 年～2018 年）、長期（2005 年から 2025 年）の 2 段階で実施を予定している。中期では 3R を 30%、廃棄物によるエネルギーを 35%、埋め立て地を 25%まで増やすなどの目標を掲げている。長期計画でも似たような数値を掲げ、環境に優しい技術処理を目指している。
- 条例によるゴミ処理は、3 R のゴミ収集所でのゴミ収集や道ばたのゴミ処理も 3 R に乗っ取って実施するなど、技術的な観点から実施し、衛生的にゴミを運搬し、埋め立てることを目指している。
- バンドン工科大学の調査によると、バンドン市から排出されるゴミの内容は、住宅が最も多い（65.5%）。青空市場（18.7%）や道ばた（5.5%）、商業施設（6%）、公共施設（2.8%）、産業（1.3%）からも排出されている。これらを平均すると住宅分野では有機 50%で非住宅分野では 48%、非有機では、住宅分野は 44%、非住宅分野は 52%となる。1 日平均の 1100 トンの廃棄物は、処分場に持っていく。その他の 200 トンの廃棄物は、ゴミ収集を職業とする人びと（インフォーマルセクター）が個別に集めて持っていく。
- ゴミ収集方法に関しては、住宅地では住民自身がゴミステーションに持っていき、清掃公社がゴミを回収し、最終処分地に持っていく。住宅地以外の道路上のゴミは、清掃公社の責任で実施している。市場や商業施設のゴミは、設置責任者が責任をもって収集し、ゴミ収集場に持っていく。
- 清掃公社が持っている施設や設備としては、ゴミ収集のトラックや剪定ゴミを収集するトラックなどがある。小型の車輌やパトロール（監視用）、有機ゴミの破砕施設、コンポストの容器なども持っている。バンドン市が管轄する地域には、162 のゴミ収集ステーションがあり、3 R 施設は 10 カ所。圧縮機を持っているところは 2 カ所ある。その他、分別ごみの施設、大きなゴミ収集箇所、最終処分地などがある。
- 2 カ所ある圧縮機施設のゴミ収集ステーションは、公共事業所の支援をうけて運営している。収集頻度を減らすことが目的となっている。この圧縮施設では、4–5 トンだったゴミが圧縮され、1 回で 8 トン（圧縮前）くらいを回収することが可能となった。
- 3R のゴミ処理施設では、破砕機やコンポストを持っている。以前は最終処分場だった施設も現在では 3 R の機能を備えている。また 3 R の機能を持つ施設では、バイオダイジェスターでメタン発酵し、そのメタンガスを調理に使っている。バイオダイジェスターは 3 カ所の収集所に設置している。自治会には小規模ながら 6 カ所設置されているが、今後増設予定としている。
- エコビレッジと位置づけられているタマンサル地域には、今後、日本からの支援を通じて大規模なバイオダイジェスターを設置予定となっている。ゴミは地域周辺のものを回収する予定となっている。
- バンドン市内にある最終処分地は、バンドン市内から 45km 離れたバンドン西部に位置し、約 25ha の規模である。1 日当たり 1100 トンほどのゴミが持ち込まれている。このような状況下において、民間支援を受けた住民参加型の廃棄物管理が行われている。
- ゴミ処理方法の今後の予定として、ゴミ収集ステーションにゴミを持ち込んでもらい、有機と非有機に分別していきたいと考えている。有機ゴミはバイオダイジェスターへ、そして非有機ゴミはゴミ銀行に持っていき、再利用していきたい。もう 1 つの予定としては、分別をゴミステーションではなく、家庭や企業がステーションに持ち込む前に分別してもらえるような形にしていきたい。

（4）バンドン市のマスタープランについて　－　Ayu Sukenjah 氏（バンドン市環境運営委員会副リーダー）

- 住宅のゴミ回収サービスは、中間処理施設が回収し、最終処分場へ持っていく。商業施設の場合は、直接処分場へ持っていく方法と、中間処理施設から最終処分場に持っていくなどのいくつかのパターンがある。道路・公共施設のゴミに関しては、清掃公社の責任で回収し、最終処分場へ持っていくという方法がとられているのが現状である。
- バンドン市における有機ゴミは 63%の排出（公園が 15%、食物残さが残りの割合）、非有機ゴミは 23%、その他のゴミは 14%の排出量である。ゴミ処理方法としては、公園ゴミはコンポスト、食物

