JCM Feasibility Study (FS) 2015

"Introduction of co-generation and solar power generation system in large shopping malls"

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Osaka Gas Co., Ltd.
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PT. AEON MALL Indonesia
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Contents

1. Project background

It is assumed that AEON MALL becomes the project owner of the application for the facilities support program. For the purpose of reducing investment burden on PT. AMSL Delta Mas, an Indonesian local corporation and SPC of this project, AEON MALL is to apply for the facilities support program.

Indonesia is short of grid power capacity, resulting in power supply instability. Especially around Jakarta, power demand and supply balance is tight, causing frequent electric outages including planned outage. The power supply deficiency by the state-run power company PLN is complemented by independent power providers (IPP) and private power operators (PPU). Especially, the following methods are needed; natural gas cogeneration which is comparatively low in energy waste and solar power generation which raises the rate of energy self-sufficiency. The Indonesian energy policy is promoted, aiming at a higher rate of energy self-sufficiency. The mainstream trend is to expand the use of its abundant resources, coal and natural gas, and renewable energies. So, this project fits the country's policy.

2. Objective of the FS

The purpose of this project is to reduce the use of fossil fuel-energy at the mall through introducing a high-efficient natural gas cogeneration system and a solar power system as energy supply system of AEON MALL Delta Mas City which PT. AMSL Delta Mas is planning to build in Delta Mas City, and eventually contribute to CO2 reduction of about 10,000tons.

The surrounding area of the AEON MALL planned site has not been developed. In Indonesia (Jakarta especially), in many cases, developments are promoted outwards to surrounding areas with shopping malls as a center. Thus, the surrounding area is planned to develop after the opening of AEON MALL or at the same time of its construction in this project.

3. Project description:

a. Project location

The construction site is in Delta Mas City, Bekasi, about 37 km from Jakarta by car.

Figure 1 Map of the site

Source) GIIC Leaflet

b. Indonesian partner

It is AEON Mall Sinarmas Land Delta Mas (AMSLD), the SPC of this project, that operates and manages the energy system on the site. On the other hand, no local partner has been decided in the consortium scheme of the JCM facilities program, so it is detailed in d. Project details below.

AMSLD is a joint venture of AEONMALL INDONESIA and PSP (rate of investment: 67% and 33%). It operates and manages the mall of this project. PSP is a subsidiary of Sinarmas Land, the largest developer in Indonesia.

Table 2 Profile of AMSLD

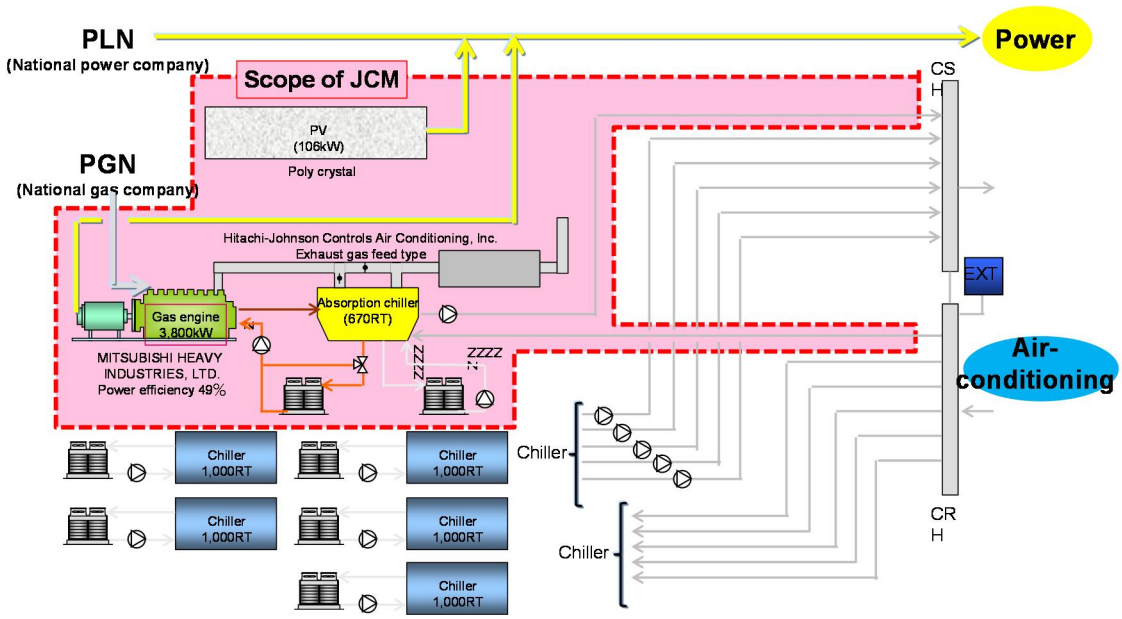
Name	PT.AMSL DELTA MAS
Date of foundation	26 / 3 / 2013
Capital fund	US$61,310,000
Shareholder	AEONMALL INDONESIA 67％ PSP 33％

