APPENDIX-B1

BOT Proposal for Yen So Central Bio-solid Processing Center

CONTENTS

Appendix-B1: BOT Proposal for Yen So Central Bio-solid Processing Center

Chapter 1 Background and Basis of the Project

1.1 Background and Necessity of the Project

Hanoi City is the Capital of the Socialist Republic of Vietnam, the center of politics, economy and culture of the country. The urbanization speed of the capital has continuously accelerated during the recent years. However, the development of the infrastructure including urban sewerage and drainage system is slower than the urbanization.

To improve the urban sewerage system in order to enhance the ambient water environment and in turn, the living condition of Hanoi City, HPC is giving utmost importance to sewerage collection and treatment facilities. Currently, there are two pilot wastewater treatment plants (WWTPs) at Truc Bach and Kim Kien, whose treatment capacities are 3,000 and 4,800 m^3/day respectively; and one medium scale WWTP at North Thang Long with a treatment capacity of 38,000 m^3/day. In addition, there are a number of WWTPs are either in the planning/ designing stage or under construction. One large scale WWTP at Yen So with a capacity of 200,000 m^3/day is now under trial run and will start operation from April, 2012. Bay Mau Lake WWTP with a treatment capacity of 13,300 m^3/day is now in the stage of detailed design/ implementation, and will be operated from 2014. Feasibility study of Yen Xa WWTP has been prepared and is now under financial arrangement stage and planned to be completed in 2017. In addition, Phu Do WWTP and Ho Tay WWTP, whose treatment capacities are 84,000 m^3/day and 15,000 m^3/day respectively, are planned to be constructed by Built-Transfer (BT) contract arrangements. The expected start time is 2015 and 2013, respectively. With completion of these WWTPs, the wastewater treatment capacity will be rapidly increased in Hanoi.

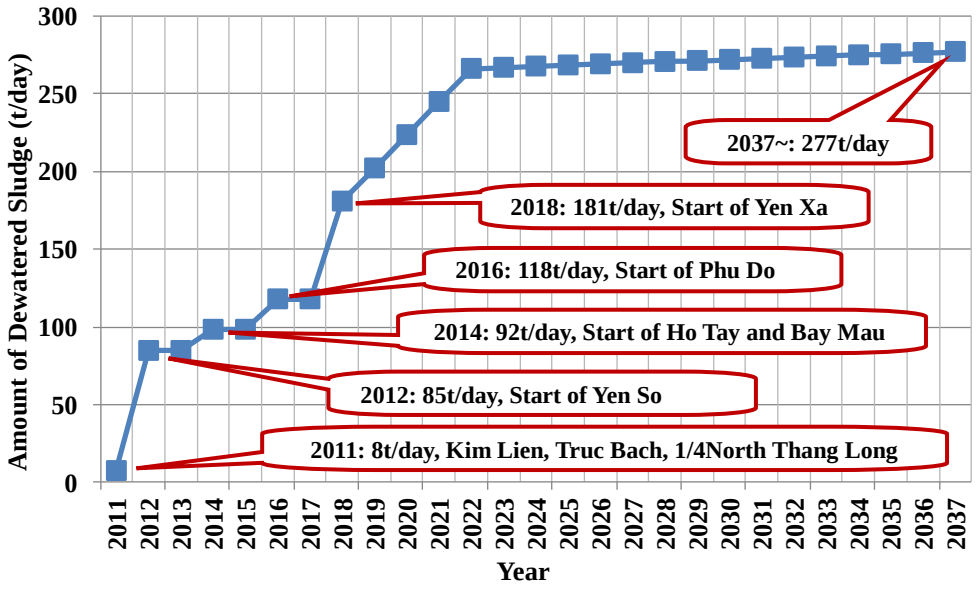
The summary of current and planned wastewater treatment plants are shown in the Table 1.1.1. By 2018, total treatment capacity will be around 630,000 m^3/day from the current 45,800 m^3/d, an increase of more than 1300%.

Table 1.1.1 Summary of Wastewater Treatment Plants in Hanoi

WWTP		Capacity (m^3/day)	Current Situation	Expected Operation Start Year
1	Truc Bach	3,000	Operational	-
2	Kim Lien	4,800	Operational	-
3	North Thang Long	42,000	Operational	-
4	Yen So	200,000	Trial run	2012
5	Bay Mau	13,300	EPC	2014
6	Yen Xa	270,000	Financial Arrangement	2018
7	Ho Tay	15,000	Planned for BT	2014
8	Phu Do	84,000	Planned for BT	2016
Total		**632,100**		

Source: Compiled by JICA Study Team, 2012

With rapid future increase of wastewater treatment capacities in Hanoi, amount of sludge generation will also increase considerably. For a full development scenario where all the WWTPs run with their design capacity, the total amount of dewatered sludge generation will be a whooping 620 t/d (refer to Chapter 2), compared to current sludge production of 8 t/d. As explained in Chapter 2, this situation is hard to reach considering the current influent water quality of the existing WWTPs, hence, instead of full development scenario, an optimum scenario can be considered. Figure 1.1.1 shows projected sludge generation amount for the optimum scenario (details can be found in Chapter 2). The maximum amount of dewatered sludge in this scenario is 277 t/d.



Source: Prepared by JICA Study Team based on secondary information

Figure 1.1.1 Sludge Generation Forecast

The sludge generated from current operating WWTPs are disposed at Nam Son Landfill site and Tieu Ky disposal site. The proposed extension of Nam Son Phase 2 will not accept sludge waste. Though HAPA is now carrying out a study on permanent sludge disposal site, there is still no conclusion. Finding a disposal site within the city limit or its vicinity for the entire amount of future sludge (263 t/d) seems to be almost impossible. Under such situation, it is required to reduce the amount of sludge waste and promote sludge reuse/ recycle. This will increase the service life of scarce landfill site, ensure proper sludge management and enhance sludge reuse/ recycle. Without such provision, smooth implementation of new/ planned WWTPs can also be hindered.

1.2 Selection and Justification of the Project Process

1.2.1 Basic Approach

As explained above, proper sludge management is a prerequisite for future sewerage sector development. At present the sludge disposal is carried out as an ad-hoc basis. The current practice is a threat to environment as it is not a sanitary landfill process. Complying with the social responsibility, HPC must stop this unhygienic practice and come up with appropriate solution.

The basic principles applicable in course of the selection of appropriate technology are as follows:

1. Centralize sludge management: Any sludge management system demands significant resource mobilization, so centralize sludge management facility which receives dewatered sludge from multiple WWTPs is cost effective and easy to manage.

2. Volume reduction: Dewatered sludge contains more than 80% water. Volume reduction can radically improve the cost requirement and operational complexity of any selected sludge management process.

3. Reuse and recycle: Sludge contains both organic and inorganic compounds, and both of which have reuse and recycle potential. Efforts to be made to impart resource recovery as much as possible.

4. Step wise development: As sludge management is rather cost incentive process, a step wise development matching with the demand increase is efficient.

1.2.2 Potential Sludge Management Options

Depending on the water content, the sludge can be divided into the followings, and for each type, there can be various management options. It is to be noted here that there are also various options to reduce the water contents.

- Dewatered sludge (water content around 80%)
- Compost or semi dried sludge (water content around 60%)
- Dried sludge (water content around 10 to 20%)
- Incinerated sludge/ ash (water content negligible)

Selection of optimum sludge management option depends on following criteria:

1. Design volume of dewatered sludge to be managed,
2. Compatibility with end use and its potential demand,
3. Easy O&M technology
4. Social acceptance
5. No impact from pathogenic microorganism and heavy metals,and
6. Promotion of reuse and recycle.

Popular sludge management options are shown in the Figure 1.2.1. It is to be noted that this is not exhaustive list. There are 11 sludge management options are proposed in the figure considering the ultimate end use.

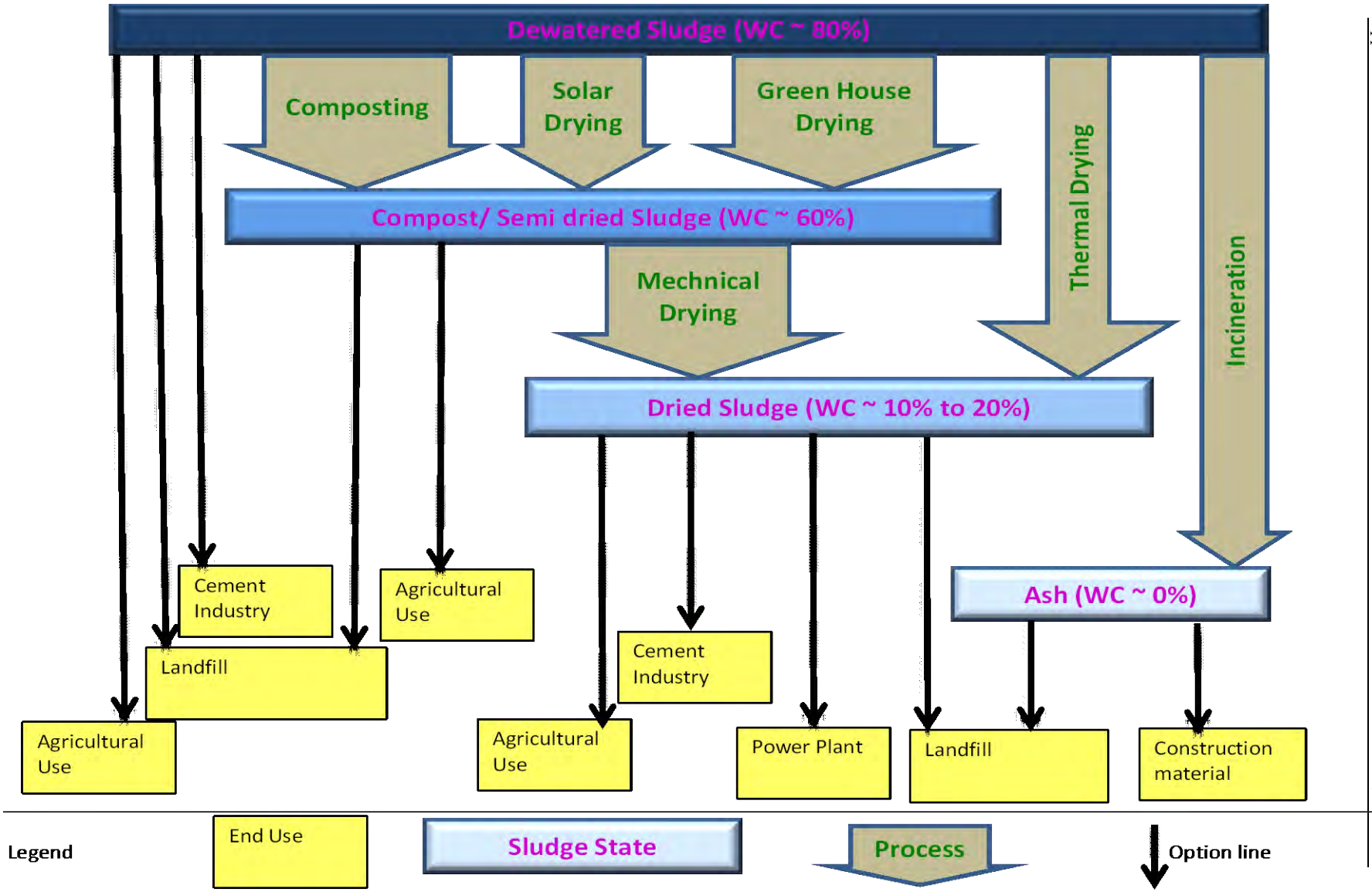


Figure 1.2.1 Popular Sludge Management Options

1.2.3 Selection of Optimum Sludge Management Options

The screening of the options for Hanoi situation is elaborated in Table 1.2.1.

Table 1.2.1 Preliminary Screening for Sludge Management Options

Option	Description	Evaluation
1. Dewatered sludge for agricultural use	To comply with criteria 1, can only be used for non human consumption purpose. Requires very advanced "no touch" mechanical mixing. No demand for such huge volume in and around Hanoi	Not possible
2. Dewatered sludge landfill	Required huge landfill volume is not possible to obtain in and around Hanoi	Can be used temporarily with other option
3. Dewatered sludge use in cement industry	Cement production capacity will reduce drastically.	Not acceptable
4. Semi dried sludge landfill	Required huge landfill volume is not possible to obtain in and around Hanoi. Does not satisfy criteria 4 after costly processing.	Not possible
5. Semi dried sludge for agricultural use	To comply with criteria 1, can only be used for non human consumption purpose. The maximum demand for greenery is 32t/d and design production of semi dried sludge is 130 t/d (Refer to Chap 2).	Can be used in parallel.
6. Dried sludge for agricultural use	To comply with criteria 1, can only be used for non human consumption purpose. The potential current demand for greenery is 32t/d and design production of dried sludge is 53t/d (Refer to Chpa 2)	Can be used in parallel.
7. Dried sludge use in cement industry	The potential current demand for cement industry is 105t/d.	Possible
8. Dried sludge use in power plant	The potential current demand for power plant is 410t/d.	Possible
9. Dried sludge landfill	Does not satisfy criteria 4 after costly processing.	Not acceptable
10. Incinerated ash landfill	Costly	Possible
11. Incinerated ash use as construction material	Costly	Possible

From the table above, it is obvious that the candidate options are composting, incineration and sludge drying (by thermal drying, etc.); although compost cannot be a stand-alone option due to lack of demand. Land filling can be carried out but as an interim measure. It is recommended to utilize a sanitary landfill option. However, in future land fill will not be a viable option.

A cost comparison of the candidate options are given below.

Table 1.2.2 Cost Comparison of Candidate Options (Unit: EUR/t of DS)

Incineration	Thermal Drying	Composting
450 – 800	300 – 800	250 – 600
High cost	Acceptable	Low cost, however consumption demand is limited. Also consumption is not constant year round.
Not recommendable	Recommendable	Can be recommended for parallel use together with other option

Source: 'Ecological and economical balance for sludge management options', by Jeremy Hall, Proceedings of the European Commission Workshop on "Problems around sludge" (http://ec.europa.eu/environment/waste/sludge/pdf/workshoppart4.pdf).

Table 1.2.2 compares the generalized treatment and disposal costs for some management options in the European context. The cost requirements in Vietnam will be less; however, the table can be a good tool for comparison. For each option, the spread of costs is large and overlap with those of other options, due to the influence of local circumstances on investment and operating costs reflecting size of plant, type of technology, etc. As can be seen, composting is a low cost option than thermal drying and incineration; but it cannot be a standalone option due to low demand and time fluctuation of demand. On the other hand, incineration is a high cost option.

Based on current operating plants in Japan, cost comparison between thermal drying and incinerator for different capacity is given in Table 1.2.3. This table also shows that thermal drying is cheaper than incinerator.

Table 1.2.3 Cost Comparison in Japanese Context (Unit: Yen/t of DS)

Incineration	Thermal Drying	Capacity
27,400	18,300	30 m3/d
20,365	16,000	60 m3/d

Source: Compiled by JICA Study Team based on primary data.

From the above discussion, it is proposed that sludge drying (by thermal drying or other similar method) is the most suitable option for sludge volume reduction in Hanoi.

The dried sludge can be reused/ recycled for greenery, cement industry and power plants.

The Proponent is therefore proposing the Project of "Central Biosolids Processing Center" at Yen So to reduce the volume of generated sewerage sludge by sludge drying principle and thereby facilitate the potential of sludge reuse and recycle.

1.2.4 Justification of BOT Scheme for the Project

Low commercial value is an inherent nature of sludge processing projects. The end product of the proposed sludge drying plant is dried sludge, which has less calorific value than coal. Similarly, the N content in the dried sludge can be at best a soil conditioner or soil improver, far short to claim as fertilizer. Though the end product can be reused and recycled in many forms, it is not expected to bring business profit. However, this kind of projects impact huge social and environmental benefits. Not only it reduces the requirement of increasingly scarce land by reducing the sludge volume drastically, but also it promotes reuse and recycle of resources. Therefore, it is a public commitment of HPC to carry out such projects.

In case HPC carries out this project mobilizing its own resources or by utilizing ODA loan, the life cycle cost of the project may be less but it will expose HPC to all kinds of risk associated with the implementation of this project. On the other hand, implementing this project by a BOT scheme will make HPC free from most of the technical and operational risk.

The main advantages of BOT scheme for this project are summarized below:

- HPC does not have to bear implementation and operation risk.
- HPC needs to deal with only one entity, the SPC for all issues covering implementation and operation.
- HPC does not have to go through the complex procedures for fund arrangement.
- HPC needs less administration works regarding bid document preparation, awarding, contract management and project management.
- Overall management skill and know-how of sludge processing and recycling could be transferred from Japanese public and private sectors.
- Integrated process of the design, construction and operation maintenance will enhance project sustainability.
- As SPC is expected to borrow fund from JICA's PSIF fund, it would be in a

better position to support HPC/MPI to pursue with JICA for realization of ODA loan for Yen Xa WWTP.

1.3 Objectives of the Project

The salient objectives of the proposed BOT scheme are,

1. To construct a biosolids (i.e., dewatered sludge) processing facility to reduce the volume of dewatered sludge in order to reduce the amount of landfill volume,
2. To promote and facilitate sludge (resource) reuse and recycle by various end users in a effective and efficient manner,
3. To support and sponsor technology transfer, and
4. To ensure maximum financial benefit to HPC.

1.4 Outline of the Project

The preliminary technical analysis and cost estimate is given in Chapter 2 and 3, respectively. The financial plan is proposed in Chapter 4. The project financing scheme is BOT as explained in Chapter 5. The summary outline is briefed here.

1.	Location	:	Near Yen So WWTP
2.	Required Area	:	3.3 ha (180 m x 180 m)
3.	Drying method	:	Hybrid (solar and mechanical)
4.	Main Facilities	:	Five green houses and four thermal dryer
5.	Input (dewatered sludge)	:	180 m3/d (moisture content of 80%)
6.	Output (dried sludge)	:	36 m3/d (moisture content of 10%)
7.	End use	:	Cement and power plants, greenery, etc.
8.	Construction Cost	:	App. 64 m US$ (preliminary)
9.	Direct O&M cost	:	Around 2 US$/year
10.	Financing scheme	:	BOT
11.	Equity: Debt	:	30:70
12.	Borrowing source	:	JICA PSIF (low interest loan)
13.	Service Change to HPC	:	Between 11 and 15 m US$/year

1.5 Legal Basis of the Proposal and the Project

The following laws and regulations are referred to for the proposal of the BOT project.

- Decision 71/2010/QD-TTg, Promulgating the regulation on pilot investment in the public – private partnership form (Pilot PPP Law)
- Decree 108/2009/ND-CP - Decree On Investment In The Form Of Build-Operate-Transfer, Build-Transfer-Operate Or Build-Transfer Contract
- Decree No. 24/2011/ND-CP - Amending A Number of Articles of the November 27, 2009 Decree No. 108/2009/ND-CP on Investment in the Form of Build-Operate-Transfer Contract, Build-Transfer-Operate Contract, Build-Transfer Contract
- Law 61/2005/QH11 – Bidding Law
- Law No.16-2003-QH11 – Law on Construction
- Law 38/2009/QH12 - Law Amending and Supplementing a Number of Articles of the Laws Concerning Capital Construction Investment
- Decree 12-2009-ND-CP Management of investment projects for construction works
- Circular 03-2009-TT-BXD Providing detailed guidelines for implementation of a number of articles of Decree 12-2009-ND-CP on management of investment projects for construction works
- Circular 03-2011-TT-BKHDT Guiding implementation of Decree 108-20090ND-CP on investment on the basis of BOT, BTO and BT contracts

Chapter 2 Technical Concept

2.1 Outline

The detail technical study is expected to be carried out during the Feasibility Study to be conducted after the conclusion of BOT contract agreement between a Special Purpose Company (SPC) and Hanoi People's Committee (HPC). This chapter provides only a basic planning and design concept.

2.2 Demand Forecast

2.2.1 Wastewater Generation

Sludge generation amount depends on wastewater flow and difference between influent water quality (SS) and effluent water quality (SS) of WWTP.

Daily maximum wastewater flow and daily average wastewater flow for the existing, under construction and planned WWTPs in Hanoi are shown in Table 2.2.1.

Table 2.2.1 Wastewater flow from WWTPs in Hanoi

WWTP	Daily Maximum Wastewater Flow (m^3/day)	Daily Average Wastewater Flow (m^3/day)	Operational Year
Kim Lien	4,800	3,920	Operational
Truc Bac	3,000	2,450	Operational
North Thang Long	42,000	34,280	Operational
Yen So	200,000	190,000	2012
Ho Tay	15,000	12,240	2013
Bay Mau	13,300	10,850	2014
Phu Do	84,000	68,500	2015
Yen Xa	270,000	220,400	2018
Total	**632,100**	**542,640**	

Source: Compiled by JICA Study Team based on secondary data

Note: Daily average wastewater flow is estimated to be 81.6% of daily maximum wastewater flow referring to the F/S report of Yen Xa WWTP, 2011 (except Yen So WWTP).

. In regard to Yen So WWTP, daily average wastewater flow is 95% of daily maximum wastewater flow, because fixed amount of wastewater inflows from 2 nearby canals, and there is no fluctuation of inflow.

2.2.2 Dewatered Sludge Generation

(1) Conditions of calculation

Amount of dewatered sludge generated from the WWTPs is calculated based on the design conditions as adopted in the WWTP design. Those are as follows,

- Inflow SS = 250mg/L, Outflow SS = 15mg/L
- Moisture content of dewatered sludge = 80%
- In case digestion tank is operated in Yen So WWTP, organic materials of sludge will be digested and volume of dewatered sludge will be reduced by 35%.

(2) Maximum Amount of Dewatered Sludge

From the above condition, amount of maximum dewatered sludge generated from each WWTP is calculated as Table 2.2.2.

Table 2.2.2 Maximum Amount of Dewatered Sludge

WWTP	Daily Maximum Dewatered Sludge Amount (t/day)	Daily Average Dewatered Sludge Amount (t/day)
Kim Lien	4.7	3.8
Truc Bac	3.3	2.7
North Thang Long	50.5	41.2
Bay Mau	17.8	14.5
Yen So	325.8 (with digester = 211.8)	265.8 (with digester = 172.8)
Phu Do	100.2	87.5
Ho Tay	19.5	15.9
Yen Xa	344.7	281.3
Total	**866.5 (752.5)**	**712.7 (619.7)**

Source: JICA Study Team

(3) Gradual Increase of Sludge Generation

The sludge generation shown in the above table is the maximum sludge when the WWTPs receive the design sewerage volume (full development scenario). For the newly established WWTPs, initially influent sewerage volume is low and gradually increases as more areas are connected to the respective WWTPs.

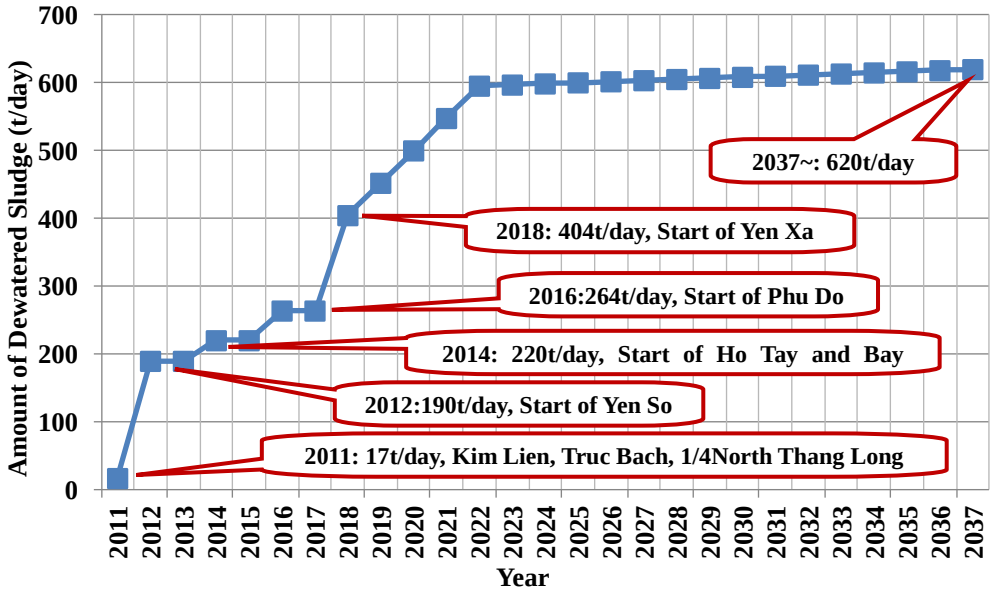
In regard to Yen Xa WWTP, although it is expected to start operating in 2018, only half the amount of planned wastewater is expected to reach the WWTP in the first year. After that the amount of wastewater shall increase gradually, and is expected to reach the planned volume in 2022.

In regard to North Thang Long WWTP, Currently, only amount 1/4th of the design flow is entering into the plant. Since the the urbanization of this basin has not progressed in comparison to previously plan and it is not expected to progress urbanization in the near future, it is expected that the full design capacity will be reached in 20 years.

The implementation schedule of Phu Do and Ho Tay WWTPs is not clear so far.

(4) Maximum Dewatered Sludge Generation (full development scenario) by year

From the above-mentioned operational condition, the maximum daily average dewatered sludge amount from 2011 to 2037 is shown in Figure 2.2.1. The maximum expected dewatered sludge is 620 t/d.