や市場のゴミは飼料や生物的な処理、非有機ゴミはリサイクルなどが考えられる。有害ゴミについては、特別な処理が必要であり、残りのゴミについては、分量を削減するというような処理方法が考えられる。

- 2015～2035 年の廃棄物管理のマスタープランについては、短期的な目標と中長期的な目標を掲げている。短期的な目標としては、地域の最終処分場の有効活用（1 日あたり 1000 トンの処理）や有機ゴミのソース別の処理量の増加やツールの検討、そしてゴミ運搬の負担抑制などである。中長期的な目標については、1 点目は有機ゴミの処理を都心部において大きくするなどであり、日常的に 200 トンから 300 トンに処理量を増やしていきたいと考えている。2 点目は、搬送する量を少なくする搬送の負担軽減である。現時点では都心部のゴミを都心部から 45km 搬送している状態であるが、それを都心部で処理できるようにしていきたい。今後は、最終処分場に持っていく量を軽減させ、都心部で処理する量を増加させ、家庭での処理も行っていくようにしていきたい。また、地域で処理できるように努めて行きたい。
- 2015 年～2016 年の短期的な計画では、ミックスの廃棄物を中間処理施設において圧縮し、処理量を少なくして、最終処分場に持っていくという計画を立てている。またゴミの種類によって処分方法を変えていく予定である。短期的に取組みたいこととしては、どのようにゴミの分別をしていくのか、それに対する規制や制度を定めていきたい。またゴミを処理し、中間処理場にどのように持っていくのかといった規制やコスト面、そしてゴミ処理することによるインセンティブを規制する内容を盛り込みたいと考えている。中期的・長期に取り組みたいこととしては、プラスチック袋に対する見直しやビル・建物についての規制、緊急事態に対する規制、廃棄物削減、パッケージングから出る有害物質をどう削減し、量を削減していくのかということを検討していきたい。
- バンドン市のマスタープランは、さまざまなステークホルダーからのインプットをもらい、過去 2 年間検討してきた。川崎市からもインプットをもらいながら、来年には市議会にかけたいと考えている。