c. Description of the technology

A cogeneration system is introduced to supply power. Cogeneration eliminates energy waste

because its emission heat generated at the same time of power generation can be effectively used for year-round cooling and the high-efficient gas engine contributes to CO2 reduction. In addition of cogeneration, the solar power generation system to be introduced replaces the grid power of high emission factor with renewable energy and reduces CO2 emissions derived from electric power.

Figure 3 Energy system



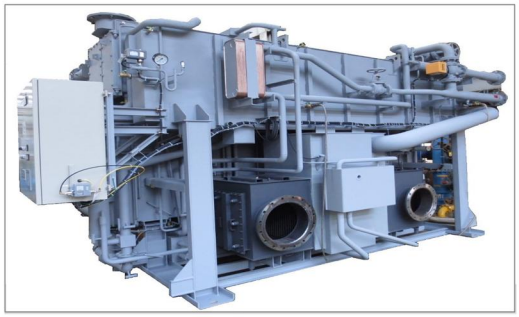
Source:Osaka Gas

Gas Engine generation

Maker	MITSUBISHI HEAVY INDUSTRIES, LTD.
Output	3,800kW
Frequency	50Hz
Rotational speed	750m-1
Size	(L) 9.85m x (W) 3.18m x (H)4.98m
weight	40ton
Nox	320ppm@0%O2
generation efficiency	49%
Gas Consumption	731m3(N)/h (* LHV:38.1MJ/m3(N))

Comparative Advantage

Absorption Chiller



Maker	Hitachi-Johnson Controls Air Conditioning, Inc.
Absorption manner	Exhaust gas and hot water input
Output	2,356kW(670RT)
Cold water temperature	7-15℃
Cold water flow rate	253m3/h
Coolant temperature	32-37℃
Jacket water temperature	88-83℃
Power supply	380V/50Hz/3ph、25kVA
Size	(L) 8.1m x (W) 3.3m x (H)3.5m
Weight	32ton

Higher efficient than hot water Input only

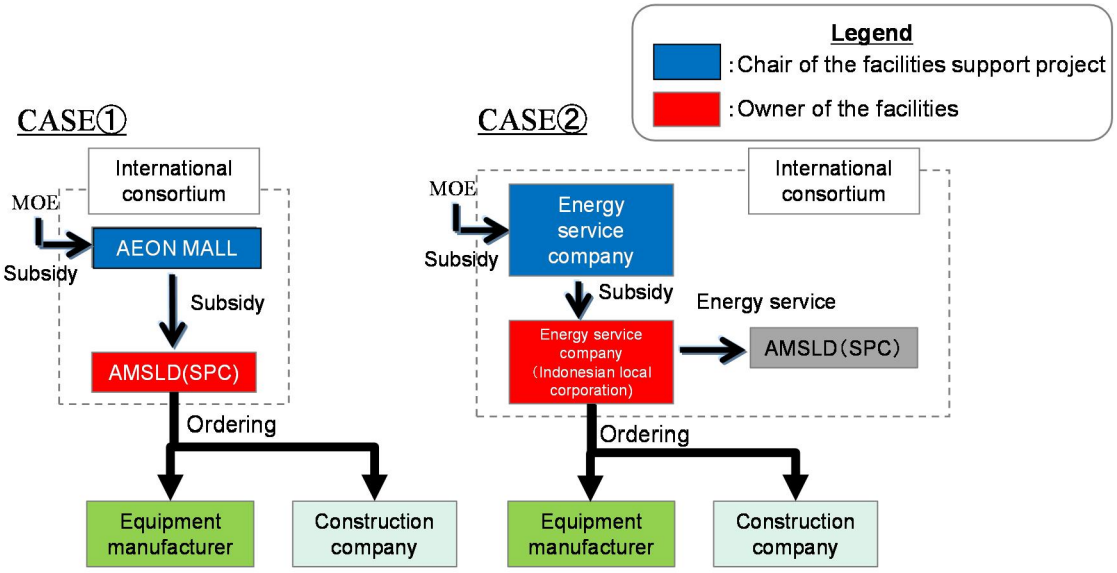
* The specification might be changed without notice by improvement of the products.

d. Project details

There are two possible cases in this project as below, depending on whether the local counterpart AMSLD owns its power generation/air-conditioning facilities or not.