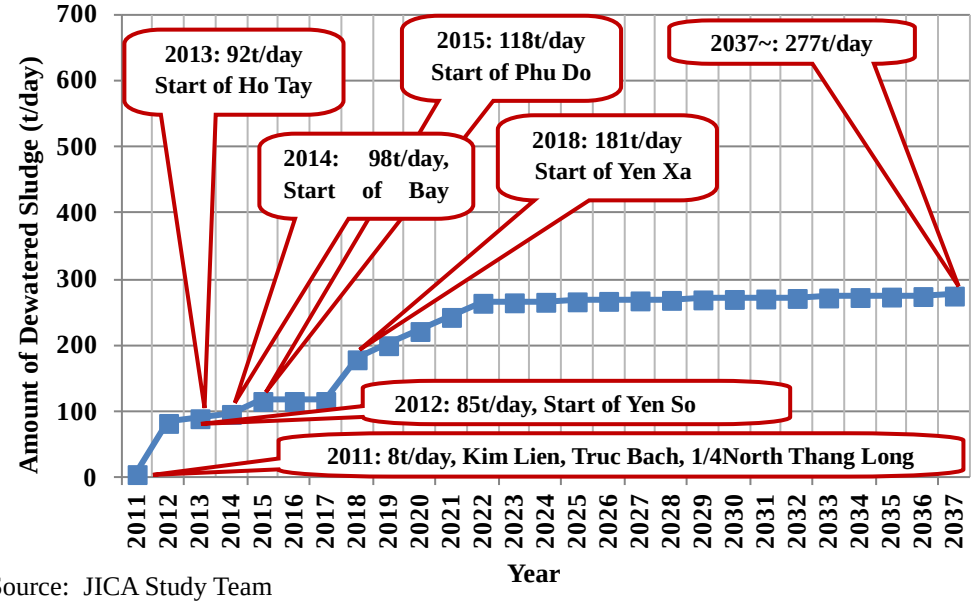
Source: JICA Study Team

Fig. 2.2.1 Annual Dewatered Sludge Generation in Hanoi (full development scenario)

(5) Optimum Scenario for Sludge Generation

At present there are 3 WWTPs are in operation and one WWTP is under trial run. In all

cases, a common problem is that the influent sewerage SS load is much lower than the design load. This is due to partial treatment in septic tank and mild sloped main sewer and due to back flow from river and canal. Solving this situation is a long time proposition. In this condition, dewatered sludge generation will also be rather low. An optimum scenario is thus proposed considering influent SS as 120 mg/l. Annual dewatered sludge generation under optimum scenario is shown below. In this scenario, maximum sludge generation is 277 t/d.



Source: JICA Study Team

Figure 2.2.2 Annual Dewatered Sludge Generation (Optimum development scenario, influent SS=120mg/L)

2.3 Basic Planning

2.3.1 Planning Conditions

As explained in Chapter 1, due to scarcity of available land, dewatered sludge disposal by landfill cannot be a standalone viable option. So volume reduction is needed. Since any volume reduction is a cost intensive measure, processing of the entire generated sludge is not the best option. Rather a combination can yield better utilization of resources. It is thus proposed that sludge processing by thermal drying will be applied for two-third of the maximum sludge generation, i.e., 185 t/d. For the remaining one-third, sanitary landfill is recommendable.

Recycle and reuse of the dried sludge must be promoted through a combination of options like greenery use as soil condition, power plant as fuel, and cement industry as

fuel and ingredient.

2.3.2 Study on Sludge Drying

As mentioned in Chapter 1, the most optimum option for sludge processing is justified to be sludge drying. However, there could be multiple ways of thermal drying, as follows:

1. Solar drying: In this method, dewatered sludge is spread over the land inside a green house covered with plastic sheet. By utilizing the heat entrapped inside the greenhouse, moisture content of the sludge is reduced. However, moisture content cannot be reduced to a low level by solar drying.
2. Thermal drying: In this method, dewatered sludge is put into a rotary dram. By burning oil or gas, air is heated and forced through the drum by a blower.
3. Hybrid: In order to reduce investment and operation cost, a new innovative process has been proposed, which is, "a pre-treatment by green house solar drying followed by thermal dryer".
4. Carbonization: By pyrolysis or destructive distillation in a specially prepared furnace, sludge can be transformed into carbon by this method. The end product is favored for use in power plants.

A comparison of the options is given below.

Table 2.3.1 Comparison of the Alternate Sludge Drying Process

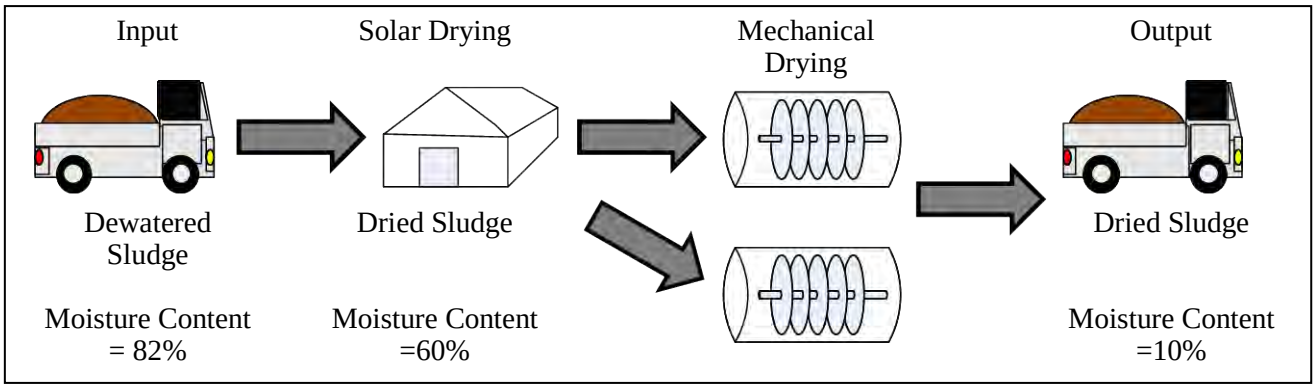
Method / Item	1) Solar Drying	2) Thermal Drying	3) Hybrid Process of Solar & Thermal	4) Carbonization
Initial Cost (million US$)	16	101	64	117
22years O&M Cost (million US$)	16	178	56	206
Total Cost (million US$)	32	279	120	323
Effect on Environment	Most eco-friendly, no energy input	Large consumption of energy	More eco-friendly than 1 and 2, More energy saving than 1 and 2	Highest consumption of energy
Required Area	4.0ha	0.9ha	3.3ha	0.9ha
Moisture content reduction to low level	Not possible	Possible	Possible	Possible

Method / Item	1) Solar Drying	2) Thermal Drying	3) Hybrid Process of Solar & Thermal	4) Carbonization
Evaluation	× Not recommended, as it requires large area and cannot attain low moisture content	△ Recommendable	○ Most appropriate process	× Not recommendable as it is most expensive and least eco-friendly.

Source: JICA Study Team

Based on evaluation shown in the above table, the hybrid process of solar drying & thermal drying is selected as the most appropriate process for the sludge drying.

The concept of the hybrid process is shown in Figure 2.3.1.



Source: JICA Study Team

Figure 2.3.1 Concept of the hybrid process

The treatment conditions of the hybrid process are shown in Table 2.3.2.

Table 2.3.2 Treatment capacity of sludge drying facilities

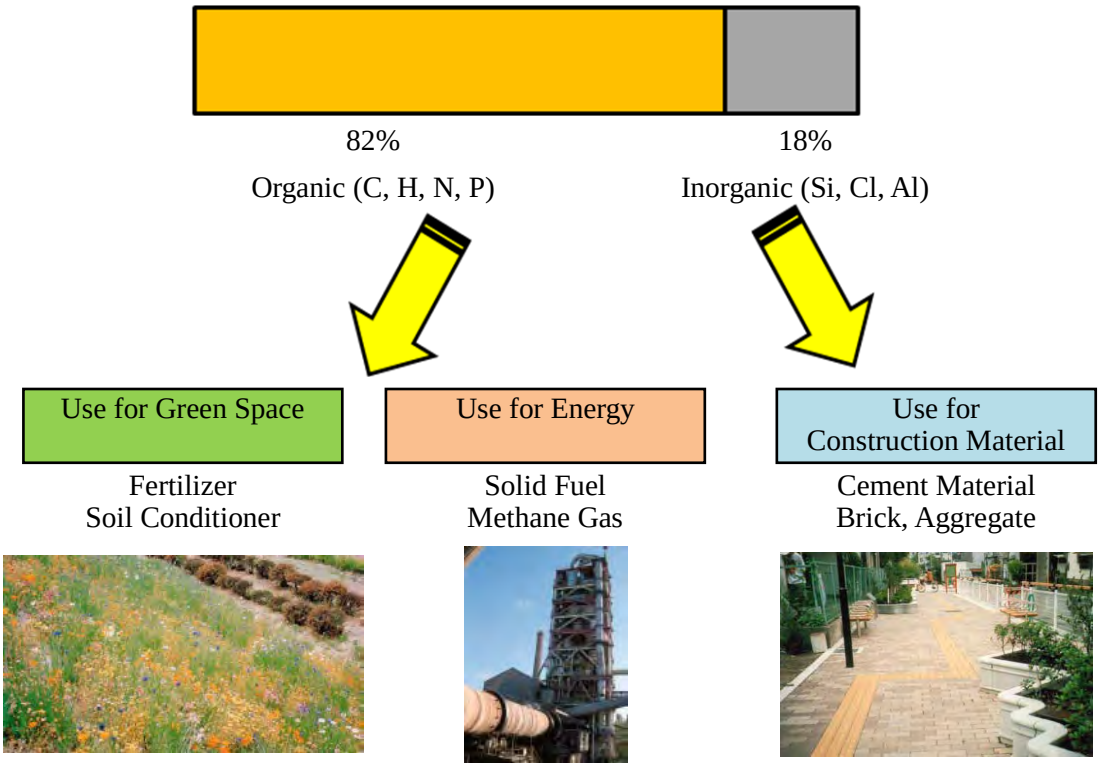
Facilities	Input	Output
Solar Green House	Dewatered Sludge Volume: 185t/day Moisture Content: 82%	Solar Dried Sludge Volume: 83.25t/day Moisture Content: 60%
Thermal Sludge Dryer	Solar Dried Sludge Volume: 83.25t/day Moisture Content: 60%	Dried Sludge Volume: 37t/day Moisture Content: 10%

Source: JICA Study Team

2.3.3 Study on End-use of Dried Sludge

(1) Sludge Reuse and Recycle

One of the major advantage of the thermal drying method is the end product can be reused. Generally sewage sludge contains about 82% organic components and 18% inorganic components. The organic components can be used as soil conditioner for the green space and as an alternate energy/ fuel source; and the inorganic components can be used for construction material as shown in Figure 2.3.2. The dried sludge has approximately 60% calorific value of low quality coal (The calorific values of carbonized sludge and coal are 3,000 and 6,300 kcal/kg). It may be noted that Sewage sludge is classified as renewable energy by Intergovernmental Panel on Climate Change (IPCC).



Source: Ministry of Land, Infrastructure, Transport and Tourism, Japan

Figure 2.3.2 Recycling Method of Sewage Sludge Component

(2) Japanese Experience regarding use of Sludge

In Japan, land filling of sewage sludge has become increasingly restricted due to scarcity of land. As a result, reuse and recycling is now predominate management

option and 78% of all generated sludge is reused and recycled in 2008. Major reuse and recycling methods adopted are greenery & agriculture, construction material, and cement industry. Out of these, cement industry is major reuse option as the share of this option reached 30 % of the whole produced sludge. Greenery & agricultural use is almost 10%, however it is applied to small scale treatment system. Changes of sewage sludge reuse and disposal in Japan is shown in Figure 2.3.3.

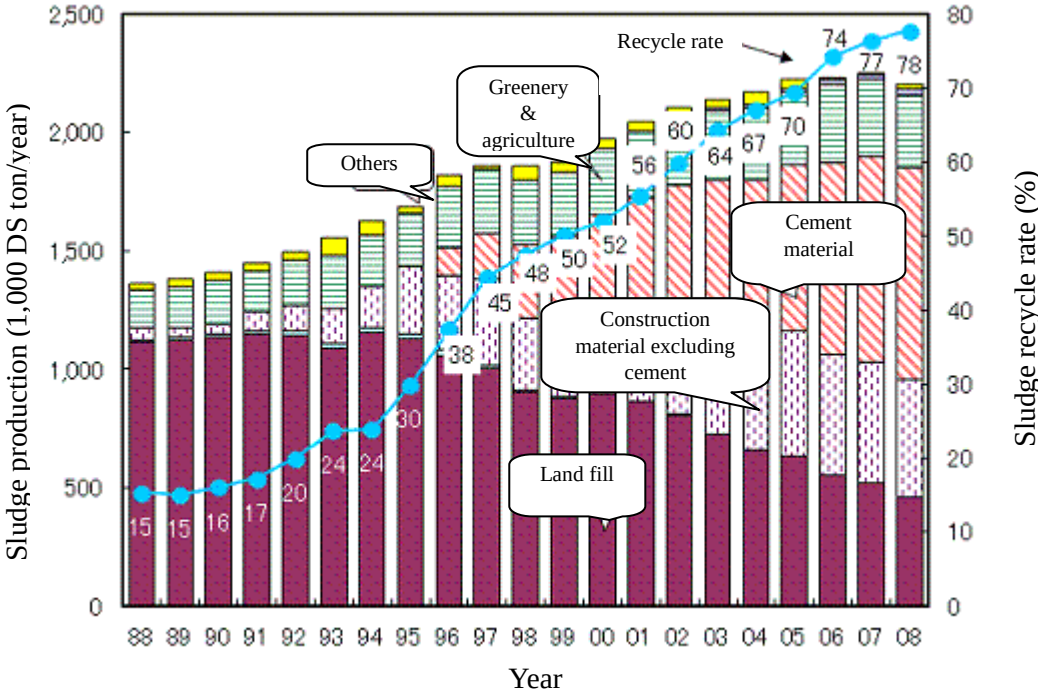


Figure 2.3.3 Sewage Sludge Reuses in Japan

Source: JICA Study Team

(3) Potential Demand Assessment of the Dried Sludge in Hanoi

The dried sludge from the thermal drying process can be used for many purposes; however, three end uses have been considered which can be applicable in Hanoi. These are,

- greenery use as soil conditioner (non human consumption products like flower),
- power plant as fuel, and
- cement industry as fuel and ingredient.

Between May and October 2011, JICA Study Team carried out needs assessment survey encompassing one power company (Pha Lai Coal-Fired Power Plant), two cement companies (But Son Cement JSC and Sai Son Cement JSC) and some

floricultural companies in and around Hanoi. The current situation, interest, opinion and evaluation based on the needs survey are shown in Table 2.3.2.

Table 2.3.2 Results of Needs Survey

	Power Company	Cement Company	Floricultural Company
Current Situation & Interest	They have high interest in environmental problems.	Coal price is rapidly increasing. So they have high interest in alternative fuel.	They are interested in the cheaper alternative of fertilizer..
Opinion	It is too early to use sewage sludge as an alternative fuel. It is necessary to carry out F/S and demonstration experiment. Approval from MOI is needed.	If sludge products have acceptable feature, they can consider using sludge products proactively. The acceptable feature; - Moisture Content is less than 10% - Calorific Value is more than 3,000kcal/kg - Exhaust Gas meets the exhaust standard	If sludge products have an advantage, they intend to try to use them. One of the floricultural companies has an interest in the demonstration experiment in his field.
Evaluation	Highest potential but considered for future adaptation	Recommendable for immediate adaptation	Recommendable as secondary consumers, as total demand is low.

Source: JICA Study Team

The potential demand of sludge recycling products by each customer has been studied and is shown in Table 2.3.3.

Table 2.3.3 Potential Demand of Sludge Recycling Products around Hanoi

	Power Company	Cement Company	Floricultural Company
Plant Capacity	Conventional coal fired, 600 MW	1. Cement: 3 million t/year 2. Cement: 300,000 t/y	
Consumption of Coal or Fertilizer	4,100t/day (1,500,000t/year)	1,050t/day (380,000t/year)	20t/day (7,000t/year)
Potential Demand	410t/day (150,000t/year) (10% Alternative Fuel)	105t/day (38,000t/year) (10% Alternative Fuel)	32t/day (11,600t/year) (50% Alternative Nitrogen of Fertilizer)

Source: JICA Study Team

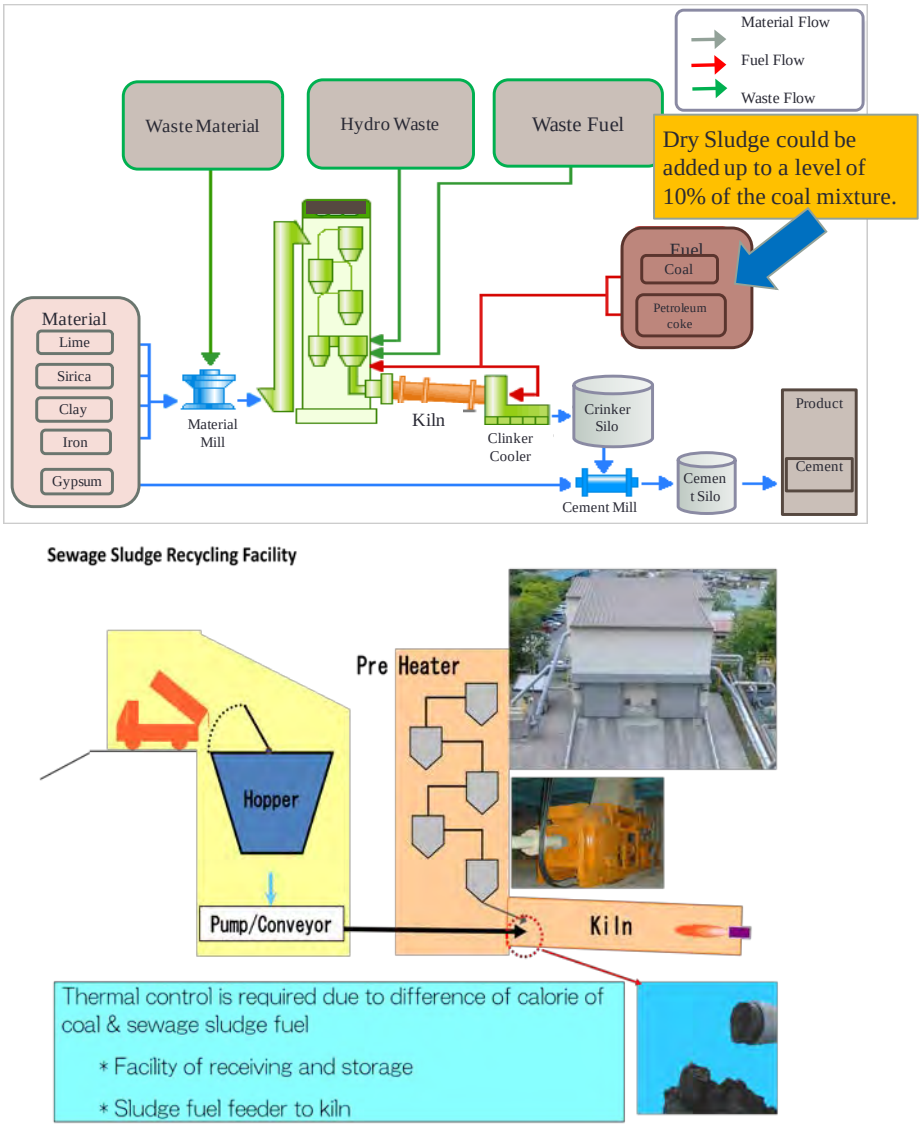
It can be said that the power company is the most potential customer followed by cement industry. However, certain adjustment is required for the power and cement

industries in order to utilize dried sludge. On the other hand, dried sludge can readily be used for greenery purpose though the demand is low and not constant year round.

(4) Potential Use of Dried Sludge in Cement Industries in Hanoi

Based on the above discussion, it is proposed that the dry sludge will be used as alternative fuel in cement factory and for greenery in the initial years of operation.

It is proposed that the dry sludge could be added to a level of 10% of the coal mixture without any adverse impact on the production system or the product as shown in Figure 2.3.4.



Source: Compiled by JICA Study Team based on secondary data

Figure 2.3.4 Sludge Recycling Process in Cement Factory

(5) Conclusion on the end user of the Dried Sludge in Hanoi

As explained above, greenery and cement industries are proposed as the initial end user of the dried sludge.

The power companies have the highest potential as end user (ref. Table 2.3.2). As a public enterprise, Government has more direct control over the power industries. It is expected that HPC together with the BOT proponent will pursue the Ministry of Industries to make adjustments in the power plants to receive the dried sludge.

As an incentive to the cement industries, HPC can issue an Eco-mark on the product. Also, HPC should promote public awareness by brochures and public events. Also, possibility of having a pilot scheme/ demonstration model should be discussed with HPC so that cement industries can get motivation.

In principle, the BOT proponent will actively engage in the promotion of dried sludge reuse and recycle with cooperation from HPC. HPC can ensure maximum utilization of dried sludge for all greenery use of HPC. Also, HPC shall consider providing new laws and/or official introductions to utilize dry sludge in greenery, cement companies and power plants. For instance, HPC can endorse an eco mark for the cement produced having dried sludge input. It is assumed that HPC will assume lead role in promoting dried sludge reuse and recycling and SPC will provide reasonable efforts in this regard.

2.3.4 Study on Sludge Transportation

In principle, respective WWTPs will deliver the dewatered sludge to the Sludge Processing Center by covered truck. It is assumed that WWTPs will bear the cost of such delivery.

It is also assumed that dried sludge will be collected by the end users from the Sludge Processing Center and the end users will bear the related cost.

For both the cases, the WWTPs and end users can maintain their own fleet or entrust the job to a transport company through out-sourcing.

2.4 Concept Design of Biosolids Processing Center

2.4.1 Applicable Standards

For the design purpose, Vietnamese Standards are applied whenever possible. In case, no VN standard is available, Japanese Standards are applied.

Table 2.4.1 Standard Applied in the Design

Item	Standard Applied
Effluent standard	Vietnamese Standard
Exhaust standard	Vietnamese Standard
Detail of Thermal Dryer	Japanese Standard

Source: JICA Study Team

2.4.2 Design Conditions

The following design conditions have been applied in the design.

Table 2.4.2 Design Conditions Applied

Item	Design Condition	Notes
Input dewatered sludge amount	185 t/d	2/3 of the planned sludge generation under optimum scenario
Input dewatered sludge moisture content	Around 82%	In line with the design output from Yen Xa WWTP
Output dried sludge moisture content	Less than 10%	Based on the request from the cement companies (refer to Table 2.3.3)
Proposed Site	Yen So dredged soil land-reclamation site	Site is owned by HPC and can be allocated by HPC for this purpose
Available Area	3.3 Ha	Maximum available land

Source: JICA Study Team

2.4.3 Solar Green House

Input sludge amount: 185 t/day
Input sludge moisture content: 82%
Output sludge moisture content: 60%

Area loading is equivalent to 6.2t/m^2/year (based on the experience of EU and South Africa)
Required drying bed area (m^2)

= 185 t/day * 365days / 6.2t/m^2/year =10,868m^2 (7 @ 12m*130m)

Amount of output sludge from solar green house =
{185 * (1-0.82)} / (1-0.6) = 83.25 t/d

Deposit sludge cake = 400mm deep.
Turn daily for approx 25 days.

Efficiency of solar drying owes to climate change. Since the wet-weather season in Hanoi has high humidity and less sunny hours, drying efficiency declines. On the other hand, efficiency in dry-weather season rises due to long sunny hours. Operation mode in dry-season and wet season shall be developed through examining drying efficiency, thickness of sludge dosing and quality of dewatered sludge.

Some examples of solar drying are shown below. List of required equipment for Green House operation is shown in Table 2.4.3.

Solar Green House, EU

Solar Drying, Nong Khaem WWTP, Bangkok

Sludge Turn-over & Drying, Johannesburg

Natural Composting, Johannesburg

Table 2.4.3. List of the Equipment of Solar Green House

Equipment	Specification	Quantity	Remark
Solar Green House	W12m*L130m*H5m	7	
Ventilating Equipment		14	2/house
Wheel Loader	For sludge spreading, agitation, conveyance	2	
Truck Scale	For measuring dewatered sludge	1	

Source: JICA Study Team

Outline of the Solar Green House

<table>
<tr><td>Specification
Steel frame,
Acrylic plastic board (Weather proof)
Exhaust equipment (5units/house),
Lighting
Rest station for workers,
Storage of equipments
Wastewater treatment facilities</td><td>Equipments
Tractor for agitating, Small track
Conveyor, Forklift
Weighing Machine</td></tr>
<tr><td>Full view
  </td><td>Full view
  </td></tr>
<tr><td>Entrance
  </td><td>Interior, Exhaust equipments
  </td></tr>
</table>

Source: JICA Study Team

2.4.4 Thermal Sludge Dryer

Input sludge amount: 83.25t/day
Input sludge moisture content: 60% (Solar dried sludge)
Output sludge moisture content: less than 10% (For use in cement industry)

Design Calculation is shown in the Table 2.4.4. List of required equipment for Thermal Sludge Drier operation is shown in Table 2.4.5.