（5）川崎市の廃棄物政策について：家庭系のごみの取り組みについて　－　木下佳也氏（川崎市環境局生活環境部廃棄物政策担当　担当係長）

- 川崎市における廃棄物に関する取り組みの役割としては、一般廃棄物の収集と処分、そして一部の事業系廃棄物の焼却と埋め立てなどである。家庭ゴミと称される家庭系一般廃棄物は、川崎市では 1955 年からゴミ収集を開始している。1961 年からは衛生的な環境を保つため「毎日収集」という形で焼却を行っていた。その後、高度成長期に伴う大量消費大量生産により、市が所有する施設では処理できなくなる状態に陥り、1990 年にゴミ非常事態宣言を発令した。非常事態宣言後、川崎市では 3R という考え方を推奨し、空き缶や乾電池などの分別から取り組みを開始した。
- 現在のゴミを 8 つに分別している。川崎市内にはゴミ収集施設が 5 カ所、焼却所が 4 カ所、中継施設が 1 カ所ある。ゴミの中継施設は、大きなトラックでゴミを運搬するための施設であり、小さいゴミ収集車が 4 台で運搬してきた量を 1 つのトラックで運ぶことができる量までゴミを圧縮することができる。また鉄道を使ったゴミ輸送もある。臨海部に埋立場が 1 カ所あり、中継施設から 83 個のコンテナを 21 両編成でまとめて運んでいる。
- 4 カ所ある焼却場では、年間 53 万トン焼却している。リサイクルできるものは極力リサイクルし、リサイクルできないものは、焼却処分して埋め立てるという方法を行っている。その結果、1/8 のゴミの埋立量が 1/8 まで減量した。
- 川崎市では、ゴミ・資源の回収を 8 分類にして行っている。なかでも市民による紙類のゴミ排出量が全体の 40%を占めている。紙類はさらに 3 つに分類している。市民主体で集めた古紙を直接古紙回収会社に引き渡す「資源集団回収」は、市が助成金を出すことにより市民が積極的に実践してもらえるような環境づくりを心がけている。汚れた紙などは「普通ゴミ」として焼却処分され、リサイクルに向かない商品を対象とする「ミックスペーパー」は、収集運搬業者が分別回収し、別途リサイクル業者がリサイクルを行う。またプラスチック類のゴミについては、1995 年に定められた容器包装リサイクル法に沿って、カップやボトルなどに分類してもらい、それを市が回収し、日本容器包装リサイクル協会に渡して適正にリサイクルしてもらうという形をとっている。
- 川崎市には「川崎エコタウン」と呼ばれるリサイクル技術を持つ企業が集約されている場所がある。市内にこのような企業拠点があることで、ゴミの運搬費用を抑え、適切にゴミ処理を行うことができている。
- 廃棄物事業における課題としては、(1)老朽化する焼却場、(2)埋立処分場の延命化がある。稼働しているゴミ処理施設を停止させることなく、施設修復を行う必要性や埋立処分場の容量期限を可能な限り延命する必要があるなどの課題を解決するため、ゴミの排出量やリサイクル、焼却廃棄量の削減を目指す一般廃棄物のマスタープラン（かわさきチャレンジ３R）を策定した。この計画づくりにあたり、毎年年報や事業概要の作成や市民のゴミ排出実態調査を定期的に行うなどしながら、川崎市の現状を理解するとともに、計画のベースを作成する。また国や他都市の状況を知ることも計画づくりにおいては重要や要素として位置づけている。
- バンドン市と川崎市のゴミ排出量の状況を見てみると、川崎市は紙類の排出量が多いが、バンドン市はキッチンから排出される廃棄物量が多いという状況が見える。川崎市ではゴミの分別化やゴミ処理業務のアウトソーシング化により、ゴミ処理にかかる経費が 216 億円から 114 億円まで削減することができた。
- マスタープランに基づく活動では、ゴミの新しい分別方法として、発生抑制のインセンティブとしてゴミ回収頻度の減少や民間事業者への委託化といったことを定めている。結果として 15000 トンの発生抑制の効果が見られた。またゴミ焼却場の修復に関しては、市内 4 カ所にある焼却場のうち、3 カ所を稼働させながら、1 カ所を立て直すという方法を取ることにした。このアプローチを通じて焼却ゴミの量を 37 万トンの削減達成を目指している。
- ごみ量の推移は川崎市の場合、人口の増加とゴミの排出量の増加は反比例である。人口が増加してもごみの排出量は減少している状況にある。また埋め立て処分場に投棄されるゴミの量も順調に減りつつある。

- 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な状況にある。長期的な計画を策定するため、市民の意見などを回収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減量推進課普及広報係長）

- 川崎市では 1999 年にゴミ非常事態宣言を出し、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 42000 カ所の集積場があり、現在は 8 分別 9 項目で実施している。リサイクルゴミは週 1 回の頻度で回収を行っており、リサイクルゴミを含め他のゴミも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。
- 市民の身近な広報媒体を活用し、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低いと考えていることから、ゆるキャラを活用し、イベントなどに参加し啓発活動を行っている。そこでは来場者がゆるキャラと一緒に写真を撮り、SNS などに写真をアップしてもらえるように心がけた活動展開や、川崎市のご当地アイドルを大使に任命し、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 3R 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「廃棄物減量指導員」を設け、地域の環境美化を推進している。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