CASE ①	AMSLD owns and operates the system.
CASE ②	The third party energy service company owns and operates the system.

Figure 4 Project scheme



Since the scheme differs depending on whether facilities support can be adopted or not, we have not decided which it would be, CASE ① or CASE ②, in this FS.

4. The result of the study

a. Current condition in Indonesia

Indonesia is short of grid power capacity, resulting in power supply instability. Especially around Jakarta, power demand and supply balance is tight, causing frequent electric outages including planned outage. The power supply deficiency of the state-run power company PLN is complemented by independent power providers (IPP) and private power operators (PPU). Especially, the following methods are needed; natural gas cogeneration which is comparatively low in energy waste and solar power generation which raises the rate of energy self-sufficiency.

b. Regulation and policy related to the project

The Indonesian energy policy is promoted, aiming at a higher rate of energy self-sufficiency. The mainstream trend is to expand the use of its abundant resources, coal and natural gas, and

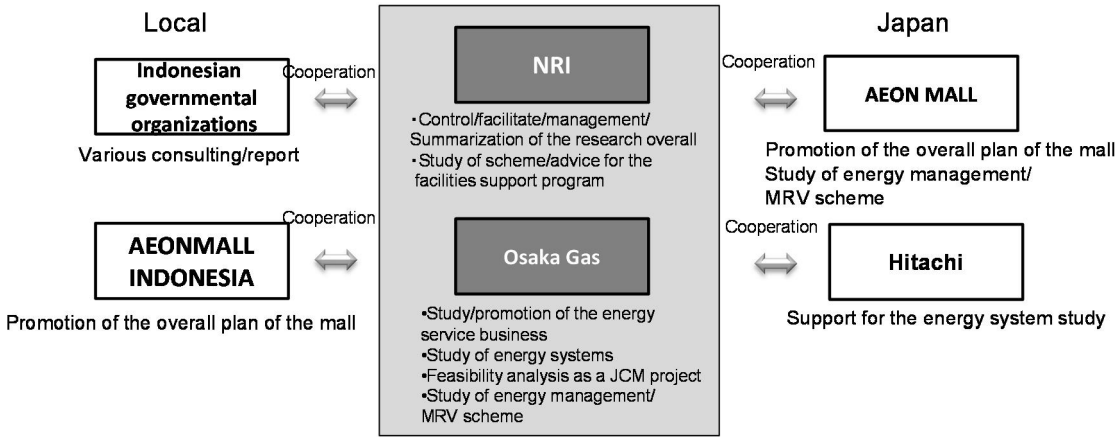
renewable energies. So, this project fits the country's policy.

c. Role of each participant

Below are the names and roles of organizations which conducted studies.

Name	Role
Nomura Research Institute	Control/facilitate/management/summarization of the research overall Presentation at various reporting occasions/meetings and generation of materials Study of scheme/advice for the facilities support program Study of spread possibility
Osaka Gas	Study/promotion of the energy service project Study of energy systems Feasibility analysis as a JCM project Study of energy management/MRV scheme
AEON MALL	Study/promotion of overall plan of AEON MALL Delta Mas City Study of energy management/MRV scheme
PT. AEONMALL Indonesia	Study/promotion of overall plan of AEON MALL Delta Mas City
Hitachi Ltd.	Support of studying energy systems