Table 2.4.4 Design Calculation of Thermal Sludge Dryer

Item	Design Calculation
1. Design Condition	
Sludge Generation	Dewatered sludge 83.25 t/day Moisture content 60% (Solar dried sludge) Amount of solid 33.3 ds-t/day
2. Sludge Thermal Drying	
Drying Method	Direct Heating Method (Rotary Dryer)
Input sludge	83.25 wet-t/day
Input solid	33.3 ds-t/day
Dried sludge moisture content	10%
Operating days	365 days/year
Operating hours	24hrs
Output of dried sludge	33.3 * 100 / (100 – 10) = 37.0 t/day
Daily amount of water evaporation	83.25 – 37.0 = 46.25 t/day
Hourly amount of water evaporation	46.25 / 24 =1.93 t/hr
<u>Machine calculations</u>	
Amount of evaporation per belt area	58 kg-water/m^2・d ～ 89 kg-water/m^2・d ※rated operation（KES standards）
Required belt area	1.93 t/hr / (89 kg/ m^2・d / 1000 / 24) = 520 m^2 1 line = 210 m^2 520 m^2 / 210 m^2/line = 2.5 lines ⇒ 3 lines are needed
Quantity of heat pump dryer	Stand by = 1 line Total including stand by = 4 lines
	<u>In the case of worst efficiency</u>

	It is depended on sludge condition, for example high viscosity, low water cooling etc. 1.93 t/hr / (58 kg/ m^2・d / 1000 / 24) = 799 m^2 799 m^2 / 210 m^2/line = 3.8 lines (4 lines) ⇒ OK If the condition will be temporarily worse, 4 line dryers would be worked and all sludge could be dried.
3. Results	
Volume of heat pump dryer	Usually working 3 lines 1 line stand by
Operating hours	3 lines: 24 hr/d×365 d/y (The dryer will be controlled by frequency inverters)

Source: Study Team

Table 2.4.5 List of the Equipment for Thermal Sludge Drier

No.	Item	Specification	Number
1	Hopper of solar dried sludge		2
2	Conveyor for sludge input	Flight conveyor Hopper of solar dried sludge → Inlet of heat pump dryer	4
3	Heat pump dryer	Amount of sludge treatment;30t/d	4
4	Conveyor for transmitting dried sludge	Screw conveyor Outlet of heat pump dryer → Conveyor for transmitting dried sludge	4
5	Conveyor for transmitting dried sludge	Flight conveyor → Hopper for dried sludge	1
6	Conveyor for transmitting dried sludge	Screw conveyor Spreading to hopper for dried sludge	1
7	Hopper for dried sludge		2
8	Fan for deodorizing	Volume;30m^3/min	1
9	Active carbon adsorption tower	Volume;30m^3/min	1
10	Discharge pump	Volume;1.7m^3/min	2
11	Feeding pump	Volume;1.6m^3/min For feeding of cooling water to the dryers	2

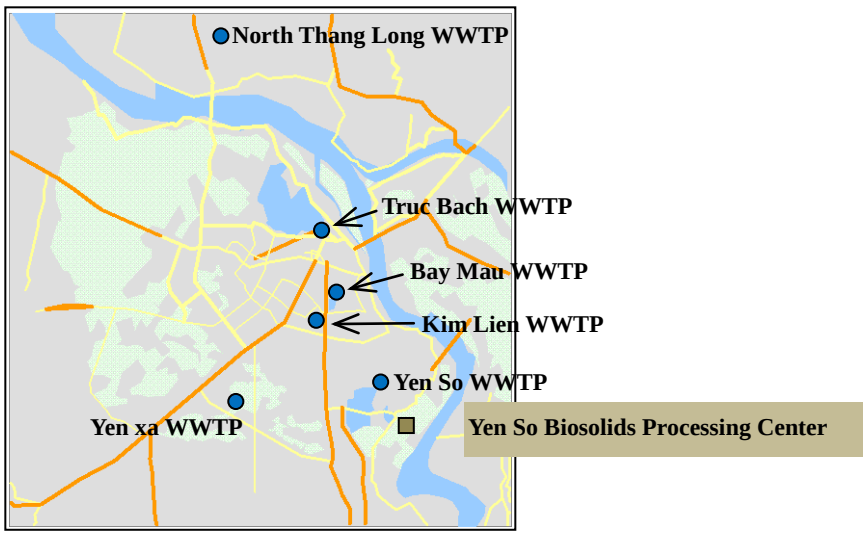
Source: Study Team

2.4.5 Location and Layout Plan

Three options were considered for the selection of the Project location, namely, Yen Xa WWTP, Yen So dredged soil land reclamation site, and Cau Dien Composting Plant. Evaluation criteria used included availability of sufficient area, traffic accessibility, environmental mitigation measure and future up-grading possibility. Yen So dredged soil reclamation site is advantageous because of availability of sufficient land area, distance from current residences and future land use plan for eliminating residences.

Though Yen So dredged soil reclamation site is located outside the dyke area, the current land elevation is as high as existing nearby residential areas. Since the center should have measures against accidental pollution run-off, such measures should be elaborated in F/S and D/D stage. Since the proposed site is far from the nearby residents, it would be possible to maintain the buffer zone against offensive odor as required by Vietnamese Law.

The recommended location of the proposed Biosolids Processing Center is shown in Figure 2.4.1.



Source: JICA Study Team (Picture courtesy of Google Map)

Figure 2.4.1 Location Map

The current condition of the proposed site is shown in the picture below.

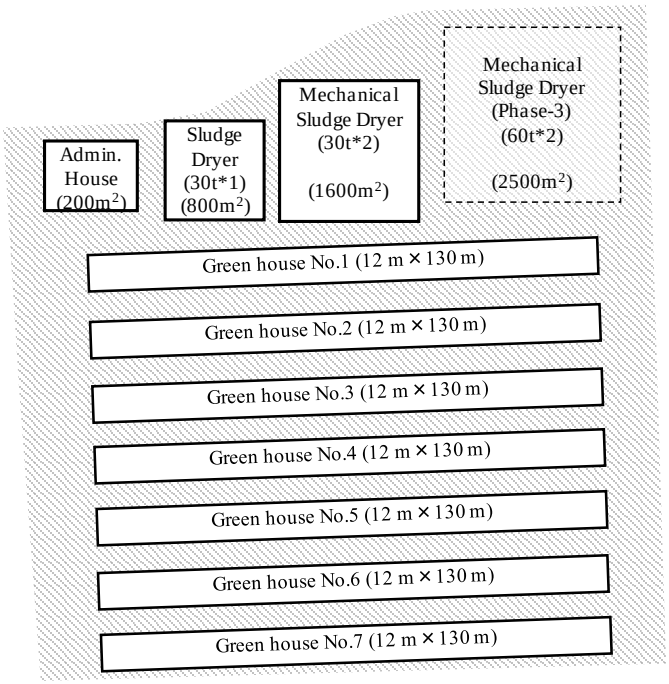
Source: JICA Study Team

Figure 2.4.2 Current Condition of the Proposed Site

The layout plan of the sludge processing center is proposed as shown in Figure 2.4.3. The area of the site is about 3.3ha (around 180 m x 180 m). The center facilities include seven (7) green houses, four (4) units of thermal dryer and an administration house.

The plan view of the Sludge Processing Center, technical plot plan of the thermal dryer units, flow diagram of the thermal dryer units, and plan of the solar green house are shown in Figure 2.4.4, 2.4.5, 2.4.6 and 2.4.7, respectively.

Yen So Sludge Recycle Center



Source: JICA Study Team

Figure 2.4.3 Sludge Recycling Process in Cement Factory

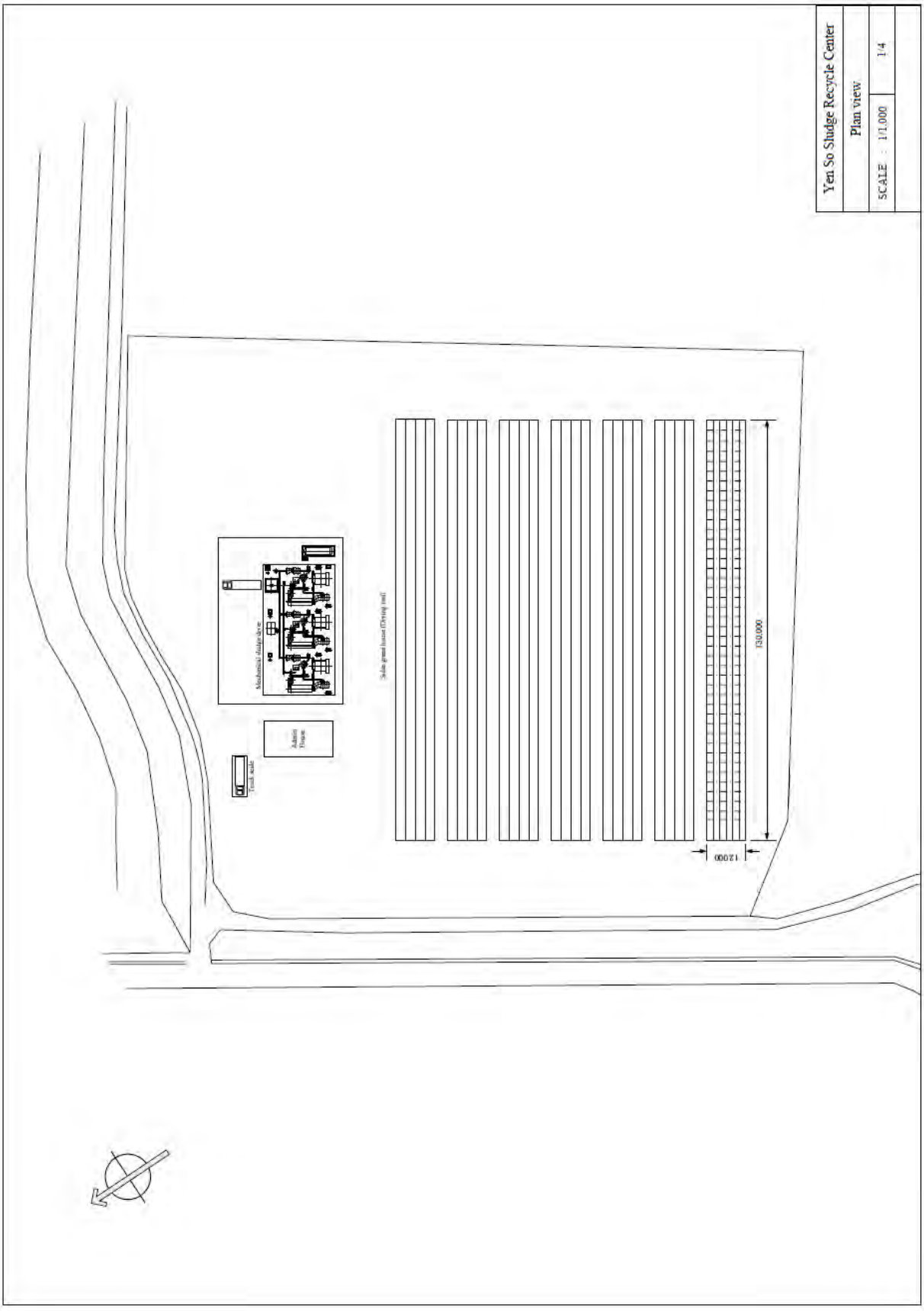


Figure 2.4.4 Plan View of the Sludge Processing Center (Source: JICA Study Team)

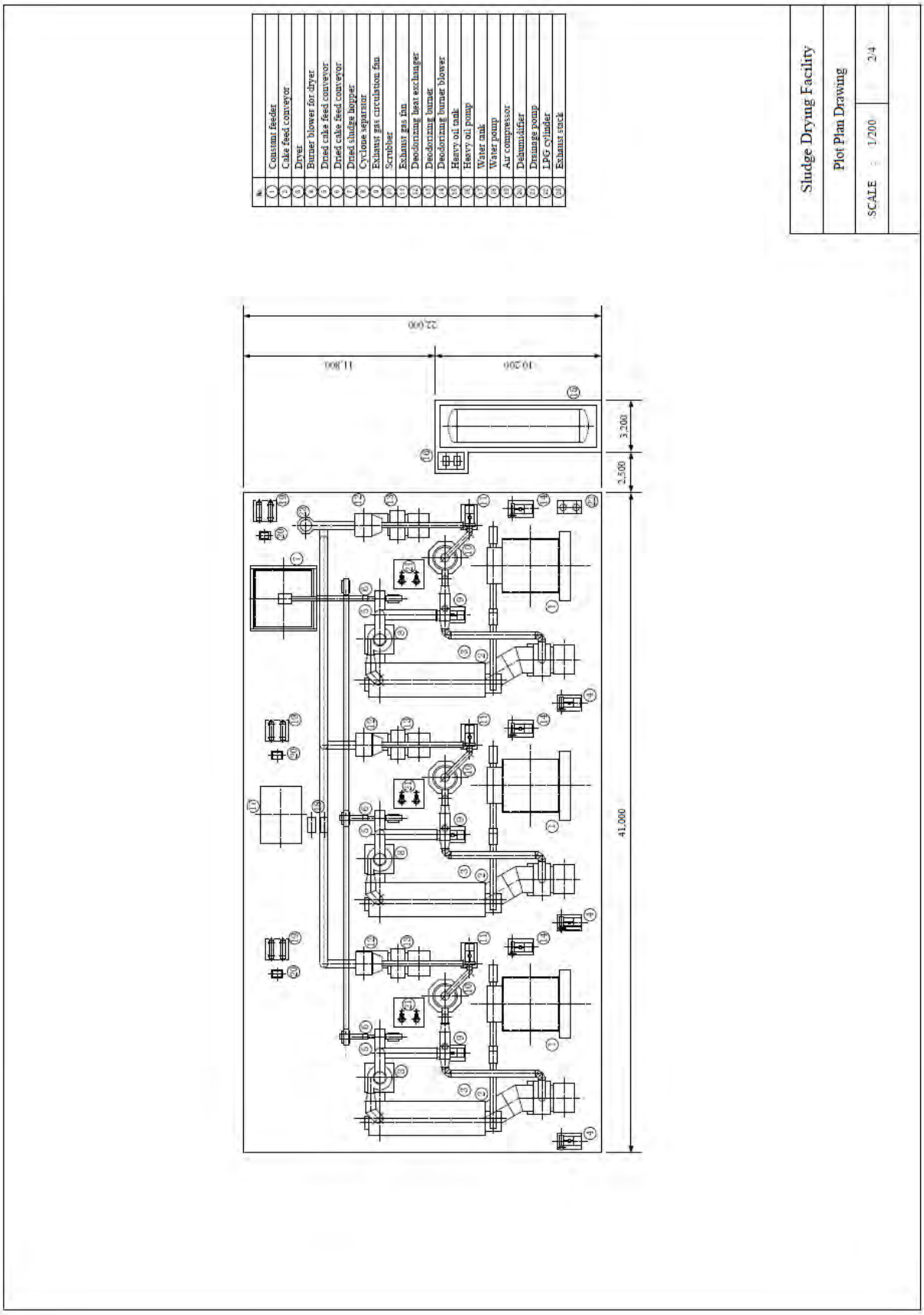


Figure 2.4.5 Plot Plan of Mechanical Facilities (Source: JICA Study Team)

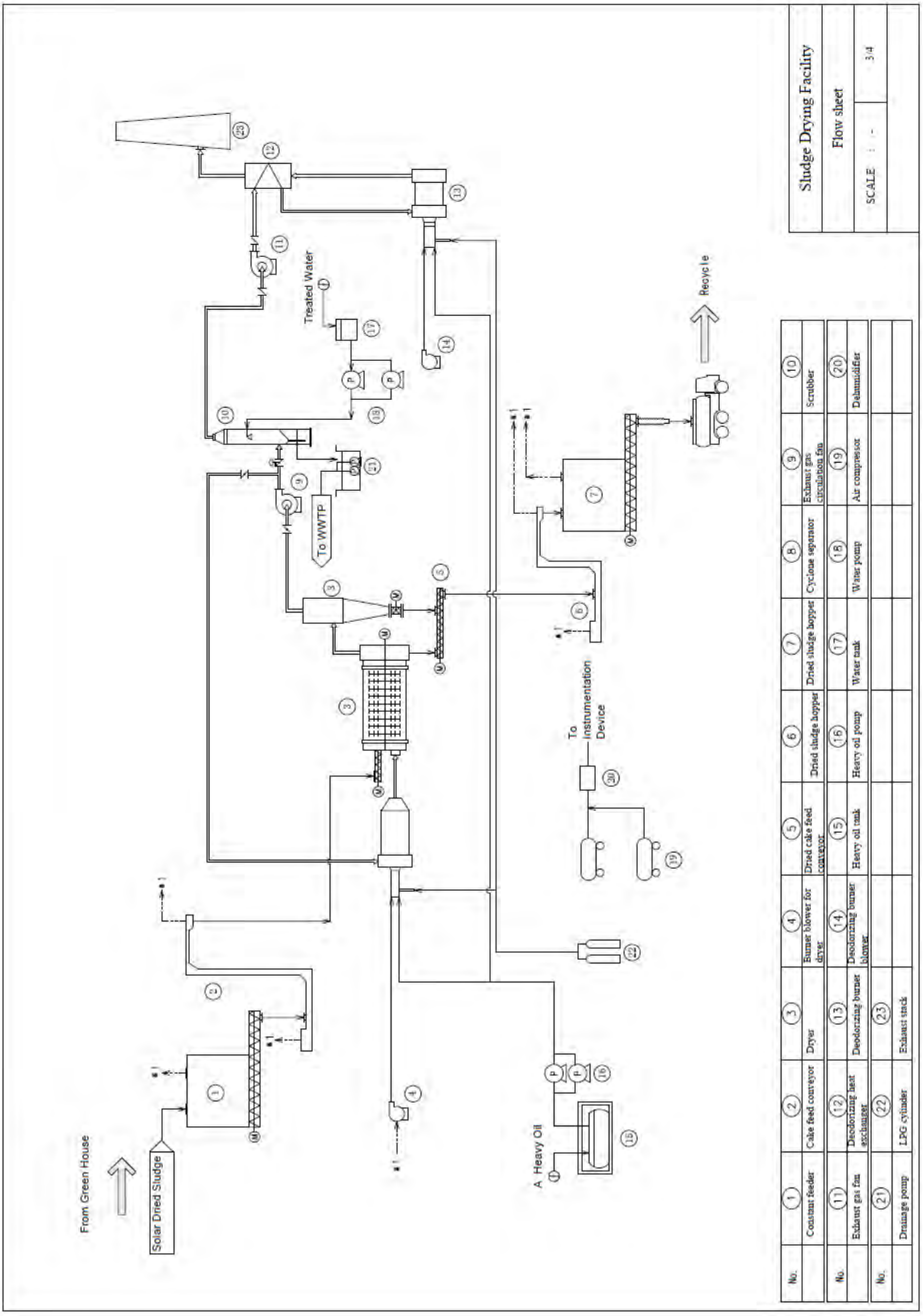


Figure 2.4.6 Flow Sheet (Source: JICA Study Team)

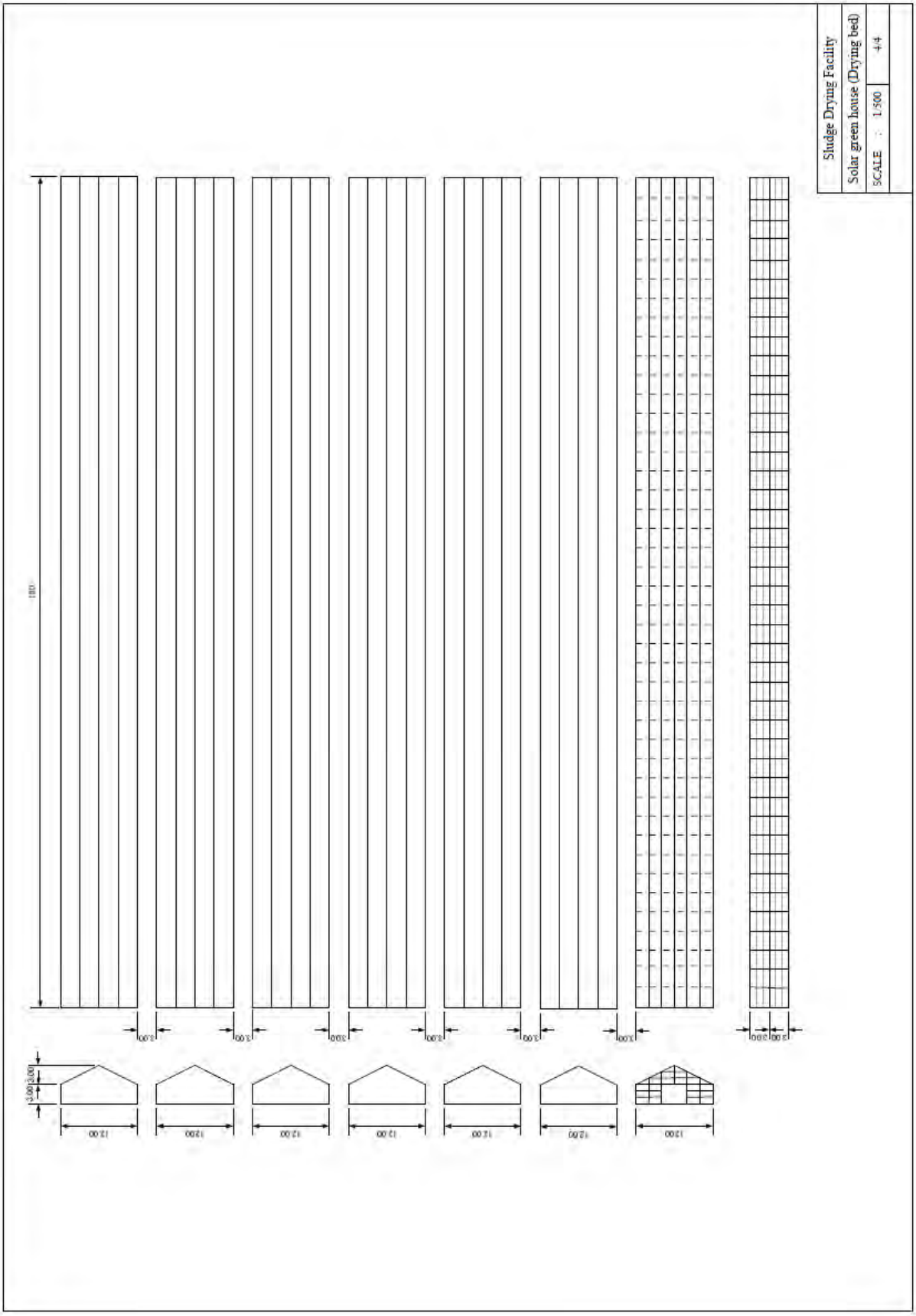


Figure 2.4.7 Plan of the Solar Green House (Source: JICA Study Team)

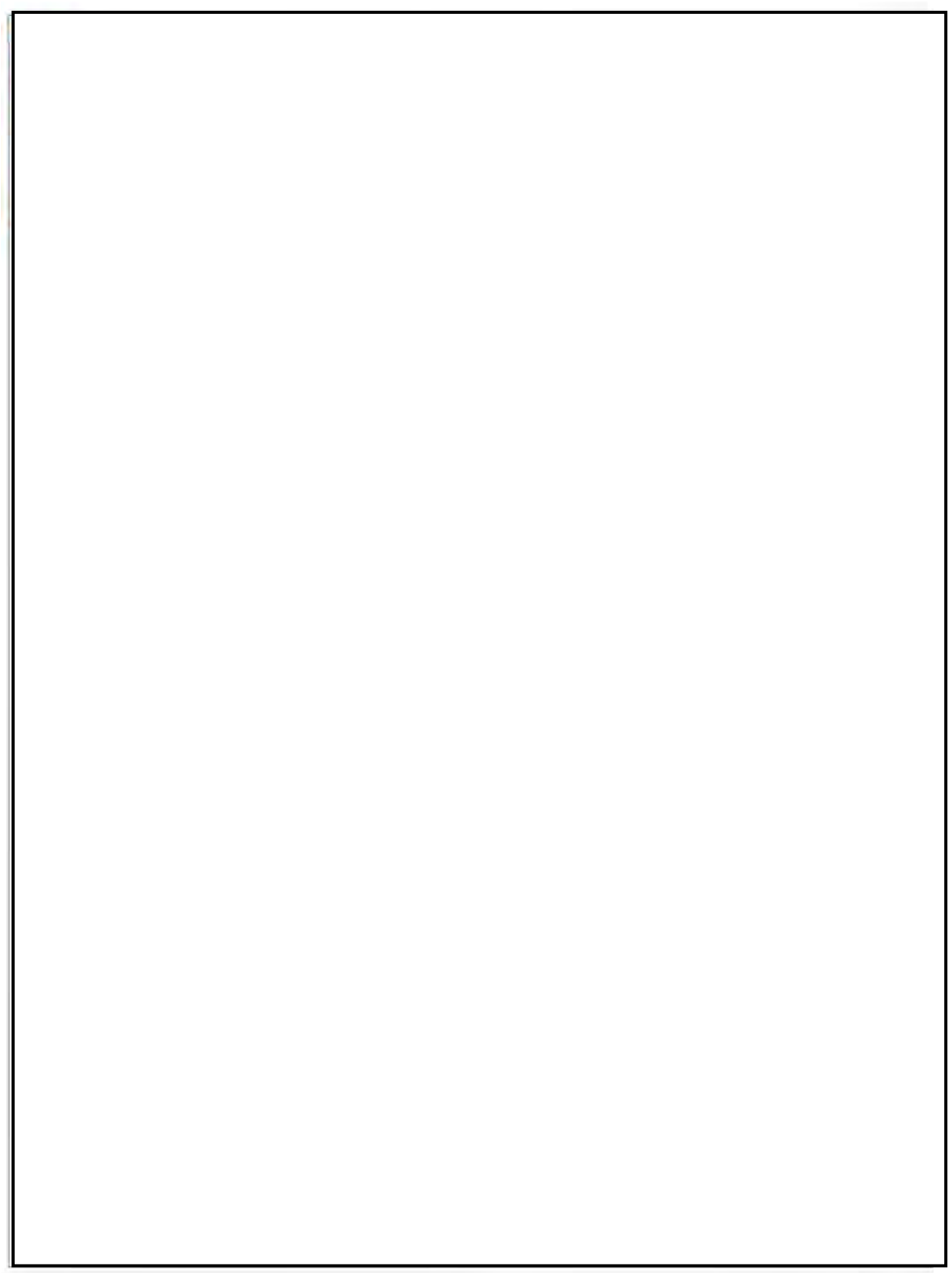


Figure 2.4.8 Plot Plan of the Sludge Dryer (Heat Pump Type) (Source: JICA Study Team)