廃棄物区分	ゴミの種類	ゴミ処理方法	ゴミ処理責任	規則	関連制度
産業廃棄物	・【廃油】 ・【廃プラスチック類】 ・【金属くず】 ・【ガラスくず】 ・【コンクリートくず】 ・【陶磁器くず】 ・【動植物性残さ】 ・【その他法令で定める 15 種類】	・【運搬・処分】行政から営業許可を受けた事業者に委託	・産業廃棄物を排出した事業者	・【委託契約書】書面作詞江し、法令で定められた事項を記載 ・【産業廃棄物管理票】産業廃棄物の排出時に必ず作成・交付	―
事業系一般廃棄物		・【収集・運搬】排出事業者ないしは行政から営業許可を受けた事業者に委託 ・【処理方法】市の処理施設にて焼却処分し、焼却灰を海面埋立場に埋立処分	・市町村	・【遵守事項】(1)可能な限り資源化を行う、(2)産業廃棄物を混入しない、(3)事業者への運搬委託の場合は、保管場所や収集時間、排出方法等について十分協議し、適正排出に努める、(3)保管場所の清掃を行い、清潔を保持する	・一般廃棄物処理計画 ・事業系一般廃棄物多量排出事業者（1 日平均 100kg 以上または月平均 3t 以上） ・事業系一般廃棄物準多量排出事業者（1 日平均 30kg 以上 100kg 未満、または月平均 0.9t 以上 3t 未満）
	・【リサイクル・資源化ゴミ】(1)古紙、(2)木くず、(3)生ゴミ	・【古紙】古紙回収業者ないしは行政が営業許可を受けた事業者へ資源化を委託 ・【木くず】行政が営業許可を受けた事業者へ資源化を委託 ・【生ゴミ】行政が営業許可を受けた事業者へ資源化を委託		・【義務】(1)行政から営業許可を受けた事業者に委託すること、(2)受託者からの再委託行為は禁止、(3)収集運搬車事業者の名義貸しは禁止→違反行為は廃棄物処理法により罰則 ――	――
家庭系一般廃棄物	・【可燃ゴミ】(1)生ゴミ、(2)小枝、(3)ガラス・陶器類、(4)廃食油 ・【使用済み乾電池】 ・【空き瓶】 ・【空き缶・ペットボトル】 ・【ミックスペーパー】 ・【プラスチック製容器包装】 ・【小物金属】 ・【粗大ゴミ】	・市による収集・処理・処分 ・【ミックスペーパー】収集運搬業者が分別回収し、古紙業者がリサイクルする ・【資源集団回収】自治会で回収し、古紙問屋ルートでリサイクル ・【可燃ゴミ】市が回収、処分 ・【プラスチック製品】自治体により回収、市が収集し、日本容器包装リサイクル協会にてリサイクル	・市町村	――	――

［発表資料に基づき作成］

質疑応答

- Lia 氏（バンドン市）：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市に欠けているところだと思う。3R はバンドン市も実践しているが、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態にある。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（川崎市）：川崎市の 3R は、大きなところでは「リサイクル」という位置づけで分別している。その中で有機包装リサイクル法（事業者の責任、拡大者責任）の履行を果たしている。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。また企業がリサイクルを果たすという意味では関連協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