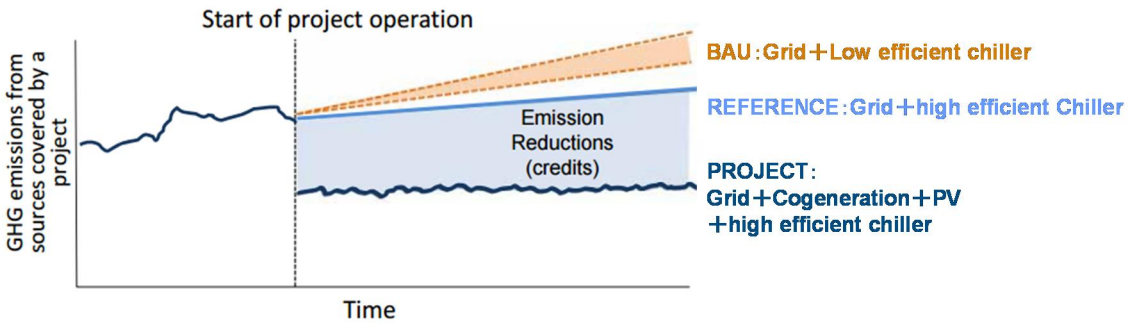
Figure 4 Scheme of the study



d. Reference scenario setting

In this methodology, BAU equipment is consisted of 6 turbo chillers only as below. The hypothesis made is that these 6 chillers are of high-efficiency in a conservative reference set up based on BAU. Therefore, saved energy by replacing low-efficiency turbo chillers with high-efficiency ones is not rendered as reduction credit in this project.

Table 5　BAU and Reference, Image of emissions of this project



Source) Created by NRI based on a new mechanism platform “Latest trend of Joint Crediting Mechanism (JCM))”

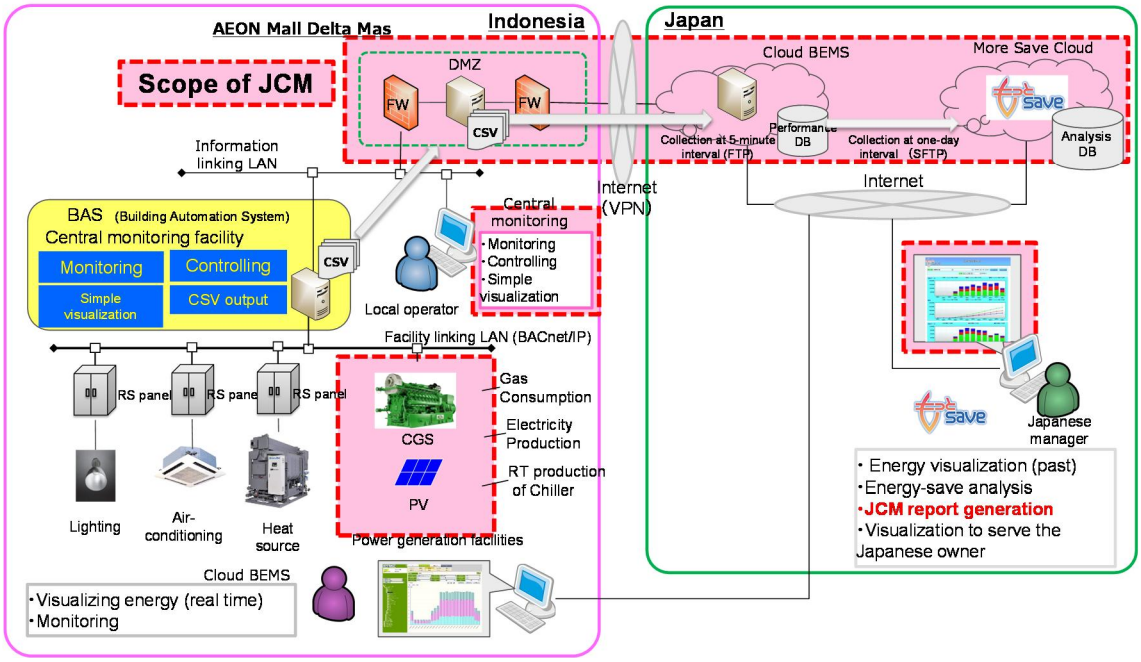
e. Monitoring methods

Below is the monitoring system in CASE ② (an energy service business is carried on).

Although the energy system is operated by AMSL Delta Mas, an energy service company carries out maintenance/improvement, monitoring and reporting to the third party organization. In CASE ①, these are carried out by AMSL Delta Mas.