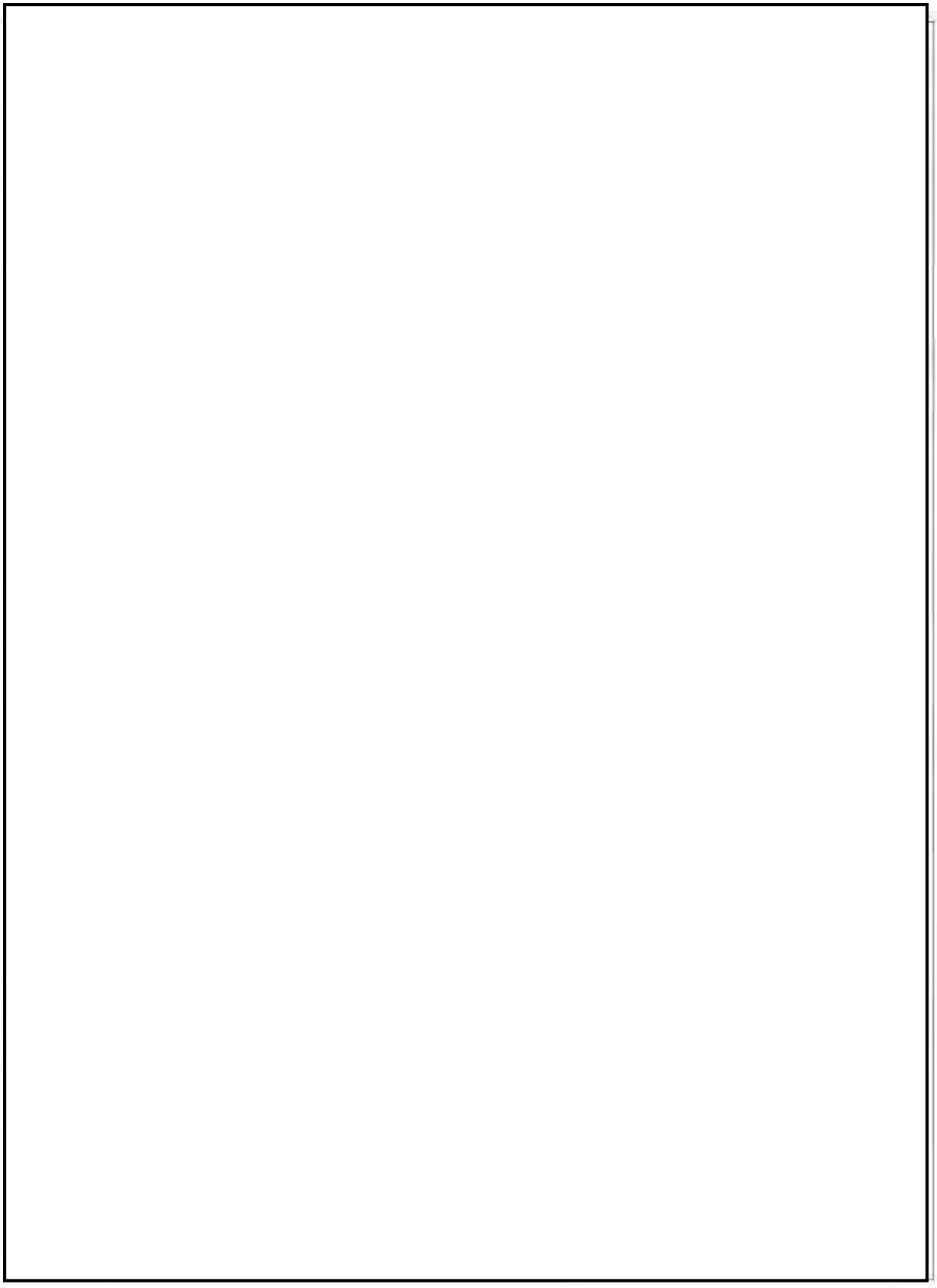


Figure 2.4.9 Flow Diagram of the Thermal Dryer Units (Source: JICA Study Team)

2.5 Plant Operation

During the operation stage, the required number of staffs are shown in the following table.

Table 2.5.1 Required Operation Staff for Sludge Processing Center

	Works items	Jobs Category	Numbers
1	Director	Wastewater treatment	1
2	General affairs	Manager	1
		General	0
		Procurement	0
		Sub total	1
4	Drying Beds	Manager	1
		Water analysis	0
		Monitoring & Control	0
		Daily check & Round	2
		Sub total	3
5	Maintenance	Manager	1
		Drying Beds	0
		Drying Machines	1
		Sub total	2
6	Drying Machines	Manager	1
		Operation	8
		Daily check & Round	3
		Sludge disposal	
		Sub total	12
7	Guards	Manager	0
		Guards	4
		Environmental Eqip.	
		Sub total	4
Total			23

Chapter 3 Preliminary Cost Estimation

3.1 Basic Condition

The basic conditions, definitions and assumptions applied for the cost estimate are presented in this section.

(1) Project Execution Method

The Feasibility Study for the BOT project will be executed by outsourcing the task to a reputed Japanese/ Vietnamese consulting company.

The design, procurement, construction will be executed by outsourcing the tasks to a reputed Japanese EPC Contractor.

The operation will be entrusted to the proposed Joint Company for sewerage sector O&M expected to form comprising HSDC and the BOT proponent.

(2) Price Level

The cost is estimated based on the price level of April 2011.

(3) Foreign Currency

For this Proposal, United States Dollar (USD) is used as only currency. Japanese Yen (JPY) and Vietnam Dong (VND) are converted to USD.

(4) Exchange Rate

The foreign currency exchange rates used are,

- VND/US$ = 20,944
- JPY/US$ = 83.15, and
- JPY/VND = 0.00397

(5) Unit Price

The construction cost is based on Vietnamese standard price and Japanese standard price as follows:

- Costs of general civil works are based on Vietnamese standard price of 2008 as

used in the JICA Yen Xa WWTP F/S after applying a price escalation from 2008 to 2011.

- Costs of green house, wheel loader, thermal dryer, administration house, storage, track scale and firefighting station are based on quotation from Japanese manufacturers.

3.2 Preparatory Cost

The cost required until the start of the EPC contract can be termed as preparatory cost. The items include,

- Establishment of SPC
- Establishment of Office
- Mobilization of SPC staff
- Feasibility Study
- EIA and environmental clearance
- Contract negotiation for EPC contract

The estimated cost is [redacted]

3.3 EPC Cost

It is proposed that engineering, procurement and construction will be carried out through one EPC contract.

(1) Direct Construction Cost

The work items of construction works are as follows:

- Civil Works: Solar green house, Administration house with storage, Fire fighting station, Land preparation, Road, General utilities, others
- Mechanical and Electrical Works: Thermal sludge dryer, Wheel loader

Table 3.3.1 shows the breakdown of construction cost. The direct construction cost is [redacted]

Table 3.3.1 Breakdown list of EPC Cost of sludge drying facilities

Source: JICA Study Team

(2) Total EPC Cost

The total EPC cost comprises the construction and procurement cost, engineering

service cost, physical contingency, and various taxes and duties. The direct construction cost is explained above; the other components are assumed as certain percentage of direct construction cost as explained below.

- The engineering service cost for detailed design and construction supervision is estimated as 10 % of total construction and procurement cost.
- The tax and duties include VAT and income tax, which is assumed to be 10% of the sum of construction and procurement cost, and engineering service cost.

The preliminary cost estimates for the EPC is shown in Table 3.3.2, which is around USD 64 million.

Table 3.3.2 Initial cost of sludge drying facilities

Source: JICA Study Team

3.4 O&M Cost (Routine O&M, Repair and Replacement)

The work items of O&M works can be divided into two broad categories.

- To receive dewatered sludge from WWTPs, to operate green house and thermal drier to make dried sludge, and to provide the dried sludge to end users, and
- To maintain all equipments of the sludge processing facilities (including repair and replacement)

The items of O&M cost is shown as below.

Table 3.4.1 Items of O&M Cost

No.	Items	Contents
1	Labor Cost	
2	Utilities	Electricity consumption cost Oils Consumables
3	Monitoring and inspection cost	
4	Major Repair	
5	Cleaning and yard maintenance	

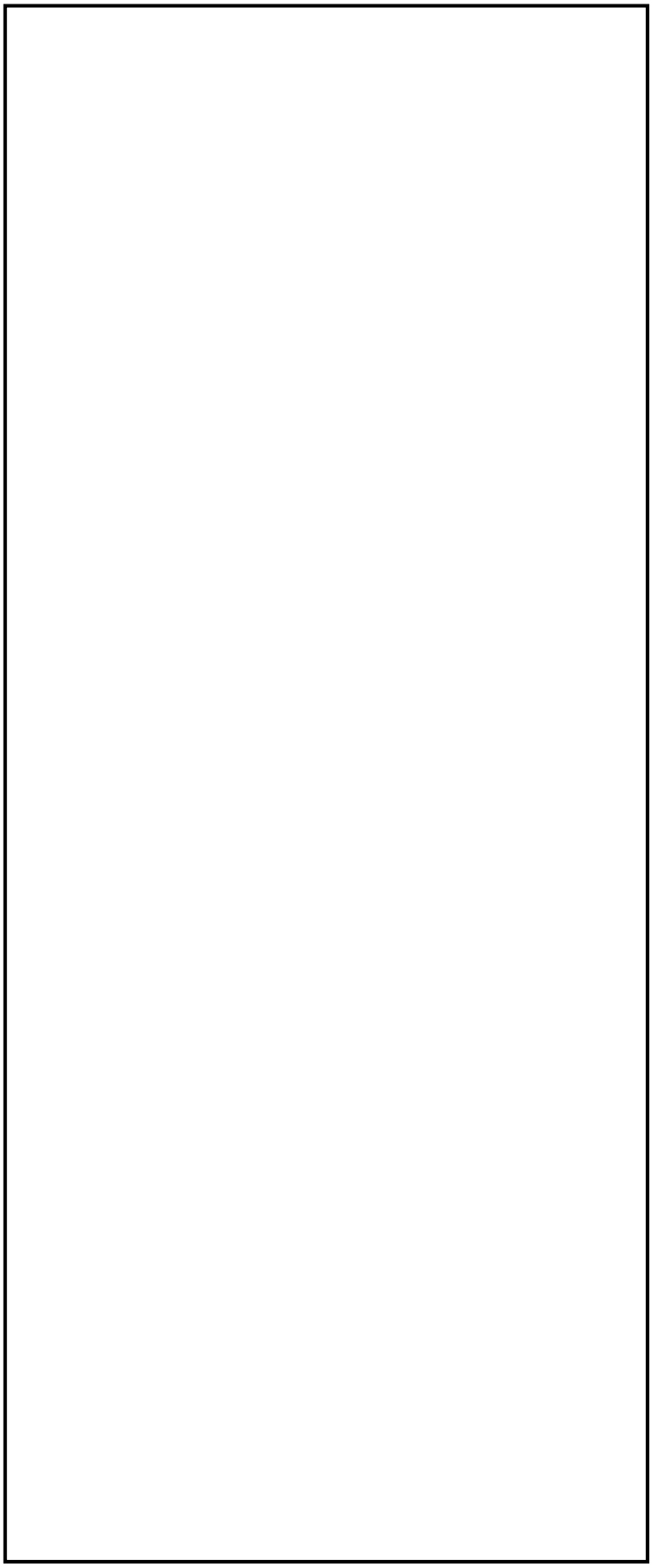
No.	Items	Contents
6	Other Expenses	Small scale repairs Rental car fee Telephone fee Business equipment rental fee Office supplies Others (water supply, etc.)
7	O&M Consultant	
8	Insurance	
9	Provisional sum for contingency	
10	Overhead	
11	Replacement	

Source: JICA Study Team

Breakdown of some of the items are elaborated further.

The O&M cost is shown in Table 3.4.2. The total O&M cost is [redacted] The average O&M cost per year is [redacted] including the replacement cost in 11th yaer.

Table 3.4.2 O&M Cost

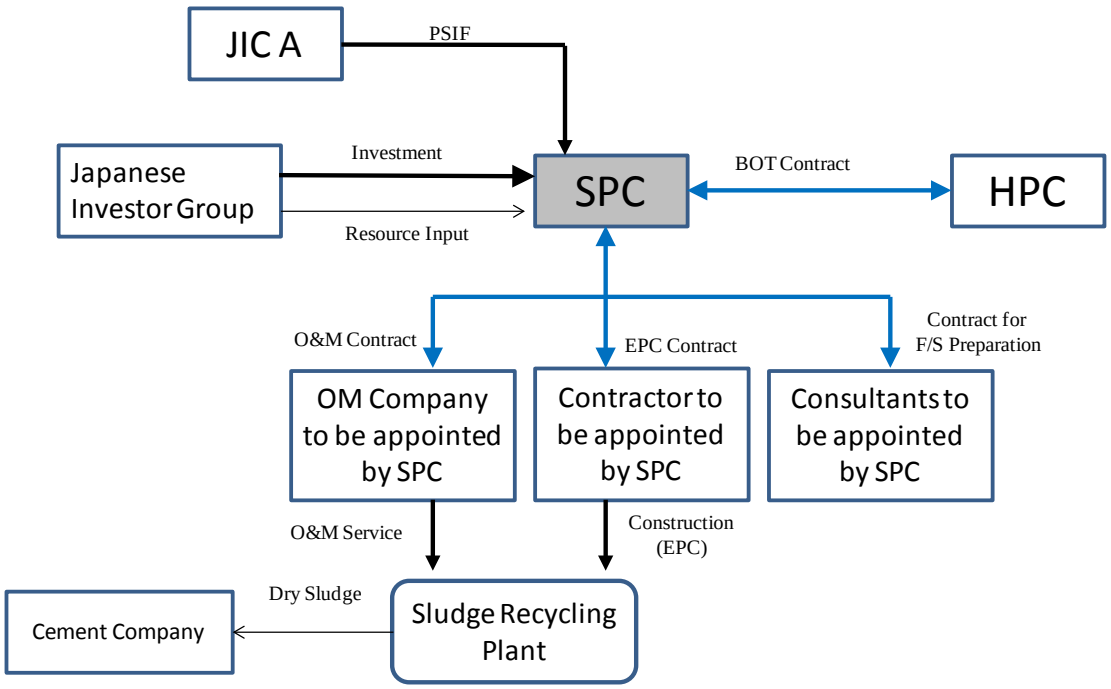


Chapter 4 Proposed Project Scheme

4.1 Outline of BOT Scheme

4.1.1 Structure of BOT Scheme

A Built-Operate-Transfer (BOT) scheme is proposed for the Yen So Biosolids Processing Center. The main advantages of such scheme are elaborated in Section 1.2.4. The proposed operation time is 22 years. After that the facilities will be transferred to HPC. The structure of the proposed scheme is shown in Figure 4.1.1.



Source: JICA Study Team

Figure 4.1.1 Structure of Proposed Project Scheme

4.1.2 Outline of SPC

It is proposed that a Special Purpose Company (SPC) will be formed who will be the executor of the BOT scheme. The SPC will be comprised of a consortium of Japanese firms arranged by ORIX Corporation.

The tasks of the SPC after the establishment of the SPC, are as below;

1) F/S preparation and approval (from October, 2013, to September, 2014)
2) Design and Construction (from October, 2014, to December, 2015)
3) O&M (from January, 2016, to December, 2034)

As shown in Figure 4.1.1, SPC will subcontract above three works. The SPC will outsource F/S preparation and approval to Japanese and Vietnamese consultants, and outsource the design and construction works to a contractor through an Engineering, Procurement and Construction (EPC) contract. In addition, the SPC will also outsource O&M of the Center to the O&M Company, which is supposed to be established by HSDC and a Japanese consortium.

Under these situations, the SPC is required to have management and administration staff only. The required staff of the SPC is shown in Table 4.1.1.

Table 4.1.1 Required Staff of SPC

Position	Nationality/Status	Number
Chairman	Japanese/Full-time	1
General Director	Japanese/Full-time	1
Chief of Technical Affairs	Japanese/Part-time	1
General Staff	Vietnamese/Full-time	1

Source: JICA Study Team

It is to be noted that the member entities of the Japanese consortium in the O&M company is preferably identical to that of SPC.

4.1.3 Equity and Debt

[redacted]

4.1.4 Investors

It is proposed that ORIX, KOBELCO and Nippon Koei to be the investors of the Project and they will be the partners of the Special Purpose Company (SPC).

(Corporate profiles of each firm have been attached with this document.)

4.2 Proposed Project Implementation Schedule

The proposed Yen Xo Biosolids Processing Center is essential to manage the huge dewatered sludge coming out from existing WWTPs and the WWTPs to be completed. The dewatered sludge productions from existing WWTPs are low and can be managed with current disposal practice. After completion of Yen So WWTP and Yen Xa WWTP, the amount of dewatered sludge will be increased rapidly, so that the center should be constructed before completion of the both WWTPs.

Yen So WWTP will generate sludge soon, but those are digested sludge, so they will have less organic matter. Such sludge is less appropriate for use as alternate fuel in cement industry. To confirm sludge recycling process, additional study is required by using sludge digested in Yen So WWTP.

For the Project implementation, the following schedule is proposed:

- March 2012 Preparation of Draft Proposal of BOT Project
  MOU for Selection of Investor of BOT Project
- August 2012 Commencement of Additional study by using digested sludge from Yen So WWTP
- September 2012 Approval by relevant ministries after addition to national BOT Project List
- March 2013 Selection of Investor of BOT Project
- August 2013 Submission of Application for Business Registration and Investment Certificate to HAPI
- September 2013 Issuance of Business Registration and Investment Certificate by HPC (Establishment of SPC)
- September 2013 Commencement of Feasibility Study
- September 2014 Approval of Feasibility Study
- September 2014 Commencement of Detailed Design
- January 2015 Commencement of Construction
- January 2016 Commencement of Operation

The implementation schedule of this BOT Project in relation with other projects (like Yen Xa WWTP and O&M Joint Company) is shown in the Figure 4.2.1.

	Month	2011				2012												2013				2014				2015				2016				2017				2018				2019				2020				2021			
		I	II	III	IV	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
(1) JICA PPP Study																																																			
(2) Funding Arrangement for Yen Xa WWTP Project	7																																																		
1) Short Listing																																																			
2) Contact & Fact Finding	3																																																		
3) Appraisal for ODA Laon	2																																																		
4) Exchange of Notes	1																																																		
5) Loan Agreement	1																																																		
(3) Implementation of Yen Xa WWTP Project	81																																																		
1) Selection of Consultant of Yen Xa WWTP Project	6																																																		
2) Detailed Design	15																																																		
3) Prequalification	4																																																		
4) Bidding Period	3																																																		
5) Evaluation and Signing of Contract	4																																																		
6) Construction Works	40																																																		
7) Operation under Gurantee Period	12																																																		
(4) Agreements for Establishment of Joint Company																																																			
1) Signing on Term Sheet (Appointment of Partner)																																																		
2) Sigjning on JV Agreement																																																		
3) Submission of Application for BR & IC to HPC																																																		
4) Issuance of BR & IC by HPC																																																		
(5) Operation of Joint Company																																																			
1) Establishment of JC																																																		
2) Preparation Works for Operation																																																		
3) Operation (Yen So WWTP) by Gamuda																																																		
4) Operation (Yen So WWTP) by JC																																																		
5) Operation (Ho Tay WWTP) by JC																																																		
6) Operation (Bay Mau WWTP) by JC																																																		
7) Operation (Phu Do WWTP) by JC																																																		
8) Operation (Yen Xa WWTP) by JC																																																		
(6) BOT (Sludge Recycling Facility)																																																		
1) Submission of Draft Proposal																																																		
2) Submission of Proposal																																																		
3) MOU for Implementation of BOT																																																		
4) Approval of BOT Project																																																		
5) Selection of Investor																																																		
6) Procedure of Business Registration																																																		
7) Establishment of SPC																																																		
8) F/S																																																		
9) Design																																																		
10) Construction																																																		
11) Operation																																																		

Critical point

Figure 4.2.1 Proposed Implementation Schedule of Yen Xa WWTP Project and Relevant Projects

Chapter 5 Financial Analysis

5.1 Methodology of Financial Analysis

To conduct the financial analysis, we prepared a financial model for the "Yen So Central Bio-solid Processing Center" (The Facility) to be conducted under the Built-Operate-Transfer scheme ("BOT Project"). The financial model is structured so that analysis of many cases can be done by changing several assumptions as described in the section "5.2 Conditions and Assumptions" below. Outputs are summary of i) Balance Sheet, ii) Profit and Loss Statement, and iii) Cash Flow Statement. Certain financial ratios to evaluate the financial viability are also calculated in the financial model.

5.2 Conditions and Assumptions

Assumptions in the financial model consist of 6 areas, i.e., i) Business plan (schedule and scope), ii) Taxes, iii) Financing, iv) Initial Development and Construction Cost v)Operation and Maintenance Cost, vi) Revenues, and vii) Reserve accounts.

Currency for calculation is US dollars.

Table 5.2.1 Business Plan Assumptions

Item	Assumption
Sharing of Roles among Related Parties in relation to the BOT Project	**HPC** - To grant long term license to SPC to construct, own, operate, and maintain the Facility effective during the period of the BOT Project. - Subject to performance by SPC in accordance with the pre-agreed operating standard, to pay to SPC the tariff for its operation of the Facility. - To be transferred the Facility by SPC at the expiry of the period of the BOT Project with no consideration. - To cooperate with SPC for smooth production and absorption of the bio-solid in accordance with the agreement for production and offtake of dry sludge (regarding the preliminary terms and conditions of the agreement, see Appendix-B2.).

Item	Assumption
	SPC - To build, own, and operate and maintain in accordance with the pre-agreed operating standard, the Facility during the period of the BOT Project (maintenance of the Facility to include to take responsibility for replacements with taking the risk of functional deterioration. SPC will do necessary replacement of the facilities with receiving "pre agreed" service charge include replacement.). - To transfer the Facility to HPC at the expiry of the period of the BOT Project with no consideration. - To cooperate with HPC for smooth production and absorption of the bio-solid in accordance with the agreement for production and offtake of dry sludge as mentioned above. **JC** - In accordance with certain long term O&M sub-contract with SPC, to operate and maintain the Facility (maintenance of the Facility to include replacement works but JC does not take the risk of functional deterioration. JC will replace the facilities with the money which it will receive then.).
Schedule	・Establishment of entities - SPC: **January 1, 2014** ; JC: **January 1, 2013** ・Construction Period: **one year (year 2015)** ・Period of O&M (operation and maintenance): **22 years from January 1, 2016** ・ Period of operation and maintenance is assumed to end the same date as the end date of JC's O&M contract for Yen Xa WWTP (which is assumed as 20th anniversary of the assumed starting date of the Yen Xa O&M contract, i.e., January 1, 2018). ・Project Period: Construction period plus period of O&M
Capacity of the Facility	The Facility is assumed to treat up to 184m^3 per day of raw sludge to be transported to the Facility from the WWTPs in Hanoi.