いる

- Cece 氏（バンドン市）：バンドン市としては驚いた。バンドン市は政策面においても 20 年後の 3R は 40%まで高めることを掲げているが、現状では難しい気もする。川崎市の場合は、政策支援に加え、費用をみても事業者が費用負担できる状況でなければできない部分も達成できている。また市民の協力も得られている。川崎市の今のような形を 10 年、20 年、30 年後になるかもしれないが、達成していきたい。バンドン市で行うためには、まずどのようなことを実施すればよいのか、アドバイスが欲しい。広報でもいいし、環境教育でもいい。どのようなプロセスを経ればいいのかが知りたい。
  - 横田氏（川崎市）：川崎市も 1990 年代まではバンドン市と同じ状況だった。一部実践していた内容は、3R ではなくゴミの散乱防止の位置づけでやっていた。1990 年にゴミ処理能力を超えるゴミの廃棄量が来るという予測がなされ、川崎市は非常事態宣言を市民に通告した。そこから、できることはなんでもやろうという位置づけで、ごみ減量指導員や分別の拡充など、できることをメニュー出しし、実践してきた。最初は市独自でできることから始まり、時代が３R になり、法整備が整ってから少しずついろいろなことを行っていった。ゴミ分別も家庭の段階で分別してもらうようにしてもらった。研修会で提供した内容は、川崎市がやってきたことも含まれているので参考にしてもらいたい。
- Ayu 氏（バンドン市）：ゴミ処理や広報、政策の策定などゴミ処理に関する業務があると思うが、バンドン市の場合、政策の策定は市役所内にある環境管理庁であり、ゴミ回収は清掃公社が行っている。川崎市の場合はどうか。
  - 木下氏（川崎市）：政策は政策担当が行っているが、回収は公社ではなく市が行っている。市の効率化を考え、民間企業へ委託をし、回収してもらっている。
- Priana 氏（バンドン市）:川崎市の場合、政策は市役所内のどの局が担当し、実務はどの局が行っているのかなど、組織内部の役割分担について知りたい
  - 木下氏（川崎市）政策策定は、政策担当を中心に行っている。具体的なゴミ収集、焼却はまた別のグループが担当している。
- Priana 氏（バンドン市）:インドネシアでは長期計画の策定は、地方開発計画庁が担当している。地方開発計画庁は政策を策定する権限を持っている。
  - 横田氏（川崎市）：今回紹介した計画は、廃棄物だけの計画なので、廃棄物政策担当が担当している。その他の計画は別の局が策定に関わっている。廃棄物のマスタープランを作るときには、そことの整合性をとりながら、廃棄物の計画を立てている。個別の政策になるので、その担当となる部署が政策を策定するという形をとっている。ゴミの収集業務は、原則的に市が全部やるという位置づけでやってきた。民間事業者がいなかったので、民間事業者を育成した上で、市のゴミ収集や焼却の委託をお願いしたという経緯がある。川崎市にあった公社は、ゴミ回収というよりも余熱の事業を担当する役割を担っていた。民間企業があまり育っていないような地域のような、たとえば横浜市も公社が中心となってやっているというところもある。横浜市も公社と民間が競争して仕事をとっているという状況であるが、市が直接実施すると人件費が高くなる。人手を必要とする分、雇用としてその分の費用を増やす必要があるため、委託するような形をとっている。川崎市の場合は、民間委託という方向をとった。
- Boy 氏（バンドン市）：2つ質問がある。1 点目は焼却場の更新について。新しい焼却場を建設するにあたって、CO2 が出てしまうという状況があるのではないか。また新しい焼却場を建設するにあたって、周辺住民の合意を得るためにどういったことをしているのか。2 点目は、120 社ほど営業許可を持っている事業者があると聞いたが、そういった社会的な貢献をする企業に対して市からのインセンティブがあるのか。また法的な違反がある場合、どういった罰則があるのか。罰則規定はだれが行うのか。住民が法律違反をした場合、誰が違法行為に対して罰則規定をするのか。行政なのか、警察なのか、裁判所なのかといった点について知りたい。
  - 木下氏（川崎市）：焼却場については、現時点では新しく焼却場を建設するスペースはない。4 カ所ある焼却場を更新していくという方法をとっている。１つずつ建て替えるという方法。建て替えの期間は 10 年間と定めている。その間に地域住民との説明会を開き、市民が納得するような形で進めるように努力している。環境アセスメントを使って、市民に広く知らせつつ、CO2 排出が多くならないような努力をしている。建てるデザイン・色についても考慮している。焼却場が迷惑施設であるため、それと併設して市民活動をサポートするような施設の建設も行っている。廃棄物処理場が見学できるような設計にもしている。
  - 内田氏（川崎市）：２つ目について。収集運搬業者を営利事業という位置づけにしているため、特にインセンティブを与えているということはない。収集運搬業者への罰則規定は、収集ルールを守らない場合、行政処分として営業許可の取り消しを行っている。収集運搬業者への刑罰は、警察が被疑者を逮捕し、その後裁判所で裁判される。住民がルールを破った場合、行政処分ということはとらず、警告シールを貼り、ゴミを回収しないという行為をとっている。マナー違反を超えて、山奥に不法投棄をするような場合は、悪質行為と見なし、法律違反となる
- Lia 氏（バンドン市）:多量排出業者と準多量排出業者について知りたい。
  - 内田氏（川崎市）：排出量によって認定している。全体で 1500 事業者程度ある。川崎市内には 4 万の事業者があり、そのうちの 4%が多量排出事業者と準多量排出事業者が占めている。4%の事業者が事業系排出ゴミの 60%を占めているため、ここに焦点をあてて啓発することが適切だと考えている。