It is planned to introduce BEMS similar to one used in existing BSD mall

Figure 6 Monitoring system of the energy service business



Source) Materials for study by Osaka Gas

f. Quantification of GHG emissions and their reductions

The methodology formula gives 33,333 t-CO_2 of the reference emission, 24,172 t-CO_2 of emission of the project and 9161 t-CO2CO_2 of reduction.

g. MRV methods

The reference assumes a case where the entire power demand is fed from a grid in this project. Thus, it can be obtained by multiplying the sum of the entire power demand derived from cogeneration, solar power and grid supply for the shortage and the power consumption when cold energy from waste energy/heat recovery chillers was calculated based on the assumption that it is derived from turbo chillers by the grid emission factor.

$$RE_p = \sum \left(EC_{RE,p} \times EF_{elec} \right)$$

$$EC_{RE,p} = EC_{Pj,g,p} + EP_{pj,s,p} + EP_{pj,c,p} + EC_{RE,t,p}$$

$$EC_{RE,t,p} = \frac{RP_{pj,e,p}}{RF_{elec}}$$

RE_p	:	Reference emissions during a period *p* [tCO_2/p]
$EC_{RE,p}$	:	Virtual total power demand during a period *p* [MWh/p]
EF_{elec}	:	CO_2 emission factor of the power grid [tCO_2/MWh]
$EC_{pj,g,p}$	:	Power supply from the power grid of the project during a period *p* [MWh/p]
$EP_{pj,s,p}$	:	Generated solar power of the project during a period *p* [MWh/p]
$EP_{pj,c,p}$	:	Generated cogeneration power of the project during a period *p* [MWh/p]
$EC_{RE,t,p}$	:	Power consumption by virtual turbo chillers during a period *p* [MWh/p]
$RP_{pj,e,p}$	:	Cold energy generation by waste energy/heat recovery chillers of the project during a period *p* [RT/p]
RF_{elec}	:	Cold energy generation efficiency of turbo chillers [RT/MWh]

In this project, CO_2 emissions are originated from the entire power received from the grid and from fuel consumption of the gas engine.

The amount of grid power reduction through solar power generation is included in the total power received from the grid.

$$PE_p = \sum \left(EC_{PJ,p} \times EF_{elec} + GC_{PJ,p} \times EF_{gas} \right)$$

PE_p : Emissions of the project during a period *p* [tCO_2/p]

$EC_{PJ,p}$: Power received from the grid in the entire energy system during a period *p* [MWh/p]

EF_{elec} : CO_2 emission factor of the power grid [tCO_2/MWh]

$GC_{PJ,p}$: Natural gas consumption by the gas engine during a period *p* [MWh/p]

EF_{gas} : CO_2 consumption rate of natural gas [tCO_2/m^3]

Thus, the CO_2 reduction can be calculated as below.

$$ER_p = RE_p - PE_p$$

ER_p : CO_2 reduction during a period *p* [tCO_2/p]

RE_p : Reference emission during a period *p* [tCO_2/p]

PE_p : Emissions of the project during a period *p* [tCO_2/p]

h. Scale of investment & financial viability

①Assumable necessary cost

Out of the cost necessary to build AEON MALL Delta Mas, we broke down those in the scope of the facilities introduction support program (See the next page). Basically, we looked at energy-supply facilities and equipment, installation, and pipe laying work and electric works to connect facilities and equipment.

As a result, the cost necessary for the energy-supply system was ¥1,730millions while the cost necessary for the project excluding those relating to turbo chillers became ¥937millions.

Turbo chillers including electric chillers do not contribute to energy saving on their own, so we did not include them in the scope of the facilities introduction support program. We excluded engineering/ construction and interior works of buildings, etc. and non-energy-supply facilities and equipment.

Table 7 Cost necessary for this project (rough estimate)

	Item	Amount
Items in the scope	1. Machinery/equipment	¥454millions
	2. Pipe laying work	¥53 millions
	3. Automatic control	¥33 millions
	4. Electric work	¥75 millions
	5. Auxiliary facilities for	¥38 millions

	the machine room	
	6. Cost for temporal works	¥22 millions
	7. Cost of field management	¥30 millions
	8. Miscellaneous expense	¥77 millions
	(sub-total))	¥937 millions
Items out of the scope	Turbo chiller-related	¥793 millions
Total		¥1,730 millions

② Analysis of economic performance

The analysis of economic performance of this project based on the below prerequisites indicated that the number of years required for recovering the investment including the initial cost and running cost is 5.7 years when the support is granted and it becomes 9.5 years when no support is granted. They are compared in detail as below.

Analysis result

		BAU	This project
Initial cost		¥993millions	With support ¥1,355millions*3 Without support ¥1,730millions*2
Yearly running cost*1		¥555millions	¥456millions
Payout time	With support	Standard	5.7 years
	Without support	Standard	9.5 years

*1 Running cost for whole building
*2 1,730M is whole initial cost and 937M is for project boundary of JCM.
*3 A support rate of 40% for project boundary was used.