<table>
<tr><th>Item</th><th>Assumption</th></tr>
<tr><td>Operating ratio</td><td>In the beginning 3 years in the operation period, less than 100% of operation is assumed. Thereafter, full operation is assumed.
<Operating Ratio Assumption>
<table><tr><th>Year</th><th>2016</th><th>2017</th><th>2018</th><th>thereafter</th></tr><tr><td>Operating Ratio</td><td>64%</td><td>64%</td><td>98%</td><td>100%</td></tr><tr><td>Annual Treatment Volume (‘000m3)</td><td>43.2</td><td>43.1</td><td>66.0</td><td>67.4</td></tr></table></td></tr>
<tr><td>Scheme</td><td>BOT scheme is assumed, where SPC, established solely for the purpose of conducting this BOT Project, shall build, own, operate, and maintain the Facility during the Project Period, and transfer the Facility to HPC at the expiry of the Project Period without consideration.</td></tr>
</table>

Table 5.2.2 Tax Assumptions

<table>
<tr><th>Item</th><th>Assumption</th></tr>
<tr><td>Taxes and rates</td><td>・Value added tax：10%
・Income tax：According to the following tax incentive
・Property tax：None</td></tr>
<tr><td>Income tax incentive</td><td>・Applicable income tax rate
<table><tr><td>Until 15th anniversary of operation</td><td>10%</td></tr><tr><td>Thereafter (until 45th anniversary of operation)</td><td>25%</td></tr></table>・Further reduction of tax rate from the above
<table><tr><td>Until 4th anniversary of operation</td><td>100%</td></tr><tr><td>Until 9th anniversary of operation thereafter</td><td>50%</td></tr></table>・Applicable income tax rate after above incentives
<table><tr><td>Until 4th anniversary of operation</td><td>0%</td></tr><tr><td>Until 9th anniversary of operation thereafter</td><td>5%</td></tr><tr><td>Until 15th anniversary of operation thereafter</td><td>10%</td></tr><tr><td>Thereafter (until 45th anniversary of operation)</td><td>25%</td></tr></table></td></tr>
</table>

Table 5.2.3 Financing Assumptions

Item	Assumption
[redacted]	[redacted]
[redacted]	[redacted]
Equity IRR	- Equity IRR ("EIRR") in this analysis is defined as the internal return rate of dividends and final equity return (after expiry of Project Period) to the initial equity investment to SPC by the shareholders of SPC. - [redacted]
Subsidy	- No subsidy is assumed.
Financing	**Debt : Equity ratio is assumed as 70 : 30** **Equity** - Equity investment is assumed to be made during Construction Period up to 30 % of the total funding amount and in accordance with the schedule for equity investment to SPC as described above. **Debt** - SPC is assumed to obtain long term loan in accordance with the following conditions: · Signing: Year 2014 · Source: Private Sector Investment Finance program (PSIF) provided by JICA · Currency: Japanese Yen (converted in its effect to USD loan using currency swap transaction) · Grace Period: until end of 2018 · Repayment Conditions: Principal repayments 19 years' equal principal payment from 2019 (ending in 2037, the last year of Project Period)

	· Fees: Not assumed · Interest rate: 5% (USD base after currency swap)
Inflation	- 3% p.a. of inflation (USD base) is assumed.

Table 5.2.4 Initial Development and Construction Cost Assumptions

Item	Assumption
Construction Cost	- Construction cost is assumed as USD 41,672 thousand, inclusive of 10% tax. (Amount described here is fixed price, i.e., Amounts actually assumed in the financial model is the same as the amount described here.) - Construction cost is assumed to be paid once at completion of the Facility in 2015.
[redacted]	[redacted]
Depreciation	- For accounting and tax calculation purpose, construction cost and replacement cost is assumed to be booked as fixed asset at completion of construction and replacement, and to be depreciated over the remaining years of the Project Period so that the fixed asset so booked at the end of the Project Period becomes zero.

O&M cost is divided into i)variable cost, ii)fixed cost, and iii)replacement cost and assumed respectively. The amounts so assumed each year (all 2011 price) are described in Attachment 1. [redacted]

The mine cost items included in the O&M cost are as follows:

Table 5.5.5 O&M Cost Assumptions

Variable cost	Utility (electricity), Chemicals, etc.
Fixed cost	Labor cost, Legal inspection cost, Repair cost, Cleaning and yard maintenance cost, O&M Consultant Fee, Insurance cost, SPC administrative cost
Replacement Cost	Cost necessary to replace functionally deteriorated equipments etc..

In addition to the cost above, JC's profit portion (which constitutes 5% of JC's O&M cost) is added to SPC's O&M cost.

Tariff revenue and interest income revenue from cash deposit to reserve accounts is assumed.

Table 5.2.6 Assumptions for revenues

Tariff revenue （Revenue from HPC）	- As is usual with this type of long term contracts, [redacted] - [redacted] the level of tariff revenue is set so that the Target EIRR [redacted] is expected to be realized.
Other revenue	- Income earned from cash deposit is assumed [redacted] . [redacted]

[redacted]

[redacted]

5.3 Results of Financial Analysis

5.3.1 Tariff

The chart below shows summary of operation and tariff based on the assumptions described in the above. Tariff (expressed in 2011 price) is calculated to be USD 136.84 per m^3 of raw sludge to be transferred to the Facility.

Table 5.3.1 Summary of Operation and Tarrifs

[redacted]

5.3.2 Cash Flow and Financial Forecast of SPC

The chart below shows summary of SPC financial results based on the assumptions described in the above. As far as the resultant financial ratios are concerned, the level of those ratios (e.g.: minimum DSCR, EIRR, etc.) could to certain extent satisfy foreign financiers and investors.

For details of SPC financial result, refer to Attachment 3

Table 5.3.2 Summary of SPC Financial Results

(USD million)

5.3.3 Proposal of Service Charge and Payment Condition

The Study Team estimated costs required for implementation of the BOT project for Sludge Recycling Facility. The cost consists of construction cost, daily operation and maintenance cost, repair cost for structures and equipments. The result of cost estimate is shown in Figure 5.3.1. As shown in the figure, significant costs are construction cost (64 million US$) and repair cost (18 million US$) in 12th year of operation period. The O&M and repair will be carried out by the Joint Company. It is assumed that the Joint Company will charge to SPC

its own O&M and repair cost plus profit which constitutes 5% of the cost.

The service charge is calculated based on the conditions as shown Table 5.3.1. The service charge is arranged to be uniformity on yearly basis as shown in Figure 5.3.2. It will be charged to HPC by SPC.

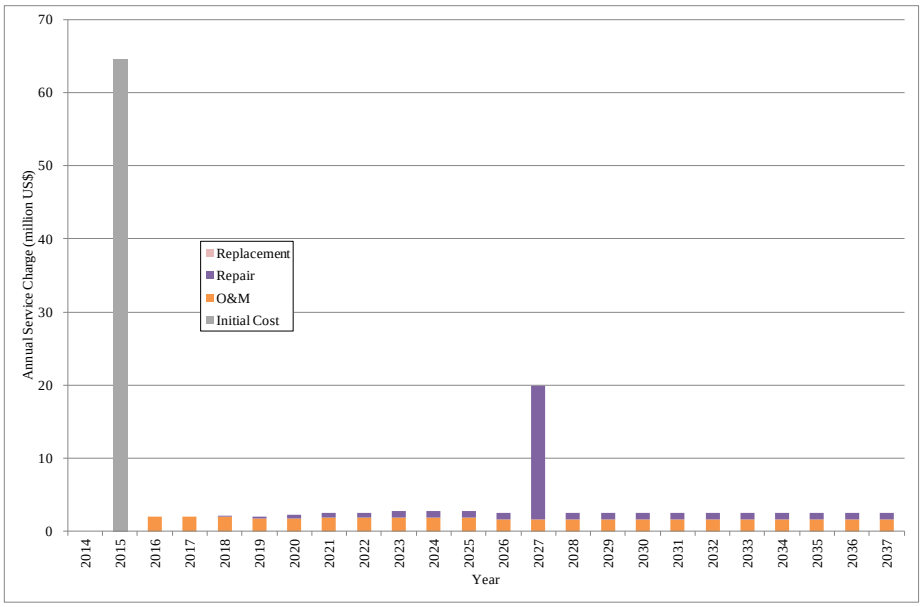


Figure 5.3.1 Actual Expenditure of Construction/O&M/Repair of Sludge Recycling Facility

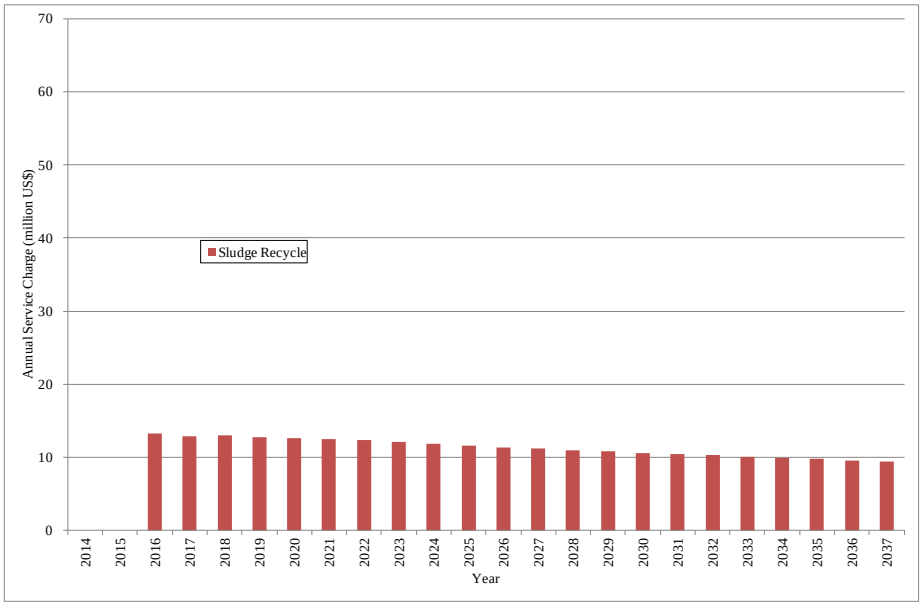


Figure 5.3.2 Service Charge to be paid by HPC for BOT of Sludge Recycling facility

The average service charge to HPC and payment for O&M to the JC are as below;

- Average Service Charge to HPC (11.6 million US$/year, 145 US$/m^3 of dewatered sludge)

- Expected Average Payment for O&M cost to JC (3.2 million US$/year, 40 US$/m^3 of dewatered sludge)

Regarding this, we summarized the contents in the attached "Preliminary Terms and Conditions for Production and Offtake of Dry Sludge" (Appendix-B2). Please refer to it.

Table 5.3.3 Operational Assumptions of Yen So Central Bio-solid Processing Center

Table 5.3.4 Revenue Structure

Note that detailed analysis of O&M costs has yet to be done to determine the structure of the Revenue in detail.

Table 5.3.5 SPC Summary Financial Forecast

Chapter 6 Project Evaluation

6.1 Technical Evaluation

This is the first project for sludge recycling in Vietnam. The Study Team proposes the Bio-solid Processing Center with hybrid process of sludge drying which consists of "Solar Green House" and "Mechanical Thermal Sludge Dryer". In the discussion in Chapter 2, it is estimated that the cost of the process is reasonable and it will be operated effectively.

The offtaker of the Dry Sludge is proposed to be But Son Cement Company. At present, But Son Cement Company is considering the offtake of the Dry Sludge positively, however, the company has still considered conditions of the offtake, and it may take a few years to achieve the agreement through many discussions and technical considerations. Under these situations, the Study Team is considering a plan of JICA technical assistant program on promotion of sludge recycling activities for smooth implementation of the Project

6.2 Financial Evaluation

In the Study, the service charge of the BOT Project is estimated at 137 US$/ton of dewatered sludge, in order to achieve the Equity IRR of 15%. It is equivalent to 0.058 US$/$m^3$ of wastewater. The service charge of wastewater treatment service (including replacement cost) is expected between 0.243 – 0.447 US$/$m^3$ (0.248 US$/$m^3$ in average), which are depending on scale of WWTP. It means the service charge of the sludge recycling is additionally required around 13 – 24 % of service charge of wastewater treatment. The Project FIRR (Financial rate of Return) is estimated around 12 %. The Project shall be financially quite feasible, if proposed service charge is accepted by HPC.

6.3 Economic Evaluation

At present, dewatered sludge is disposed (landfilled) at Nam Son Landfill site and Tieu Ky disposal site. The cost of the landfill is low at the present, however, it is supposed to be forbidden near future, because of land availability and environmental reason. In the Study, it is assumed that the landfill of the dewatered sludge will be forbidden and the dewatered sludge should be dried to reduce the volume. Under theses conditions, the Study Team proposed the BOT Project, which adopts the lowest cost method of sludge drying.

The service cost of the BOT Project is estimated around 137 US$/ton, which is much higher than the current disposal cost of dewatered sludge. In the current conditions in Hanoi, the landfill cost is estimated less than 50 US$. If there is a possibility of disposal/ landfill of dewatered sludge outside of the dyke in Hanoi, the economic benefit is not expected to meet the cost of the BOT Project. Only in the case that landfill site is not available, or the land cost become much more expensive, the economic benefit will meet the cost of the BOT Project, and will become economically feasible.

6.4 Environmental and Social Evaluation

It is proposed that a Feasibility Study will be conducted after the approval of the BOT scheme. An Environmental Impact Assessment (EIA) will be carried out during the F/S. An Environmental Management Plan (EMP) will also be prepared to address any negative impact found.

A preliminary environmental assessment indicates the following positive and negative impacts.

Positive impacts

- Proposed project will ensure much better environmental disposal of sewage sludge compared to land filling.
- The project will provide opportunities for resources recovery (fuel, soil nutrient).
- This project will also contribute to global warming reduction by reducing methane production as compared to land filling.

Negative impacts

- Offensive odor if buffer zone is not maintained properly
- Heavy metals might accumulate in soil, if dried sludge is used as soil conditioner.

The project location is selected in a way to ensure the required buffer zone as required by the Vietnamese law. So, odor will not be an issue.

To understand the chemical composition of the dewatered sludge, JICA Study Team carried out chemical analysis during April 2011 by taking dewatered sludge samples from 3 existing WWTPs, namely, Kim Lien, Truc Bach, and North Thang Long. The result is shown in the following table. The result shows that only Hg cross the allowable limit.

Table 6.5.1 Chemical Composition of Dewatered Sludge

Parameter	Unit	Kim Lien **WWTP**	Truc Bach **WWTP**	North Thang Long **WWTP**	**Maximum allowable limit by Japanese Standard** *1	**Note**
Cd	mg/kg	1.65	1.83	1.54	0.005%	
Ni	mg/kg	61.26	37.1	181.55	0.03%	
Pb	mg/kg	67.45	77.68	91.04	0.01%	
Cr	mg/kg	88.65	37.1	181.55	0.05%	
Hg	mg/kg	22.96	12.51	11.52	0.0002%	NG

Source: JICA Study Team

*1: There is not Vietnamese fertilizer official standard on sewage sludge, so Japanese standard is applied.

6.5 Institutional Evaluation

The SPC is the executor of the BOT Project. The SPC will outsource his major works, such as F/S preparation and approval, Design and Construction, and O&M, to reliable companies, and the SPC will take all responsibilities of the works. The work performance will highly depend on selection of the outsourcing companies. The outsourcing companies shall be selected carefully.

Chapter 7 Qualifications of the Proposal/ Risk Management

7.1 Risk Matrix

The risk matrix of the BOT Project is shown in Table 7.1.1.

Table 7.1.1 Risk Matrix (BOT Project)

Phase	Classification	Risk	Impact to the project	Comment	SPC	HPC	Insurance
Common	Financial Arrangement		Cost increase Project delay/halt		○		
	Site	Land contamination, defect and so on	Cost increase Project delay/halt	If the risk occurs due to grounds attributable to SPC, SPC is to bear the risk and the cost.		○	
		The choice of the proper site for the facility	Project delay/halt Project termination	If the risk occurs due to grounds attributable to SPC, SPC is to bear the risk and the cost.		○	
	Licenses and charters	The delay on procedures for setting up JC and gaining licenses	Cost increase Project delay/halt		○		
	Change of laws	The change or establishment of regulations and laws related to the construction, operation and maintenance for the facility	Cost increase Project delay/halt	JC is incapable of controlling the situation		○	
		Except above, the change or establishment of regulations and laws applied in general	Cost increase Project delay/halt	JC is incapable of controlling the situation The scope for the risk JC takes is to be determined in the documentation	△	△	
	Tax reforms	The change of the tax coverage and tax rate, or the establishment of the new tax code	Cost increase Project delay/halt	JC is incapable of controlling the situation	—	○	
	Licenses	The delay on gaining licenses which HPC should proceed	Cost increase Project delay/halt			○	
		The delay on gaining licenses which SPC should proceed	Cost increase Project delay/halt		○		
		Incapable of gaining licenses caused by HPC	Project termination			○	
		Incapable of gaining licenses caused by SPC	Project termination		○		
	Politics	The policy change and political matter	Project delay/halt Project termination	JC is incapable of controlling the situation		○	
	Sabotage and pressure by industrial group	The difficult situation to continue the facility operation caused by the acts of sabotage by industrial group	Cost increase Project delay/halt Project termination			○	
	Infrastructure	Inadequate infrastructure to operate the facility, such as the lack of enough electricity, water supply, roads and so on.	Cost increase Project delay/halt Project termination			○	○
	Neighborhood	The lawsuits, claims and riots from neighborhood	Cost increase Project delay/halt Project termination	If the risk occurs due to grounds attributable to SPC, SPC is to bear the risk and the cost.		○	
	Environment	Environmental problems influenced by the instruction or requirement from HPC	Cost increase Project delay/halt Project termination			○	○

		Environmental problems caused by SPC conducts, for instance toxic substance release	Cost increase Project delay/halt Project termination		○		○
	Third party liability	The damage to the third party caused by the conduct attributable to HPC	Cost increase			○	○
		The damage to the third party caused by the conduct attributable to SPC	Cost increase		○	—	○
	Interest rate fluctuations		Cost increase	No assumption for borrowing	○		
	Foreign exchange fluctuations /Price fluctuations		Cost increase	The risk to be shared with the calculating formula in the Service Charge	○	○	
	Force majeure	Natural disaster, war, terror, strikes, riots, civil commotions and so on	Cost increase Project delay/halt Project termination	The definition of "force majeure" needs to be discussed JC is incapable of controlling the situation		○	○
	HPC default		Cost increase Project delay/halt Project termination			○	
	SPC default		Cost increaseProject delay/haltProject termination		○		
Planning & design	Planning & design	The delay and the increase of the cost due to the significant design change, exceeding the demand standard, requested by HPC	Cost increase Project delay/halt			○	
		The request for the significant design change from SPC	Cost increase Project delay/halt		○		
Construction	Construction period	The delay on the completion date, or incompletion of the facility, caused by HPC	Cost increase Project delay/halt			○	
		The delay on the completion date, or incompletion of the facility, caused by SPC	Cost increase Project delay/halt		○		
	Construction cost	Cost overrun caused by HPC, for instance, the instruction issued by HPC	Cost increase			○	
		Cost overrun caused by SPC	Cost increase		○		
	Construction management	The failure on supervision of the construction process	Cost increase Project delay/halt		○		
	Damage to the facility	The damage to the facility caused by the contractor during the construction period expect the force majeure	Cost increase Project delay/halt		○		
		The damage to the facility caused by HPC during the construction period expect the force majeure (if any)	Cost increase Project delay/halt			○	
	Facility performance	Not to meet the requirement including shoddy construction	Cost increase Project delay/halt		○		

		Not to meet the qualification for performance test	Cost increase Project delay/halt		○		
	Cost control for the operation of the facility	The increase of the operation cost due to the poor management done by SPC	Cost increase	SPC offsets the risk with JC under O&M agreement	○		
		Price fluctuations/ foreign rate fluctuations	Cost increase	The risk to be shared with the calculating formula in the Service Charge	○	○	
	Replacement cost for the facility	Price fluctuations/ foreign rate fluctuations	Cost increase	The risk to be shared with the calculating formula in the Service Charge	○	○	
		The increase of the replacement cost due to the poor management done by SPC	Cost increase		○		
		The increase of the replacement cost due to more frequent replacements than estimated	Cost increase		○		
	Demand volatility	The volatility on the amount of dewatered sludge carried in to the facility	Cost increase	The risk to be shared with the calculating formula in the Service Charge (Capacity Payment)	○	○	
	Disposal of dry sludge	The refusal to accept the dry sludge from anyone despite the best efforts by SPC	Cost increase			○	
	Lower quality of the processed water (than the demand standard)	Not to meet the requirement for the ability/performance projected, caused by HPC	Cost increase Project delay/halt			○	
		Not to meet the requirement for the ability/performance projected, caused by SPC	Cost increase Project delay/halt		○		
		Not to meet the requirement for the ability/performance due to the force majeure	Cost increase Project delay/halt	The definition of "force majeure" needs to be discussed JC is incapable of controlling the situation		○	
	Over capacity in the facility	To exceed the ability/capacity to process dry sludge in the facility	Project delay/halt	JC does not accept the excess sludge over capacity		○	
	Labor management	The negative reputation accompanied with the employee scandal, corruption,	Cost increase		○		
	Crisis management	Imperfect manuals for the crisis Disconnected communication in the crisis	Cost increase Project delay/halt		○		
		The increase of the cost caused by mismanaging the strikes, the natural disaster, the pandemic and so on	Cost increaseProject delay/halt		○		
	Damage to and deterioration of the facility, machines and equipment	The damage to the facility, machines and equipment caused by SPC misconduct	Cost increase	SPC offsets the risk with JC under O&M agreement	○		
		The damage to the facility, machines and equipment caused by HPC	Cost increase			○	○
		The damage to the facility, machines and equipment due	Cost increase Project delay/halt	The definition of "force majeure" needs to be discussed		○	○

		to the force majeure		JC is incapable of controlling the situation			
		The damage by having machineries and valuables stolen	Cost increase Project delay/halt		○		○
	Facility defect	The repair cost for fixing the defect discovered during the defect liability period	Cost increase Project delay/halt		○	—	—
		The repair cost for fixing the defect discovered beyond the defect liability period	Cost increase Project delay/halt		○	—	—
Termination	Contract termination (during the contract period and at the expiry of the contract)	Incapable of terminating the contract and operation	Cost increase		○		
		The increase of the cost at the termination of the contract, caused by HPC	Cost increase			○	
		The increase of the cost at the termination of the contract, caused by JC	Cost increase		○		
		The increase of the cost at the termination of the contract, due to the force majeure	Cost increase	The definition of "force majeure" needs to be discussed JC is incapable of controlling the situation		○	
	Title transfer	Not to meet the condition stipulated at the date of the title transfer	Cost increase		○		

APPENDIX-C

ワーキンググループ、セミナー等の
説明用資料

第 1 回ワーキンググループ資料

（2011 年 5 月 17 日開催）

Working Group Progress Meeting (1) on 17th May, 2011

PART (1): Development Schedule of Hanoi Sewerage PPP Model

- Regulatory Flame Works
- Confirmation of Current Status, Schedule and Outputs

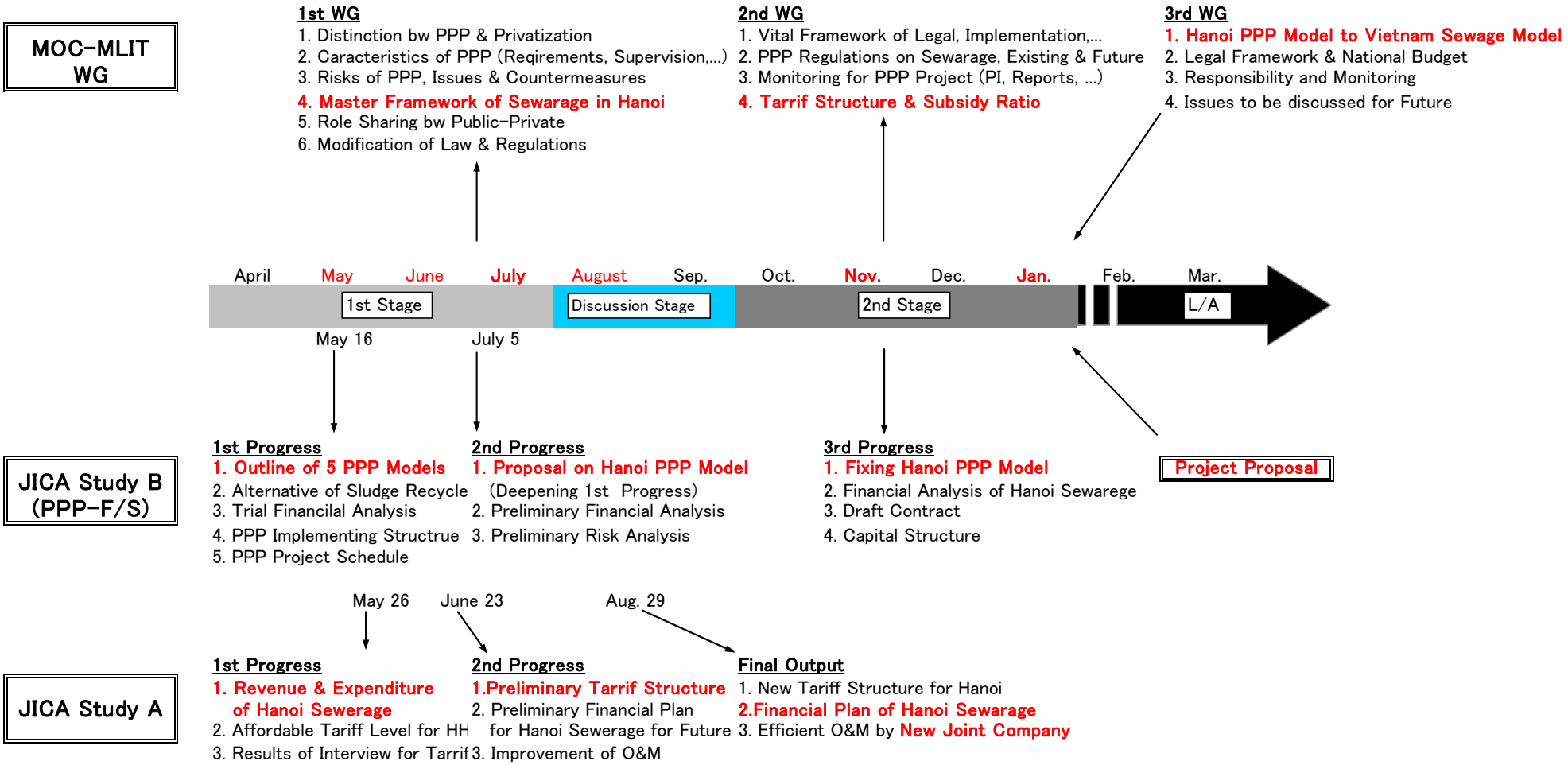
PART (2): Overall Progress of the Study B

(1) Purpose of the Study and Overall Progress
(2) Project Implementation Schedule
(3) Work Schedule of the Study
(4) Alternatives of Facilities of Sludge Recycle
  - Three (3) Alternatives of Sludge Recycle Facilities
  - Two (2) Alternatives Sites for Sludge Recycle Center
(5) Five (5) PPP Models
  - Classification of 5 PPP Models
  - Comparison of 5 PPP Models
(6) Training Program
  - Consideration of Four Training Programs

PART (3): Planning for Sludge Recycle

- Selection of Sewage Sludge Reuse
- Concept of Step-wised Project Programming
- Sludge Treatment Facility Planning for Recycle
- Alternative Study of Site for Sludge Recycle Center

< Development Schedule of Hanoi Sewarage PPP Model >



PART (2) Overall Progress of the Study B

(1) Major Purposes of the Study and Progress of the Study

1) To realize Yen Xa WWTP Construction Project as soon as possible
(To formulate suitable PPP sewerage project models with HPC, for smooth implementation and MPI approval.)