（７）低炭素技術の広域展開 － Eric Zusman 研究員（地球環境戦略研究機関(IGES)）

- 本国内研修のまとめ。JCM は日本から他国に技術移転するためのスキームである。単純に技術移転ではなく、包括的に解決していくということが望ましい。時間軸や地理的範囲の拡大が必要となってくる。技術がどう移転していくことができるのか。
- 都市は、特に変革を起こすためには長期的なスパンが必要であり、広域展開をするためには非常に重要なアクターである。都市の発展は、見える・見えない課題を抱えている。バンドン市の都市状

況について、1991 年と 2001 年を比較すると過去 10 年間で変わっている。現在は 2014 年だからもっと変わってきていると思う。

- 廃棄物の増量の推移に伴い、廃棄物から排出される CO2 量はアジア地域が多くなってきている。都市の拡大に比例して廃棄物の排出量も増加している。低炭素技術を導入することで、必要な時間やファイナンスなどが増えないように考慮していく必要がある。これまでのプレゼンテーションでもあったように、技術変革だけではなく社会変革が必要になってくると思う。インターネットや携帯電話は、固定電話回線を代替する形で使用されてきている。このような動きを他分野でどのように実践できるのか。この点において地元の政府（市行政）が重要なキーとなると考える。市政府の観点だけではなく、幅広い視野をみると市と NGO、事業者、他レベル、他国との連携したガバナンスが可能なのではないか。その際にマルチステークホルダー・ガバナンスでは、役割を明確にしていく必要がある。
- バンドンの交通セクターでは、法規制や環境の法律などが他国と共有されてきており、そういう意味でよくなってきたが、さまざまな機関と一緒に連携して活動展開していく必要がある。そのためにはネットワークの形成が必要になってくる。
- 能力育成：（1）すでにある能力と必要とする能力は何か、（2）能力育成のために必要となる資源とナレッジは何か、（3）既存のナレッジを統合するプロセスは何か
- ステークホルダーの連携：（1）誰がキーアクター・組織なのか、（2）彼らの利益と資源は何か、（3）キーアクター同士には、十分な協力とコミュニケーションは存在するのか
- ファイナンスの流動化：（1）資金の主な資源は何か、（2）これらの資源は十分足りるか、もしくは外部資源は必要とされているのか、（3）どんな資金サイクルなのか
- 教訓の共有：（1）：パフォーマンスがどのように評価されるのか、（2）：経験の共有のために、プロセスとメカニズムがどのように整備される必要があるのか、（3）既存のプロセスとメカニズムは必要なステークホルダー全てに対して行き届いているのか
- キーメッセージとして、新しい技術移転は時間軸が必要であり、広域展開していくためには何が必要なのかを考える必要がある。都市はそういった点において大きなキーとなっていると思う。また 4 つの視点をマッピングすることで進んでいくのではないか。2 都市でどのような取り組みが展開できるのかを考えることから始める必要がある

Ver. January 30th, 2015

Wrap up meeting of
Project for Developing a Low Carbon Society under
collaboration between Bandung city and Kawasaki city in Bandung, Indonesia
Draft agenda

January 30th 2015　Wrap-Up Workshop

Venue：The Luxton, Riviera 2, Bandung Jalan Ir. H. Juanda No. 18 Bandung 40115, Indonesia
会場：　ラクストンホテル リビエラ２、バンドン
Participants: Bandung city related agencies, JCM Indonesia secretariat, Kawasaki team members
参加者：　バンドン市行政当局、JCM インドネシア事務局、川崎市行政当局、日本側 FS 関係者

Purpose 目的	Wrap up meeting for FS stakeholders 関係者の最終進捗報告会
Language 言語	Translation will be provided for Bahasa <-> Japanese バハサ語⇔日本語　の通訳付き