③ Financing plan

The percentage of investment of AMSL Delta Mas, the operator of this mall, is 67% by AEON MALL Indonesia and AEON MALL, the headquarters in Japan, is planned to collect funds. At the moment, no problem is foreseen in collecting fund and additional fund-raising is not assumed.

i. Contribution to Indonesian Sustainable Development

The concrete store-roll-out plan of AEON MALL in Indonesia has been ongoing up to No. 4 as of

today (see the below table). Since AEON MALL adopted an aggressive store-roll-out and development in China and ASEAN countries as its strategy for growth, the number of AEON MALLs is expected to increase (aiming at eight malls in total by 2020).

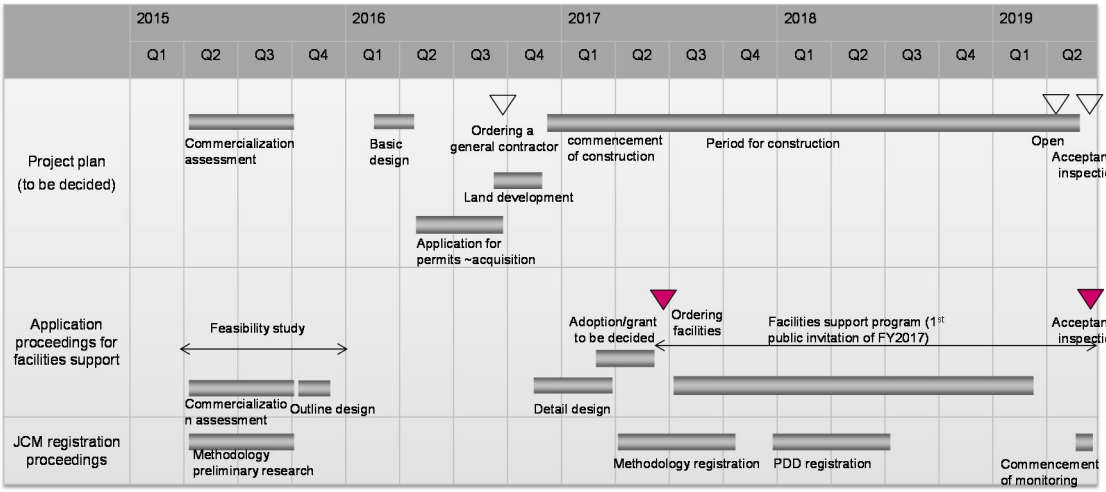
Urbanization is promoted as Indonesia grows in economy and shopping malls play an important role in creating communities in urban development. By integrating various commercial facilities around a shopping mall and preparing a transportation network, it is expected that building AEON MALL there triggers communities in Indonesia to develop and raise their living standard further.

Furthermore, AEON MALL is an environment-friendly shopping mall with various environmental measures provided, besides an energy-saving energy system and solar power generation. It is positioned as model shopping mall in Indonesia and it can contribute to sustainable development of Indonesia by inspiring its customers and people living around it to become environment-conscious.

j. Proposed implementation schedule

Construction plan and operation plan of the project

Table 8 Whole project schedule



k. Capacity building to the host country

Since this project is implemented by a joint venture with Sinarmas Land, many local staff members are borrowed from Sinarmas. We expect them to absorb the high quality operation knowhow of AEON MALL with excellent records in Japan and then use it for developing new mall businesses by new Sinarmas. (The operation knowhow will be transferred through education of local staff by AEON MALL.)

Also, the energy system enables bringing out its original energy-saving performance through

high-quality output adjustment of cogeneration, PV and Grid using BEMS.

Based on the study at the moment, it is highly possible that the energy service company which collectively manages related data and other companies advise the staff on energy saving, allowing local engineers to obtain knowhow for energy-saving.

5. Conclusion and Next Steps

The configuration of the energy system has almost assumed by the outline design. But, the detail design is to be elaborated, while considering the result of the basic design of the mall overall expected to develop.

The number of years for recovering the investment on the energy system is 5.7 years when facilities support (40%) is used. On the other hand, it is 9.5 years without the support. The adoption of the facilities support is a prerequisite for introducing the system.

The whole designing of the mall will be started as soon as the headquarters of AEON MALL approves of the investment. We continue to study, aiming for applying for the facilities support program 2017.