⇩

[What we did]
To prepare 5 Alternatives of PPP Sewerage Project Models
To consider the Project Implementation Schedule
[What we will do]
To select the Best Models through Alternative Studies, through Financial Analysis, Risk Analysis and Study on Laws and Regulations, etc.
To propose the Project Implementation Schedule

2) To realize sludge recycle in Hanoi
(To propose suitable sludge recycle facility)

⇩

[What we did]
To prepare 3 Options of Sludge Recycle Facilities
To prepare 2 Alternatives of Construction Site
To carry out sludge recycle demand survey and sludge quality analysis
[What we will do]
To select the Best Option of Sludge Recycle Facility in the Best Location

3) To carry Training Program

⇩

[What we did]
To prepare outline of 4 Types of Training Program through discussion
[What we will do]
To fix details of the Training Programs and carry out the program

(2) Project Implementation Schedule

Table-1 shows the Draft Project Implementation Schedule for our discussion. The procedure of investment preparation of the SPC portion is still not clear. The procedure in the table is tentatively prepared, based on the Action Plan for the Period 2011 – 2013, PPP Inter-Ministerial Task Force, MPI.

The procedure of the ODA portion in the table is tentatively prepared, following a typical procedure of a normal ODA loan project. The time of the L/A shall be considered for the SPC portion and the ODAQ portion, respectively.

(3) Work Schedule of the Study

Table-2 shows the Work Schedule of the Study.

The major events are as below;

17th May	First Progress Meeting
5th July	Second Progress Meeting
Someday, July	PPP Lectures
21st July	Third Progress Meeting
	Submission of the Progress Report
August	Preparation of comments to the Progress Report
End, August	Fixing Outline of the PPP Sewerage Project

Table-1 Consideration of Project Implementation Schedule

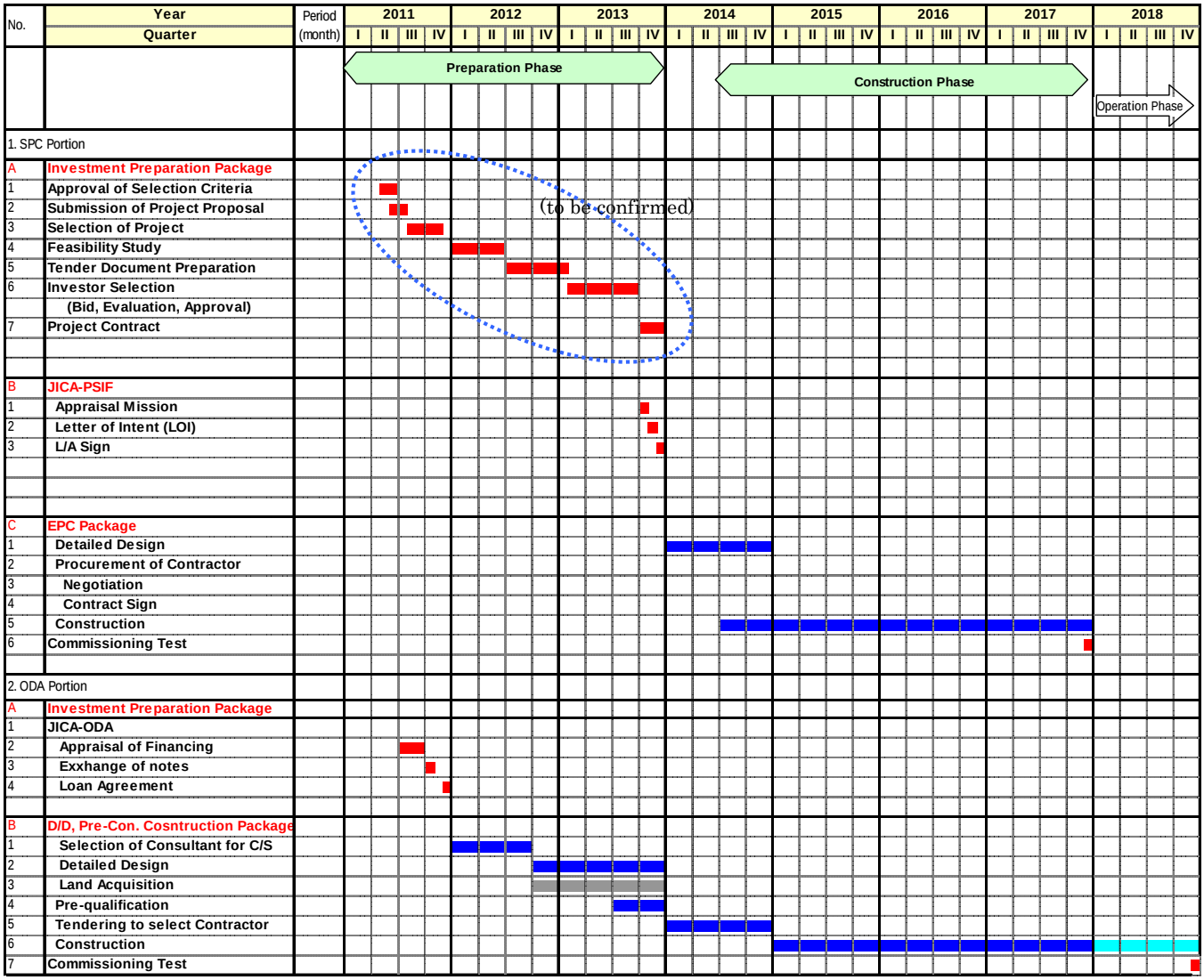


Table-2 Work Schedule of Study-B, Phase 1 "Formulation of Proposal on PPP Sewerage Project (Hanoi Model)"

		Study Team	Counterpart	April	May	June	July	August
1)	Study on Current Condition and Future Plan of SewerageDevelopment in Hanoi							
1-1)	Social Condition and Relevant Policies	OR						
1-2)	Review and Analysis of Relevant PPP Laws							
	Collection and Review and of Relevant PPP Laws	OR, PWC						
	Analysis of Current Problems and Recommendation	PWC						
1-3)	Study on Current Condition and Alalysis of Problems of Water and Sewerage Sector	NK						
1-4)	Review of Relevant Laws and Regulation for Construction	NK						
1-5)	Survey for Trends of Activities of Private Companies and Donners in PPP Pprojects in Hanoi	NK						
2)	Study on Sewerage System Development in Hanoi							
2-1)	**Confirmation of Planning Condition and Alternative Study of Sludge Treatment and Recycling**							
	Current Situation and Problems, Sludge Generation Forecast, Study on Potential of Recycling Sludge Use, Study on Target Area of Sludge Collection	OR/NK						
	Proposal of 3 Alternative Plans for Additional Treatment and Alternative Study	OR/NK						
	Sludge Quality Analysis (Laboratory Test)	OR/NK						
	Study and Proposal for Suitable Sludge Treatment	OR						
2-2)	Study on Integrated Control and Monitoring System							
	Confirmation of Concept of Integrated System	HEL						
	Alternative Study for System Development	HEL						
	Basic Design	HEL						
2-3)	Study on Financial Obligation of Beneficiallies and Relevan Organizatins							
	Study on Suitable Sewerage Tariff Level of Domustic and Non-domestic Useres	PWC						
	Confirmation of Financial Condition of HPC and Financial Capacity for Preparation of Subsidy	PWC						
	Study on Options of Private Funds to the Project	PWC						
3)	Study on PPP Scheme							
3-1)	Study on Basic Condition of "Hanoi Model" of PPP Project							
	Data Collation/ Review/ Analysis of Similar Projects (Case Study)	NK/OR						
	Study on Basic PPP Scheme	NK/OR/PWC						
	Study on Task Allocation/ Risk Allocation	PWC						
3-2)	**Alternative Study of Four (4) PPP Models**							
	Confirmation of Conditions of Project Scheme	NK/OR/PWC						
	Preparation of Preliminary Business Plans (including Financial Model Study)	PWC						
3-3)	Proposal and Discussion for "Hanoi Model" of PPP Project							
	Formulation of "Hanoi Model" of PPP Project	PWC						
	Evaluation of Effects of PPP Introduction	PWC						
					1st Cost Estimate	2nd Cost Estimate		
4)	Preliminary Design and Cost Estimate							
4-1)	**Preliminary Design of Sludge Treatment Facilities**							
	Fixing Required Capacity, Scale and Type of facilities	OR						
	Layout Plan of Facilities	OR/NK						
4-2)	**Review of Design of Wastewater Treatment Facilities and Wastewater Collection System**							
	Preparation of Review Report	NK						
	Preparation of Alternative Design (if necessary)	NK						
4-3)	**Preliminary Design of Integrated Control and Monitoring System**							
	System Design	HEL						
	Preparation of Major Equipment List	HEL						
4-3)	**Construction Cost Estimate and Construction Schedule**							
	F/S Design Review	NK						
	Construction Cost Estimate of Wastewater Treatment Facilities	NK						
	Construction Cost Estimate of Sludge Treatment Facilities	OR/NK						
4-3)	**Operation, Maintenance and Replacement Cost Estimate**							
	O&M Cost of Wastewater Treatment Facilities	HEL						
	O&M Cost of Sludge Treatment Facilities	HEL						
	(including proposal for future O&M Method, and Replacement Plan for Equipments)							
6)	Final Confirmation and Arrangement in Phase 1							
	Preparation of Progress Report							
	Modification based on Comments							
	Final Confirmation and Arrangement through Discussions							
	Working Group Meeting (Study B)				5/17		7/5 7/21	8/30
	Working Group Meeting (Study A)				5/26	6/20 6/23 6/28		8/24 8/29

Study A
Study B

(4) Alternatives of Facilities for Sludge Recycle

The Study Team selected suitable three (3) options of sludge recycle methods, 1) Solar Drying Bed/ Compost, 2) Mechanical Drying and 3) Carbonaization, among six (6) alternative methods. Two alternative sites (Yen So and Yen Xa) are selected for construction of the facilities among three alternatives.

(5) 5 PPP Models for Sewerage Project

1) Outline of the Project

The outline of the Yen Xa WWTP Construction Project is shown in Table-3. In this stage, the Study Team study on the Phase 1 portion.

Table-3 Outline of Yen Xa WWTP Construction Project

	Service Population	Wastewater Collection System (Length of Pipe Installation)	Wastewater Treatment Plant (capacity)	Facilities for Sludge Recycle
Phase-1	**548,000**	**15,415 m**	**135,000 m^3/day**	(under the Study)
Overall	882,000	27,641 m	270,000 m^3/day	

2) Classification of PPP Models

Five PPP Models for Sewerage Project are proposed as below;

Table-4 Classification of Five PPP Models

	Wastewater Collection System	Wastewater Treatment Plant	Facilities for Sludge Recycle
Model-1	ODA	ODA	ODA
Model-2	ODA	ODA	SPC
Model-3	ODA	SPC	SPC
Model-4	ODA	SPC	ODA
Model-5	SPC	SPC	SPC

Conditions:

- As for ODA portion, the central government will arrange funding for the Project, and HPC will have responsibility for construction and O&M. The loan will be paid back by the central government. So it is same as a government subsidy for Hanoi.
- As for SPC portion, SPC will have responsibility for funding, construction and O&M. HPC will pay sewerage service fee to SPC, which will cover construction cost and O&M cost, etc.

3) Comparison of 5 PPP Models

The results of rough cost estimate are shown in Table-4. The estimated values are quite tentative ones, so they will be reviewed and modified. Table-5 shows Comparison of Five (5) PPP Models.

Table-5 Trial Calculation of Construction Cost and O&M Cost (Phase 1)

(1) Entire Project (Construction Cost and O&M Cost) (million. US$)

	Wastewater Collection System	Wastewater Treatment Plant	Facility for Sludge Recycle		Total
Construction Cost	114	220	Case-1	13	347
			Case-2	24	358
			Case-3	26	360
O&M Cost (Yearly)	-	5.6	Case-1	0.5	6.1
			Case-2	0.9	6.5
			Case-3	0.9	6.5

(2) SPC Portion

(Construction Cost) (million. US$)

	Wastewater Collection System	Wastewater Treatment Plant	Facility for Sludge Recycle			Total		
			1)	2)	3)	Case-1	Case-2	Case-3
Model-1	-	-	-			-		
Model-2	-	-	13	24	26	13	24	26
Model-3	-	220	13	24	26	233	244	246
Model-4	-	220	-			220		
Model-5	114	220	13	24	26	347	358	360

(O&M Cost) (milion. US$/year)

	Wastewater Collection System	Wastewater Treatment Plant	Facility for Sludge Recycle			Total		
			1)	2)	3)	Case-1	Case-2	Case-3
Model-1	-	-	-			-		
Model-2	-	-	0.5	0.9	0.9	0.5	0.9	0.9
Model-3	-	5.6	0.5	0.9	0.9	6.1	6.5	6.5
Model-4	-	5.6	-			5.6		
Model-5	-	5.6	0.5	0.9	0.9	6.1	6.5	6.5

Case-1) Solar Drying Bed / Compost

Case-2) Mechanical Drying

Case-3) Carbonization

Table-6 Comparison of 5 PPP Models

	Required Cost for Sewerage Service		Funding	Control of Construction Work Schedule	Introduction of New Technology for Sludge Recycling
	Construction Cost and O&M Cost	Cost for Funding			
Model-1 (ODA/ODA/ODA)	Expensive More	Cheaper	Difficult So large amount for ODA and GOV	Easy One executing agency will manage entire project.	Technical assistance program will be prepared under ODA program.
Model-2 (ODA/ODA/SPC)			Difficult So large amount for ODA and GOV	Easy Almost same as Model-1.	SPC will take the responsibility
Model-3 (ODA/SPC/SPC)			Relatively easy Funds come from ODA and SPC	Difficult Two executing agencies will manage each portion of project, separately.	Same as Model-2
Model-4 (ODA/SPC/ODA)			Relatively easy Funds come from ODA and SPC	Difficult Same as Model-2	Same as Model-1
Model-5 (SPC/SPC/SPC)	Cheaper	Expensive More	Difficult So large amount for SPC and HPC	Easy Same as Model-1	Same as Model-2

4) Trial Financial Analysis

The sewerage tariff income from Yen Xa WWTP Service Area is roughly calculated on three cases as shown in Table-7. Rough Estimate of O&M and Replacement Cost is shown in Table-8.

Table-7 Rough Estimate of Tariff Income

Tariff Level	Tariff Income	
	Phase 1 Area	Entire Area
Case-1 Current Sewerage Tariff VND 391/m^3 (US$ 0.019/m^3)	0.75 million US$/ year (US$ 0.019 m^3 x 135,000 m^3/day x 80% x 365 days)	1.50 million US$/ year
Case-2 Affordable to Pay, based on around 1% of Household Income VND 1,564/m^3 (US$ 0.076/m^3) (4.0 times of Case 1)	3.00 million US$/ year (US$ 0.076 m^3 x 135,000 m^3/day x 80% x 365 days)	6.00 million US$/ year
Case-3 Affordable to Pay, based on around 2% of Household Income VND 3,600/m^3 (US$ 0.180/m^3) (9.5 times of Case 1)	7.10 million US$/ year (US$ 0.180 m^3 x 135,000 m^3/day x 80% x 365 days)	14.20 million US$/ year

Table-8 Rough Estimate of O&M and Replacement Cost

(Yen Xa WWTP + Solar Drying Bed/ Compost)

Item	Rough Estimation of Average Yearly Expenditure
O&M Cost	US$ 6.1 million /year
Replacement Cost of Mechanical and Electrical Equipment	US$ 4.5 million /year (US$ 90 million in 20 years)
Total	US$ 10.6 million /year

Above rough estimate shows as below;
The tariff income from Yen Xa WWTP Service Area is expected US$ 0.75 – 7.10 million/ year in the Phase 1 area and US$ 1.50 million/ year in the entire area. It can hardly cover the total amount (US$ 10.6 million/ year) of O&M cost and replacement cost of mechanical and electrical equipment of Yen Xa WWTP (Phase 1). The initial construction cost of Yen Xa WWTP shall be depending on government subsidy and/or other financial sources, except for sewerage tariff income in Yen Xa WWTP service area.

In order to formulate suitable PPP Sewerage Project Model in Hanoi, the Study Team will carry out on the followings;

1) Study on cost reduction of O&M cost, Replacement Cost and Initial Construction Cost

- Review of the O&M cost and replacement costs and initial construction cost, considering merits of introduction of PPP (the target is 30% reduction)
- Study on cost effectiveness of the entire project implementation of Yen Xa WWTP, (The Phase 1 Project implementation is more costly than the entire project implementation)

2) Study on Possible Increase of Sewerage Tariff Income to Yen Xa WWTP

- Consideration on yearly increasing tariff structure with household income increasing (except for inflation ratio)
- Consideration on higher tariff on commercial and industrial activities
- Consideration on transfer of sewerage tariff income from other areas to Yen Xa WWTP

3) Study on Additional Financial Sources

- Consideration on possibility of general account expenditure of HPC (financial source based on tax income)
- Consideration on governmental subsidy yearly basis

(6) Training Program

1) PPP Lecture in Hanoi

Period: 2 days in July, 2011

Attendants: 15 - 20

Contents of Program:

Draft Contents are shown in Table-9.

2) Visit to PPP Project Sites

Period: ---

Attendants: around 10

Contents of Program:

Inspection of PPP Projects

(To be discussed with JICA, Tokyo)

3) Training Program in Japan(Original Proposal)

3-1) Training Program for Executive Class

Period: 2 times of 10 days

(28^{th} Sep. – 7^{th} Oct.) & (6^{th} Nov. – 15^{th} Nov.) tentative

Attendants: 6 - 8

Contents of Program:

Draft Contents are shown in Attachment

3-2) Training Program for O&M Group Leaders

Period: 21 days (12^{th} Oct. – 1^{st} Nov.) tentative

Attendants: 6 - 8

Contents of Program:

Draft Contents are shown in Attachment

Table-9 Draft Contents of PPP Seminar in Hanoi, July 2011

(Seminar for 10 - 20 members in 2 days)

	Subject	Content of presentation
Part 1: Sewerage works in Japan		
9:00-9:15	Opening	
9:15-10:00	Sewerage works in Japan	Role of sewerage History of sewerage Water pollution control Safety in urban activity & disaster mitigation Global environmental issues Protection of sound water resources Policy, legal and financial system Public relation Sewerage in new era Water & waste cycle (from waste to resources) Asset management PI & sewerage works operation
10:00-1020	Break	
10:20-11:05	Sewerage works in Hanoi	Wastewater management, water environment Storm water drainage
11:05-11:50	Sewerage works in Yokohama	Sewerage system Regional sewage sludge treatment Features of water environment restoration Flood mitigation Public relation
Part 2: PPP project		
13:15-14:00	PPP overview	History of PPP & PFI Features of PPP project What is PPP in sewerage?
14:00-14:45	PPP project in Sewerage Works	PFI projects of sludge treatment Procurement procedure & performance monitoring
	Break	
15:00-15:45	Proposed PPP in Hanoi (1)	Overview of PPP study in Yen Xa sewerage project PPP model simulation Issues of sustainable PPP project operation
15:45-16:30	Proposed PPP in Hanoi (2)	Projection of sewerage works operation in Hanoi Remaining issues on finance and regulation system Best solution and what is Hanoi PPP model?
16:30-17:30	Discussion	
	Closing	

	Subject	Content of presentation
Part 3: Sewerage Administration of local government		
9:00-9:50	Sewerage Ordinance	
9:50-10:40	Tariff system	Tariff system, poverty alleviation Tariff levy & tariff collection Financial operation
10:40-11:00	Break	
11:00-12:00	Water quality management	Business water monitoring House connection approval
13:30-15:00	Discussion on sewerage works operation	

HANOI CITY:
Preparatory Survey on Project for Yen Xa WWTP (Study B)

Sludge Recycle Planning

JICA Study Team
May. 2011

Methodology of sludge recycle facility planning

Discussion topics

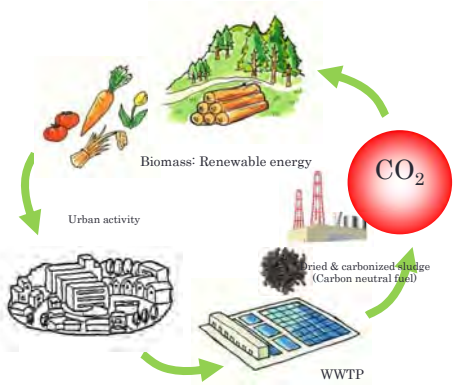
- Selection of sewage sludge reuse
  - Through Needs Survey on field and literature
- Concept of step-wised project programming
- Sludge treatment facility planning for recycle
  - Step-1:Selection of final sludge product
  - Step 2: Alternative study of sludge treatment process
- Alternative study of site of Sludge Recycle Center

Sewage sludge reuse (1/2)

IPCC defines sewage sludge as “Renewable energy”.