13:30-13:40(10 min)　Opening Remarks
- Hikmat Ginanjar, Director, Environmental Management Agency, Bandung City Government　<language: Bahasa>
  ヒクマット・ジナンジャル、環境運営委員会、バンドン市
- Mr. Akio Okumura, Chairman, Japan Environmental Sanitation Center
  奥村昭雄、会長、（一財）日本環境衛生センター <language: Japanese>

13:40-14:00(20min)　Indonesia JCM Secretariat Presentation on 1st JCM Project approved
インドネシア JCM 事務局：インドネシアの JCM 1 号案件が承認された経緯、理由
- Ms. Ratu Keni Atika, Indonesia JCM Secretariat
  ラトゥ・ケニ・アティカ　インドネシアＪＣＭ事務局

4:00-14:20(20min)　Indonesia JCM Secretariat Presentation on Financing and Implementation of JCM Project
インドネシア JCM 事務局：JCM の資金スキームと事業実施について
- Mr. Dicky Edwin Hindarto, Indonesia JCM Secretariat
  ディッキ・エドウイン・ヒンダルト　インドネシアＪＣＭ事務局

4:20-14:30 (10 min)　FS Outline FS の概要説明
- Ryoko Nakano, Policy Researcher, IGES
  中野綾子　研究員（公財）地球環境戦略研究機関

14:30-15:00 (30min)　Report of Feasibility Study (1): Biodigester
日本環境衛生センター、日立造船：バイオダイジェスタのＦＳ報告
- Mr. Shigenobu Ohbayashi, Japan Environmental Sanitation Center
  大林重信、国際事業部長、（一財）日本環境衛生センター
- Mr. Hidemasa Kobayashi, Hitachi Zosen Corporation
  小林英正、水環境第一設計部長、日立造船株式会社

15:00-15:10(10min)　Q＆A　質疑応答

15:10-15:40(30min)　Report of Feasibility Study (2): Energy efficiency for streetlamps and buildings
NTT グループ：街路灯、建物内省エネのＦＳ報告
- Mr. Naoki Ishitani, Director, NTT GP-Eco communication, Inc.
  石谷　直樹、ＮＴＴジー・ピー・エコ　株式会社　環境エネルギー部　課長

15:40-15:50(10min)　Q＆A　質疑応答

15:50-16:00(10min)　Coffee Break　休憩

16:00-16:30(30min)　Regulations and legislations for developing and implementing international consortiums for government led projects in Bandung
国際コンソーシアムが公共事業を進める際のバンドン市の規制と法制度

16:30-16:50(20min)　Kawasaki presentation on possible input for Bandung as a result of capacity building training 川崎市、IGES：人材育成の結果、川崎市からバンドン市への提案
- Akira Ogihara,　Head of project and research section, Kawasaki Environmental Research Institute
  荻原朗、都市環境課　課長、川崎市環境総合研究所

16:50-17:20(30min)　IGES & ITB presentation on scaling technology transfer
IGES, バンドン工科大学：技術移転の広域展開について
- Nugroho Sudarmanto　Researcher Institute for Global Environmental Strategies
  ヌグロッホ・スダルマント、研究員、（公財）地球環境戦略研究機関
- Dr. Russ Bona Frazila　Institute Technology Bandung
  ルス・ボナ・スダルマント、バンドン工科大学　教授

17:20-17:40(20min)　Discussions on the way forward　今後のステップについて意見交換
- Ms. Ayu Sukenjah, Deputy Director, Environmental Management Agency, Bandung
  アユ・スケンジャ　環境運営委員会、バンドン市

17:40-17:50(10min)　Closing Remarks by Kawasaki City Government 閉会の挨拶:川崎市
- Akira Ogihara,　Head of project and research section, Kawasaki Environmental Research Institute
  荻原朗、都市環境課　課長、川崎市環境総合研究所

Reception for Workshop Participants
懇親会
Date and time: January 30th　18:30～20:00
日時：1 月 30 日 18:30～20:00
Venue: Luxton Hotel 2nd Floor
場所：ラクストン　ホテル 2 階

Feasibility Study on FY2014 JCM Large-Scale Project for Development of Low-Carbon Societies in Asia
- Support for Development of a Low-Carbon Society through Intercity Cooperation between Bandung and Kawasaki

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