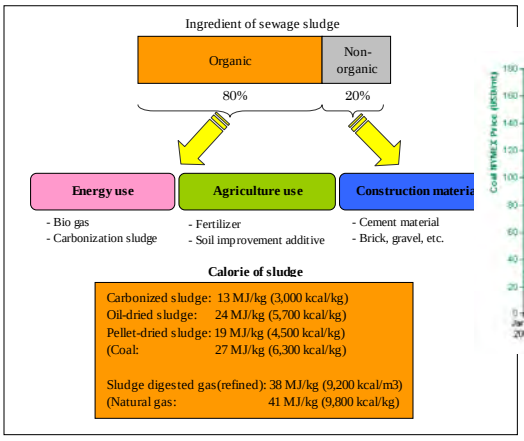
Sewage sludge is replaced to fossil fuel, therefore mitigates CO_2 & CH_4 emission in land fill site

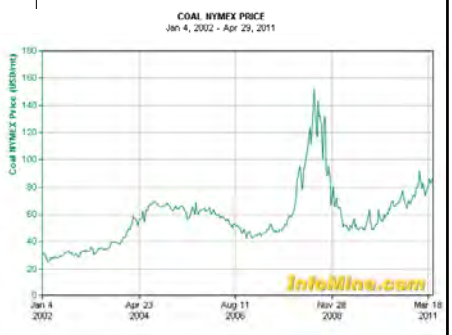
Gas	Global warming potential
CO_2	1
CH_4	21
N_2O	310



Sewage sludge reuse (2/2)

contains calorie of approx. 60 % of coal



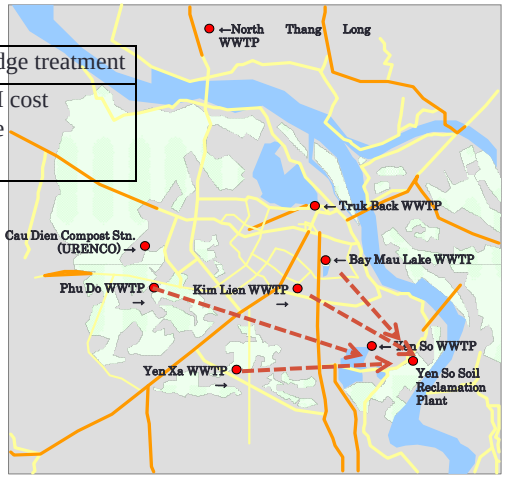


- Right: Coal price, New York Merchandize EX.50-80 USD/ton
- Left: Calorie of fuel sludge, Japan

Sludge treatment facility planning (1/3)

- **Regional sewerage sludge treatment**

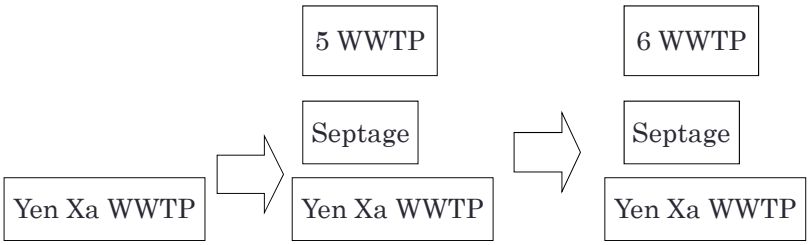
Advantages of regional sewage sludge treatment
Scale merit of construction & OM cost
Qualified sludge product for reuse
Offensive odor control



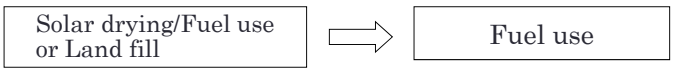
Concept of project programming (1/2)

Step-wised development

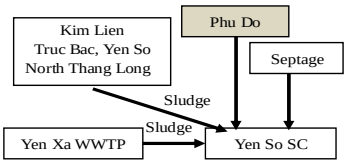
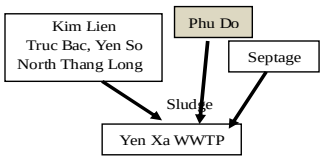
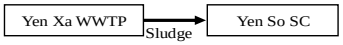
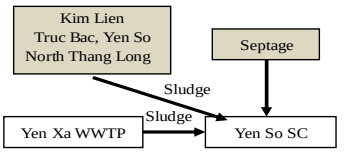
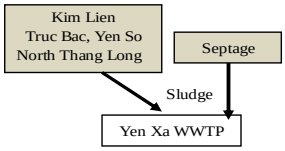
Individual treatment to regional sewage sludge treatment



Natural treatment to artificial treatment due to sludge increase



Concept of project programming (2/2)

Phasing	Alternative 1	Alternative 2&3
Long term	(Dried & Carbonized Fuel) 	(Dried & Carbonized Fuel) 
Phase 1	(Solar Drying Bed & Yen So Sludge Center) 	(Dried & Carbonized Fuel) 
Phase 2	(Dried & Carbonized Fuel) 	(Dried & Carbonized Fuel) 

Sludge treatment facility planning (2/3)

Step 1: Selection of sewage sludge reuse (final product):

- Soil conditioner (soil improvement additive)
- Dried sludge fuel for bio-mass boiler or cement material
- Carbonized sludge fuel for bio-mass boiler

Step 2: Determine potential treatment process

- Alternative 1: thickening – dewatering – solar drying (green house) ---------- 1st priority
- Alternative 2: thickening – dewatering –drying (mechanical drying)
- Alternative 3: thickening – dewatering – carbonizing

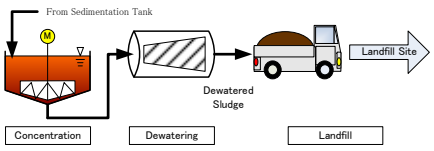
Sludge treatment facility planning (3/3)

Step 1: Primary Screening

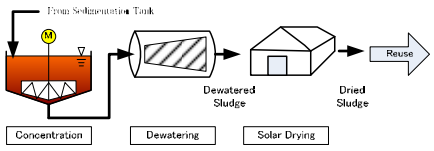
Final Form of Sludge Treatment	Estimation	Step 2
Landfill of Dewatered Sludge	Baseline (Current Condition)	○
Compost for Agriculture	Heavy Metals Accumulation in Soil High Competition against Kitchen Garbage Compost	×
Compost for Soil Conditioner (Solar Drying)	Low Cost, Sustainable	○
Dried Sludge Fuel for Biomass Boiler or Cement Material	Environmentally-Acceptable Sustainable Environment-Conscious Technology	○
Carbonized Sludge Fuel for Biomass Boiler	Environmentally-Acceptable Sustainable Environment-Conscious Technology	○
Construction Material of Burned Ash	High Cost of Incinerator LCC	×
Construction Material of Melt Slag	High Cost of Melting Furnace LCC	×

Base Model and 3 Alternatives

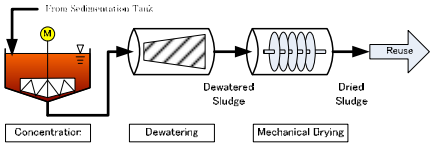
Base Model (Current Condition)



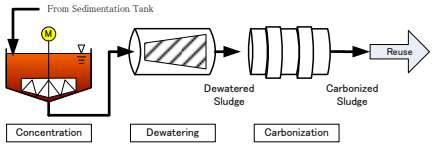
Alternative-1 (Solar Drying)



Alternative-2 (Dried Sludge Fuel)

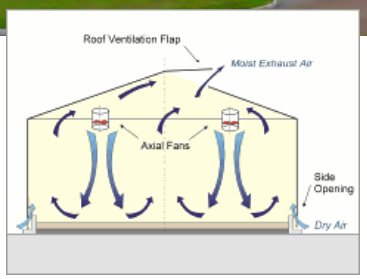


Alternative-3 (Carbonized Sludge Fuel)

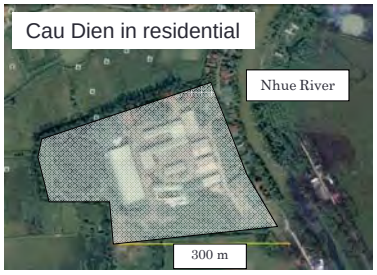


Solar green house of sewage sludge drying

- Solar energy is environmentally friendly and low cost.
- Green house is applicable to Hanoi climate.



Alternatives of Sludge Recycle Center (1/2)



- Conditions are

  area, environment issue, traffic access and EIA for land application.

Alternatives of Sludge Recycle Center (2/2)

Alternatives	Yen So dredged soil land-reclamation site	Cau Dien Composting Plant	Yen Xa WWTP
Sludge treatment process	Green house & solar drying (Phase-1)	Mechanical drying & carbonization	Mechanical drying & carbonization
Existing land use	Opened space and reclaimed land	Solid waste composting plant	Planned WWTP
Area	Sufficient	Too small	Enough for mechanical drying & carbonization
Traffic accessibility	Easy	Congested small road	Easy
Environmental issue	Acceptable 500 m from residences	Difficult due to adjacent residences	Acceptable
Upgrading in future	Flexible	Less Possible	Flexible
Recommendation	Recommendable if complied with EIA	Not recommendable	Recommendable

Conclusion of sludge recycle facility planning

- Step-wised project programming
  - Long term
    - Regional sewage sludge treatment = 7 WWTP + Septage
  - Phase-1 = PPP project
    - Yen Xa WWTP
- Alternatives of site & sludge treatment facility
  - Yen Xa WWTP
    - Mechanical drying or carbonization
  - Yen So land-reclamation site, if EIA approved
    - Solar drying of green house

第 2 回ワーキンググループ資料

（2011 年 7 月 15 日開催）

Consideration of PPP Model for Sewerage System Development in Hanoi

July 15th, 2011

1

Purpose of the Study

1. For Effective and Smooth Implementation of Construction of Yen Xa Wastewater Treatment Plant

Topics

1. Outline of Construction Project of Yen Xa Wastewater Treatment Plant
2. Consideration of Source of Funding, Repayment, and Operation and Maintenance
3. Study on PPP Model for Hanoi Sewerage

2

Project Outline

Image of Yen Xa Wastewater Treatment Plant

Project Outline	
Service Population	900,000
Service Area (ha)	4,874
Main Sewer Length (m)	27,641
Treatment Capacity (m^3/day)	270,000

Consideration of Sources for Funding, Repayment and Operation/ Maintenance

	Initial Construction Cost			Expenditure in Operation Period
Items of Cost	Pipe Network	WWTP	Sludge Recycling	OM Cost/ Replacement Cost
Payer (Source)	Central Government (Tax Income)	HPC (Tax Income)		Beneficiaries (Tariff Income)
Type of Payment	Initial Expenditure	Yearly Expenditure		Monthly Expenditure

Characteristic of Sewerage Project

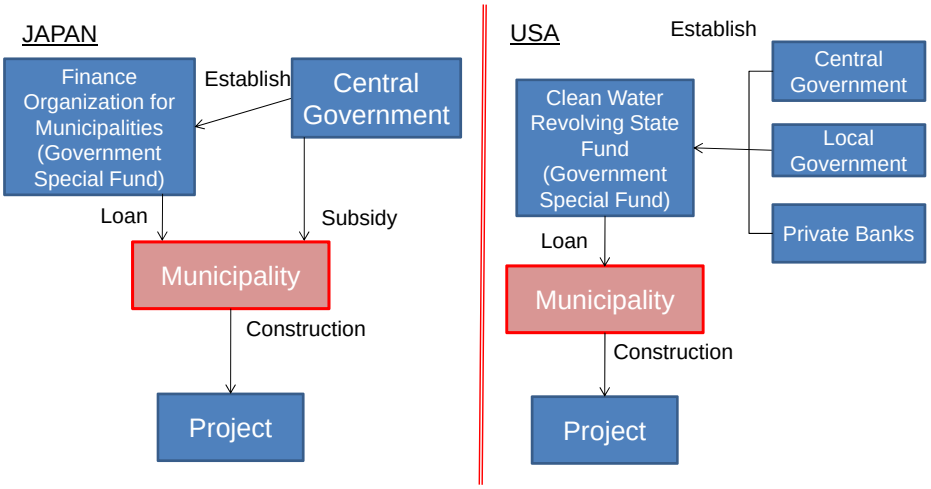
- Initial investment cost is huge, so Large amount of loan and subsidy is generally required.
- Sewerage tariff income is expected to cover OM costs, however, it can hardly cover repayment of initial investment cost. The financial gap is usually covered by tax income.

Alternatives of Source of Funding for Initial Investment (Hanoi)

	Funding Source for Initial Investment	Interest (US$ basis)
Public Funding Source		
1	Central Government Subsidy (including Funding by ODA Loan: 2.75-3.50%)	-
2	HPC Development and Investment Budget *18,249 billion VND (871 billion US$) in 2011	-
3	Municipality Bond	(7-10%)
Private Funding Source		
1	Private Investment (including benefit and risk hedge cost)	12-18%
2	Private Investment with JICA PSIF (Private Sector Investment Fund: 4-5%)	5-10%

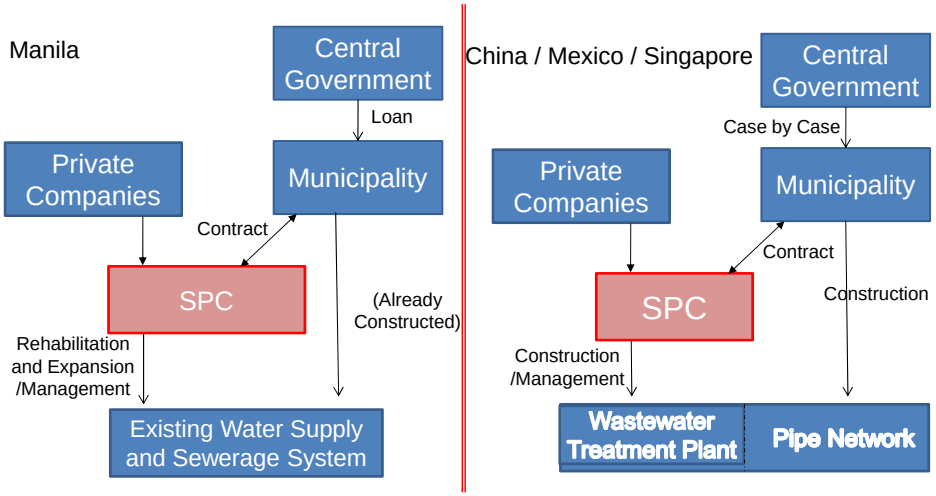
- From view point of fund preparation cost for HPC, "Central Government Subsidy " is the best option, and "HPC own budget" is the second best. However, total of these sources is not enough to cover the initial investment cost for the sewerage system development.
- If municipal pond is not available, private project finance is only the method.

Case Study of Funding Source in Traditional Sewerage System Development in USA/Japan



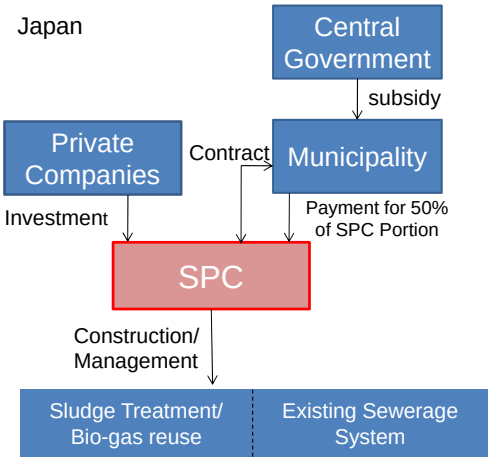
Both governments established organizations to provide low interest loan to municipalities for sewerage system development. This system is very useful for development of many municipalities in long term

Case Study of Private Participation for Sewerage Sector



In these cases, private sectors (using private fund) have contributed to sewerage system development, in cooperate with public sectors. Public sector spent large amount of tax income for initial investment. SPC is expected to do effective management , using their own technologies and know-how.

Case Study of Private Participation for Sewerage Sector



In case of Japan, only some specific technical fields (such as sludge treatment and bio-gas reuse) are applied by PPP, after sewerage system development by public sector. SPC is expected to do more effective mangement than Public Sector in these field.

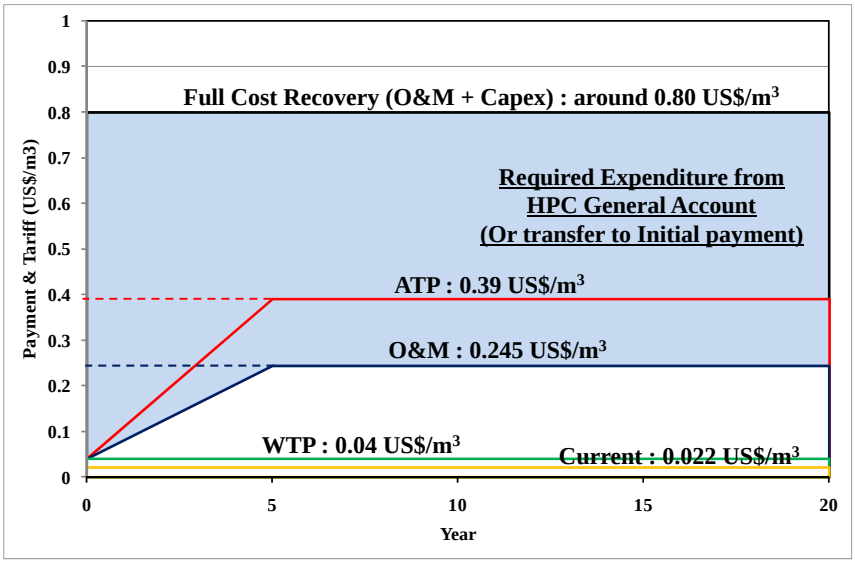
Alternatives of Source of Repayment, Operation/ Maintenance

	Financial Source of Repayment, O&M, etc.	Amount
1	Sewerage Tariff	4500 VND/m^3 (0.022 US$/$m^3$)
2	HPC Ordinary Account in 2011 budget	21 ,431 billion VND (1,023 million US$)

	Type	Amount
1	Current Sewerage Tariff	450 VND/m^3 (0.022 US$/$m^3$)
2	Current Water Tariff	4,500 VND/m^3 (0.220 US$/$m^3$)
3	For OM Cost Recovery	4,900 VND/m^3 (0.235 US$/$m^3$)
4	Full Cost Recovery (Initial and OM Cost)	16,800 VND/m^3 (0.800 US$/$m^3$)

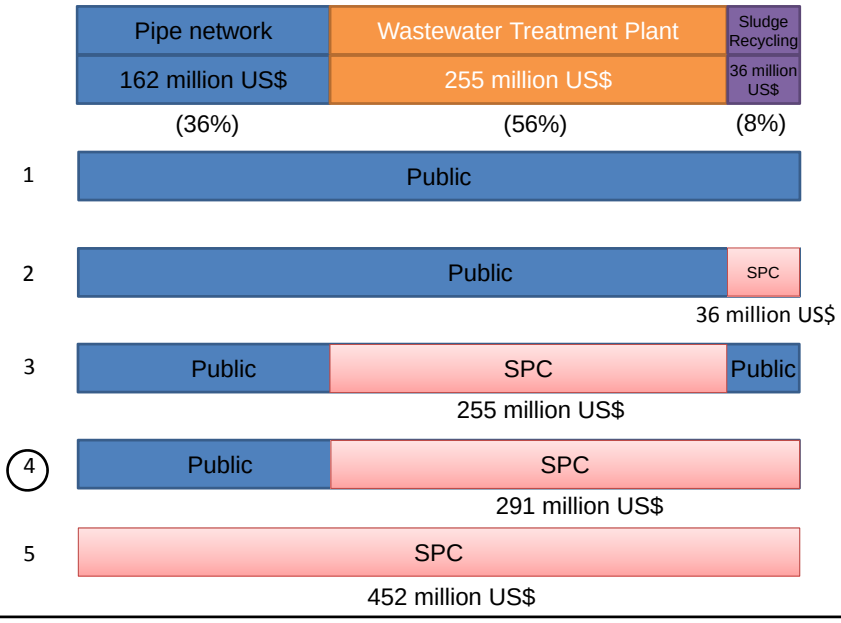
It is almost impossible to increase sewerage tariff to “Full Cost Recovery” level.

Financial Gap between Full Cost Recovery and Tariff Income



Study on PPP Model for Hanoi Sewerage

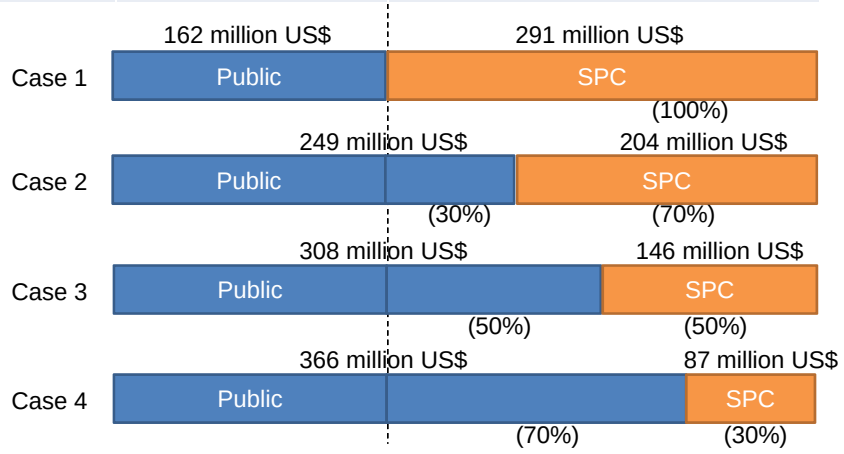
Scope Sharing between Public and SPC/ PPP 5 Models



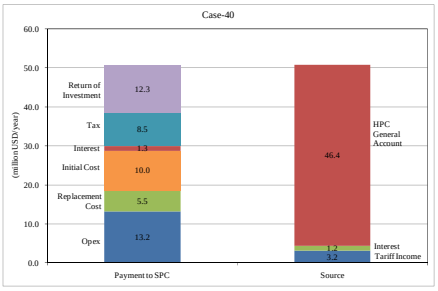
Consideration of Funding Source for Initial Investment

Case Study: PPP Model - 4

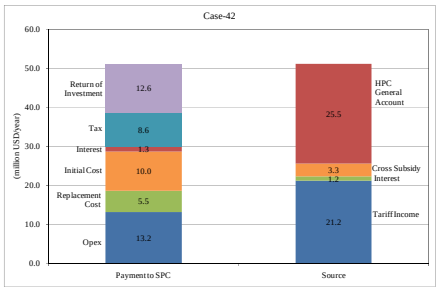
	Pipe Network	Wastewater Treatment Plant + Sludge Recycling Facility
Management	Public	SPC
Construction Cost	162 million US$	291 million US$



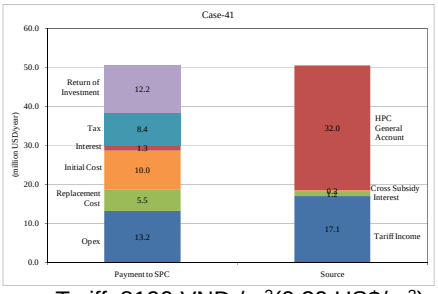
Financial Analysis: Case (Subsidy: 30%)



Tariff: 840 VND /m^3(0.04 US$/m^3)

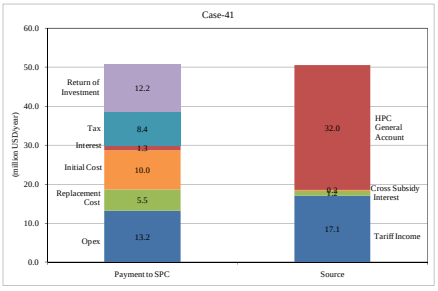


Tariff: 5145 VND /m^3(0.245 US$/m^3)

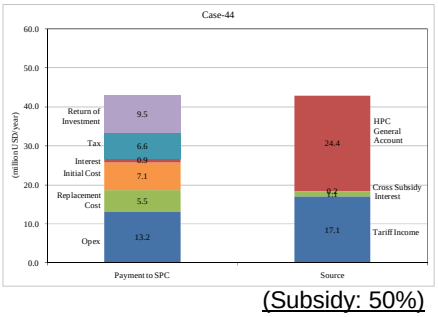


Tariff: 8190 VND /m^3(0.39 US$/m^3)

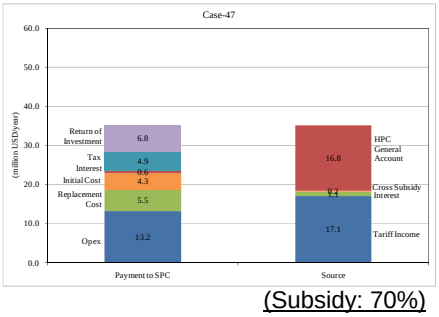
Financial Analysis: Case (Tariff: 5150 VND /m^3)



(Subsidy: 30%)

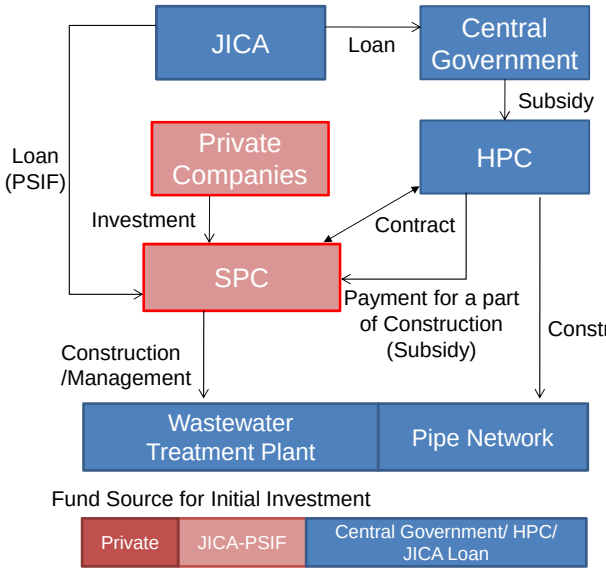


(Subsidy: 50%)



(Subsidy: 70%)

Draft Proposal of Hanoi PPP Model



It is proposed to provide low interest fund from JICA.

Private Sector Investment Fund (PSIF) could cover maximum 70 % of total investment cost of SPC

Rough estimate of Yearly Expenditure from HPC General Account, for Sewerage Service

(million US$/ year)
(billion VND/ year)

	Subsidy:30%	Subsidy:50%	Subsidy: 70%
VND 840 /m^3(US$ 0.04/m^3) Willingness-to-Pay (0.2% of household Income)	46.4 (956)	38.8 (800)	31.3 (642)
VND 5,150 /m^3 (US$ 0.245/m^3) Management Cost Recovery (1.1% of household Income)	32.0 (600)	24.4 (443)	16.8 (285)
VND 8,190 /m^3 (US$ 0.39/m^3) Affordable-to-Pay (1.8% of household Income)	25.5 (332)	17.9 (174)	10.3 (17)

Thank you for your attention

HANOI CITY:
Sludge Recycle Facility Planning on Project for Yen Xa WWTP
(Study B)

JICA Study Team
15 July 2011

Methodology of sludge recycle facility planning

Out-standing topics of Progress Meeting in May

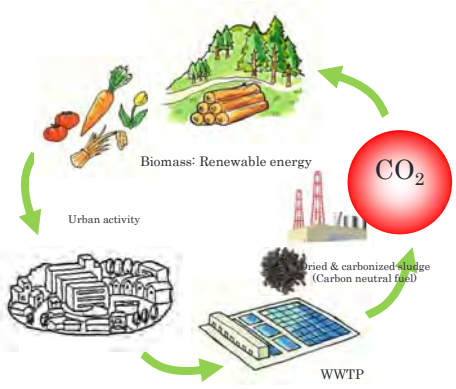
- Selection of Sewage Sludge Recycling Plant
- Applicability of Solar Drying Technology
- Potential Demand of Sludge Fuel & Soil Conditioner
- Selection of Sewage Sludge Treatment Process

Sewage sludge reuse (1/2)

IPCC defines sewage sludge as “Renewable energy”.

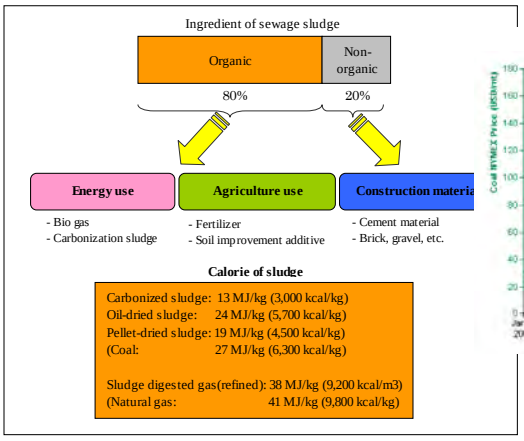
Sewage sludge is replaced to fossil fuel, therefore mitigates CO_2 & CH_4 emission in land fill site

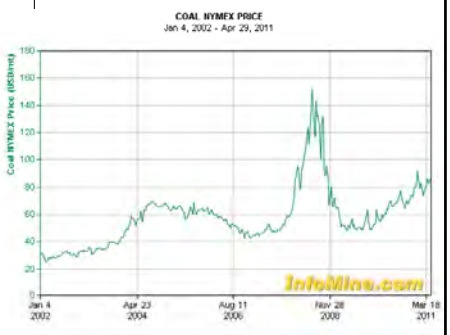
Gas	Global warning potential
CO_2	1
CH_4	21
N_2O	310



Sewage sludge reuse (2/2)

contains calorie of approx. 60 % of coal



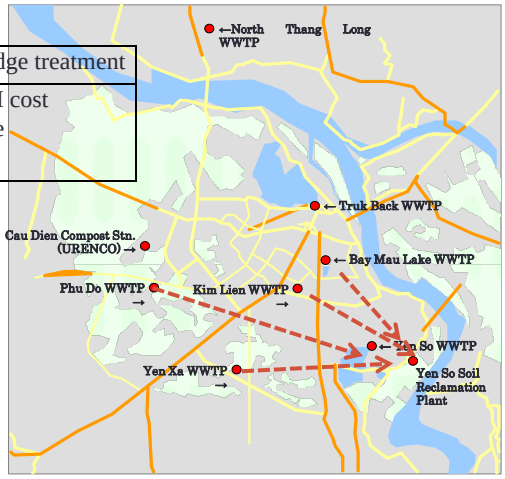


- Right: Coal price, New York Merchandize EX.50-80 USD/ton
- Left: Calorie of fuel sludge, Japan

Sludge treatment facility planning

- **Regional sewerage sludge treatment**

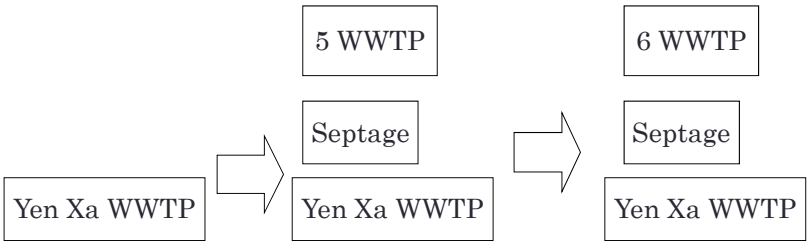
Advantages of regional sewage sludge treatment
Scale merit of construction & OM cost Qualified sludge product for reuse Offensive odor control



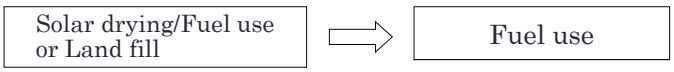
Concept of project programming (1/2)

Step-wised development

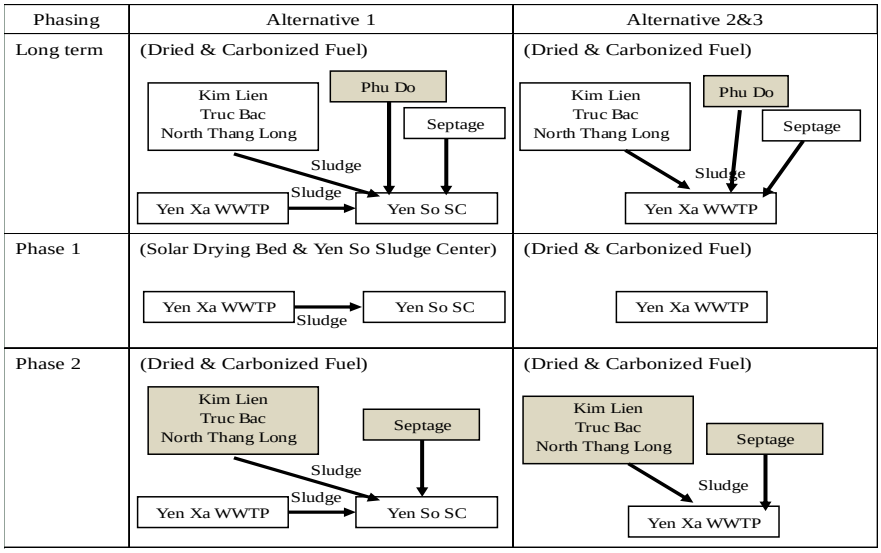
Individual treatment to regional sewage sludge treatment



Natural treatment to artificial treatment due to sludge increase



Concept of project programming (2/2)



Conclusion of PGM in May

- Step-wised project programming
  - Long term
    - Regional sewage sludge treatment = 7 WWTP + Septage
  - Phase-1 = PPP project
    - Yen Xa WWTP
- Alternatives of site & sludge treatment facility
  - Yen Xa WWTP
    - Mechanical drying or carbonization
  - Yen So land-reclamation site, if EIA approved
    - Solar drying of green house

Subjects in PGM in 15th July

Part-1

- Applicability of Solar Drying Technology
- Selection of Sewage Sludge Recycling Plant
- Selection of SRC Site & Sludge Treatment Process

Part-2

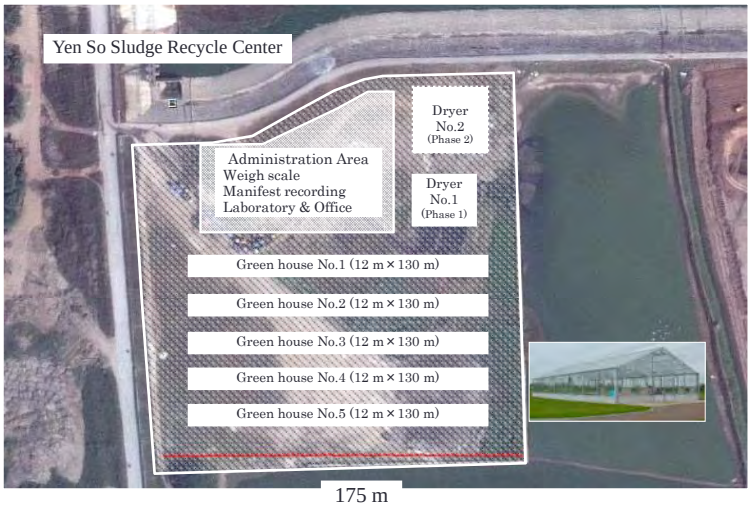
- Sludge Examination Plan

Continued to 3rd Field Survey in Oct.-Nov.

- Potential Demand of Sludge Fuel & Soil Conditioner

Part-1
Applicability of Solar Drying Technology (1)

- Lay out Plan of Yen So dredged soil reclamation site



Applicability of Solar Drying Technology (2)

Dewatered Sludge “Liquefied”

Demonstration Solar Green House

Aggregated , 2 days solar-dried

Dried Sludge, 6dats solar-dried

Applicability of Solar Drying Technology (3)

Examples in Overseas

Solar Green House, EU

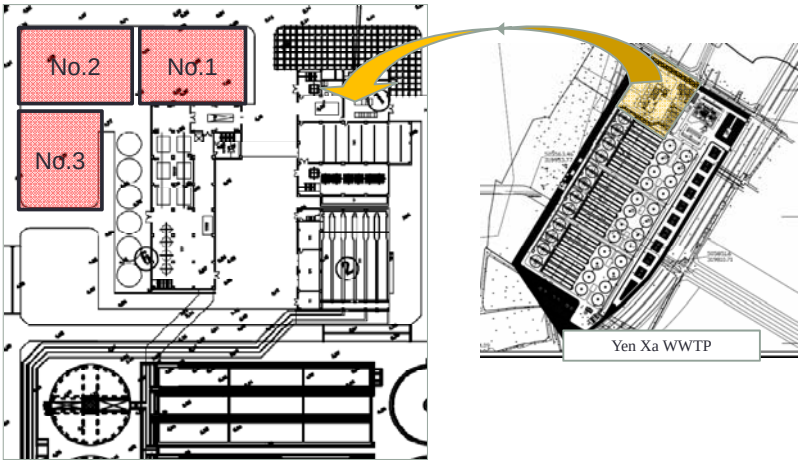
Solar Drying, Nong Khaem WWTP, Bangkok

Sludge Turn-over & Drying, Johannesburg

Natural Composting, Johannesburg

Applicability of Solar Drying Technology (4)

- Lay out Plan of Yen So Dredged soil reclamation site
  Mechanical Drying for Yen Xa WWTP



Construction Phasing
Construction Phasing
Yen So Sludge Recycling Center
Yen So Sludge Recycling Center
Yen Xa WWTP

Selection of SRC Site & Treatment Process(1)

Project Programming (1)

Yen So Sludge Recycling Center

7 WWTP + Septage	Mechanical Dryer			No.3
			No.2	No.2
Yen Xa 270,000m³/d		No.1	No.1	No.1
	Solar Green House			No.4
Project Phase		Phase-1	Phase-2	Long Term
Wastewater Flow(m³/day)		270,000	485,450	606,200
Produced Sludge (m³/day)		108	201.4	384.6

Yen Xa WWTP

7 WWTP + Septage	Mechanical Dryer			No.4
			No.3	No.3
Yen Xa 270,000m³/d		No.2	No.2	No.2
		No.1	No.1	No.1
Project Phase		Phase-1	Phase-2	Long Term
Wastewater Flow(m³/day)		270,000	485,450	606,200
Produced Sludge (m³/day)		108	201.4	384.6

Selection of SRC Site & Treatment Process(2)

Project Programming (2)

Operation Mode of Yen So SRC, Phase-1

	Dry Season	Rainy Season	Dry Season
Mechanical Dryer	Off	On (54 m^3/day)	Off
Solar Green House	On (108 m^3/day)	On (54 m^3/day)	On (108 m^3/day)
Remarks: Solar Drying efficiency is high in dry season and declined in rain season.			

Selection of SRC Site & Treatment Process(3)

Comparison of SRC site

	Yen So (dredged soil reclamation site)	Yen Xa WWTP
Sludge drying process	**Solar Drying "natural energy" + Mechanical Drying**	Mechanical drying "using fossil fuel"
Technology	Easy for green house drying Moderate for mechanical drying	Moderate
Quality of product	Fluctuates, however acceptable	Uniform high quality attained
Environmental acceptance	**Sufficient distance from residences, however EIA required**	Close to residences
Traffic accessibility	Easy	Easy
Upgrading flexibility in future	Easy	Easy
Water supply & wastewater utility	Yen So WWTP supports (Zero emission)	In side of Yen Xa WWTP
Construction cost	**Low**	Moderate
OM cost	**Low**	Moderate
Recommendation	**Recommendable**	Provisional option

Sludge Examination Plan (1)

Examination subjects

- Production process development
  Solar drying, composting & carbonizing
- Evaluation on behavior & effectiveness of sludge use
  Element analysis, Germination test, Cultivating & Burning

Questionnaire of for sewage sludge use of “Fertilizer & Soil Conditioner” and “Sludge Fuel”

Questionnaire will detects:

- Willing and potential demand
- Barriers on sludge product profile and assembly line

Sludge Examination Plan (2)

Sludge Examination aims “Sustainable Sludge Management”

- Practicable sludge reuse manner decides the sustainability of sludge management.
- Since land filling will be restricted, user’s willing affects sludge use practicability.
- Preliminary Sludge Examination Plan aims to detect sludge quality and willing of sludge product use of flower farms and cement factories.

Sludge Examination Plan (3)

Examined elements of sewage sludge

No.	Parameter	Unit	RESULTS			Analytical Method
			WWTP (A)	WWTP (B)	WWTP (C)	
Elements Analysis						
1	T- C	%	15.64	23.85	22.39	IET/ĐCMT TOC/ TN-2006
2	T-N	mg/kg	5142.5	6125.3	6577.2	
3	T-S	%	1.89	1.53	1.12	TCVN 4567-1998
4	T-P	mg/kg	20,449.89	24,183.26	23,014.89	TCVN 6202:2008
5	T-K(*)	mg/kg	10,853.52	3,644.52	9,352.81	EPA 3052-1996 SMEWW 3125-2005
Other Parameter						
19	Calorific value	Kcal/kg	3598.75	2395.62	3544.72	ASTMD 240-02
20	Loses of ignition	%	31.99	53.5	54.02	TCVN 4049-85
21	Ash content	%	39.5	26.13	33.44	TCVN 2688 – 1978
22	Moisture content	%	28.3	20.37	12.34	ASTMD 2216
23	Fixed carbon content	%	10.49	10.17	7.98	ASTM 3172 - 1997
24	pH	-	7.19	7.37	7.04	TCVN 6492:1999
25	Cl	mg/kg	689.68	662.32	674.9	EPA 9253

Sludge Examination Plan (4)

Elements:

- Elements of fertilizer contained.
- Ash content is a little higher than coal.
- Calorie is sufficient for fuel as 60 % of low quality carbon

Potential use:

- Soil conditioner for flower farm, park, and construction projects, etc. Vegetable use shall be refrained due to urban-originated waste.
- Sludge fuel of cement material and bio-mass boiler

Cement factories addressed Global Environment Concerns, and require more information on technical/political of sludge fuel use.

*-1 “Technical” by JICA Study and “Political” by Hanoi PC

*-2 Collaborations with Flower & Cement are indispensable.

Sludge Examination Plan (5)

3rd Sludge Examination on October

- Summarizes practicability on sludge elements & sludge processing.
- Applicability on soil conditioner/fertilizer through cultivating test, which is on-going, and Questionnaire of flower farm
- Applicability on sludge fuel of cement factories. Questionnaire survey will be examined.

Sludge Examination Plan (6)

Composting Test

Sludge Examination Plan (7)

Carbonizing Test

Oven

Carbonized Sludge

Sludge Examination Plan (8)

Germination Test

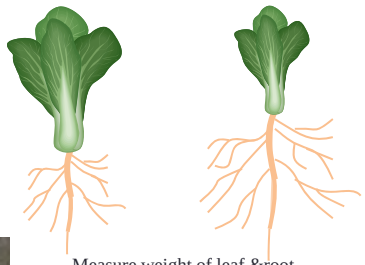
Test samples of mixed soil of
- Dried sludge
- Carbonized sludge

Seeding

Sludge Examination Plan (9)

Cultivating Test : Test samples of mixed soil of Dried sludge & Carbonized sludge

3days after seeding



Measure weight of leaf &root and EC (Electric Conductivity)

Thank you

第 3 回ワーキンググループ資料

（2011 年 9 月 23 日開催）

Working Group Meeting (23rd September, 2011)

Agenda

1) Confirmation of Project Scheme (ODA Portion / SPC Portion)

2) Confirmation of Implementation Schedule the Project

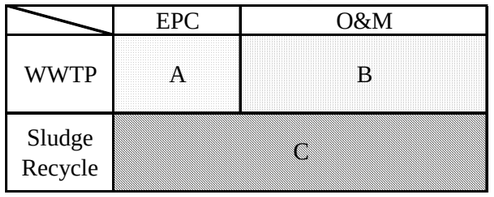
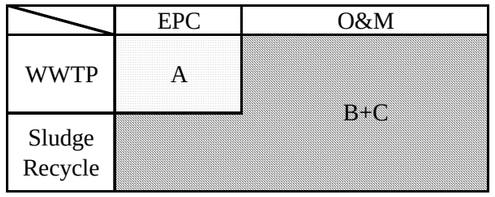
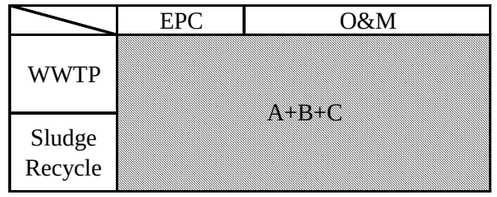
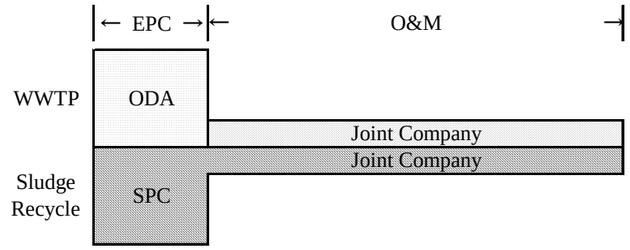
3) Confirmation of Selection Procedures of Consultant and SPC in SPC Portion

4) Confirmation of Scale of Sludge Recycling Facility

5) Confirmation of the Work Schedule of the Study

End of the document

Yen Xa WWTP ODA-Portion and Private-Portion Comparative Table of Project Scheme

Option	Option-1 A / B / C	Option-2 A / B+C	Option-3 A+B+C
Outline	(A) Construction of WWTP, (B) O&M of WWTP, (C) Construction and O&M of Sludge Recycling Facility, Each work is done separately. 	(A) Construction of WWTP (B) O&M of WWTP + Construction and O&M of Sludge Recycling Facility are jointly done. 	(A) Construction and O&M of WWTP + Construction and O&M of Sludge recycling Facility are jointly done. 
Fund			
Merit	・ Ordinary ODA Loan system and familiar to all.	・ HPC have only to select 1 operator for whole O&M. ・ Better & sustainable sludge recycling can be secured. ・ HPC can get PSIF and TA through SPC. ・ HPC can establish JC for IOMS with SPC, and Training Center by Grant through SPC.	In addition to Option-2: ・ Through DBO, lifecycle cost is much lower than Option-1 because Quality of Construction and O&M can be secured from both sides. ・ It streamlines the bidding process and shortens period up to Operation.
Demerit	・ It takes longer time than DBO. ・ Operator cannot secure quality of construction. ・ Lifecycle cost is much higher than DBO. ・ SPC for Sludge Recycle cannot be feasible and no PSIF & T/A (Grant) for the Project. (Sludge recycling contractor shall be the same as WWTP operator from the points of better & sustainable recycling.)	・ There is no big change from the standard procedures.	・ Sludge recycle have to be done completely under ODA process and it needs discussion internally in HPC. ・ If FS for Sludge recycle is necessary, contractor have to make it and HPC shall make the direct appointment.
Evaluation			

Project for Yen Xa WWTP ODA-Portion Comparative Table of Project Scheme

Option	Option-1 D-B + O (Public)	Option-2-A D-B + O (Private) (1)	Option-2-B D-B + O (Private) (2)	Option-3 D-B-O (1)	Option-4 D-B-O (2)
Design / Construction	「Design-Bid- Build」 or 「Design-Build」	「Design-Bid- Build」 or 「Design-Build」	「Design-Bid- Build」 or 「Design-Build」	「Design-Build-Operation」 Contract of O&M: less than 5 years	「Design-Build-Operation」 Contract of O&M: around 20 years
O & M	Public (HSDC)	Contract with private company separately (less than 5 years)	Contract with private company separately (around 20 years)		
Total Project Cost (20years operation)	1) Design ~ Build = 2) 20years Operation = 3) Renewal = Total =	1) Design ~ Build = 2) 20years Operation = 3) Renewal = Total =	1) Design ~ Build = 2) 20years Operation = 3) Renewal = Total =	1) Design ~ Build = 2) 20years Operation = 3) Renewal = Total =	1) Design ~ Build = 2) 20years Operation = 3) Renewal = Total =
Merit	・ It is familiar to HPC because of conventional way.	・ It is not difficult to change the contract conditions and O&M companies flexibly because of short-term O&M contract.	・ O&M work from long-term view makes the reduction of life cycle cost. ・ It is expected to trim down the organization because it is not necessary to continue putting in the expert in the public sector.	Similar to Option-2-A	・ It is possible to consider the construction and long-term O&M from design stage, and the drastic reduction of the life cycle cost is expected due to maximum use of know-how of the private sector. ・ It is possible to shorten the amount of time to completion of construction because the ordering work shall be done only once.
Demerit	・ It takes time at each stage of design, construction and O&M, and the procedure of bidding and contract is troublesome. ・ Option-1 is existing specification order system, so cost reduction by the idea of private sector is not expected.	・ O&M company will not maintain the facilities from long-term view, so drastic renewal works will be required. ・ Private sector should check the condition of facilities at every time O&M company changes. ・ Private sector should put in the expert for a long period, so cost reduction from long-term view is not expected.	・ It is necessary to study the details of contract conditions due to the long-term contract of O&M.	Similar to Option-2-A	・ It is necessary to study the details of contract conditions due to the very long-term contract of design, construction and O&M.
Experience	Previous precedents of Hanoi City	Some precedents	No precedent of Yen loan	Some precedents of Yen loan	No precedent of Yen loan

Implementation Schedule of the Yen Xa Sewerage Project in Hanoi (Option-1,2)

	Month	2008				2009				2010				2011				2012				2013				2014				2015				2016				2017				2018				2019				2020				2021			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
(1) Feasibility Study																	Revised FS																																					
(2) Land Acquisition and Resettlement	24																																																				
(3) Funding Arrangement for Project	4																																																				
1) Appraisal for Financing	2																																																				
2) Exchange of notes	1																																																				
3) Loan Agreement	1																																																				
(4) Selection of Consultant	6																																																				
(5) Detailed Design	30																																																				
1) Site Survey	16																																																				
2) Design Works	30																																																				
3) Preparation of Tender Documents	8																																																				
(6) Pre-construction Stage	24																																																				
1) Prequalification	10																																																				
2) Bidding Period	4																																																				
3) Evaluation and Signing of Contract	10																																																				
(7) Construction Stage	93																																																					
1) Construction Works (A1, B1)	45																																																				
1) Construction Works (A2, B2)	36																																																				
2) Test Operation	12																																																				
(8) Sludge Recycle Facilities (PPP Project)	84																																																				
1) Technical Cooperation Project	24																																																				
2) Selection of Consultant for F/S	6																																																				
3) Feasibility Study and Appraval	12																																																				
4) Selection of Consultant for Preparation of T/D	6																																																			
5) Preparation of Tender Document	12																																																				
6) Selection of SPC	12																																																				
7) Detailed Design	9																																																				
8) Construction Stage	12																																																				
(9) Investigation and Recommendation on Tariff Collection System	12																																																				
(10) Capacity Development Program	81																																																				
1) Preparation of the Program	6																																																				
2) Training Program in Overseas (intermittent)	75																																																			
3) Training in Vietnam (on the job training)	75																																																			

Selection of Consultant and SPC

	Consultant for F/S	Consultant for Tender Document Preparation and C/S	SPC
1	Local Consultant (To be selected by bid)		Private Companies (To be selected by bid)
2	ODA Consultant		Private Companies (To be selected by bid)
3	Local Consultant (appointed by HPC/MPI)		Private Companies (To be selected by bid)
4	Private Companies (direct appointment)		

Outline of Sludge Recycle Project

<Investment Cost>

（million US$）

Items	Solar Drying Bed (Capacity＝54m^3/day)	Mechanical Sludge Dryer (Capacity＝54m^3/day)	Total (Capacity＝108m^3/day)
Initial Cost	13	23	36

*Initial Cost = Construction Cost + Engineering Fee + Contingency

<Project Option>

	2013	2014	2015	2016	2017	2018	2019	・・・	20xx	Initial Cost
Option-A Yen Xa(270,000m^3/day) Capacity = 108m^3/day					↓Beginning treatment Yen Xa sludge →Amount of sludge = 108m^3/day					36
Option-B Yen So in first Capacity = 108m^3/day		↑Beginning treatment Yen So Sludge			↓Beginning treatment Yen Xa sludge					36

<Expected Daily Average of Sludge Generation>

WWTP	Sludge Generation (m^3/day)
Yen Xa	88.2
Yen So	40.3
Bay Mau	4.6
North Thang Long	13.7
Total	146.8
Capacity vs. Total Generation	73%

第 4 回ワーキンググループ資料

（2011 年 11 月 11 日開催）

Agenda of Working Group Meeting on 11th November, 2011

(1) Introduction (Fujii)
- Explanation of Outline of Today's Presentation
- Confirmation of Several Discussions on Condition of Preparation of ODA Loan for Yen Xa Wastewater Treatment Project

(2) JICA's understanding of the PPP Study and the Projects (Mr. Nagase or Mr. Yamamoto)
- Procedure of selection of ODA Loan Project
- ODA Projects attractive to Japanese side
- Understanding of PPP Study and Advantage of the Study Team Member Companies to Participation of the Project

(3) Approach of the Study (Fujii)
- Basic Concept of the Study (Maximization of benefits of Vietnamese and Japanese both sides)
- Outline of Project Scheme proposed by the Study Team

(4) ORIX's Proposal (Mr. Yamamoto, Mr. Sasaki or Mr.Murakami)
- ORIX's proposal on schedule of the Study
- Advantage of ORIX participation

(5) Outline of Proposal of Sludge Recycling Facility BOT Project (Mr. Kajiura or Mr. Fujii)

(6) Outline of Proposal for Establishment of Joint Company (Mr. Fujii)

(7) Approach to EPC of Yen Xa Wastewater Treatment Project (Mr. Yamamoto, Mr. Sasaki or Mr.Murakami)

Attachment

Att.-1: Project Scheme

Att.-2: Implementation Schedule

Att.-3: Draft Proposal of Joint Company and BOT Project

Att.-4: Presentation Material (PPT) of Sludge Recycling Facility

Introduction

- The Objectives of “PPP Study of Yen Xa WWTP Construction Project” (Study-B) is to promote Entry of Japanese Private Companies (lead by ORIX) to Business of Sewerage Field in Hanoi, in cooperation with HPC and JICA

- Frankly speaking, from commencement of the Study (April, 2011), it has taken so long time for both of Vietnamese and Japanese sides to understand what is required for sewerage system development in the Field of PPP.

- The Main Purpose of Today’s Meeting is to confirm the Possibility of Entry of ORIX Group into Business of “OM of Yen Xa WWTP”, “OM of Ten Xa WWTP” and “BOT of Sludge Recycling Facility”

- If HPC has no intention of doing above Business with ORIX Group, the Study Team had better to stop doing the Study, because any more study is meaningless.

Approach of the Study

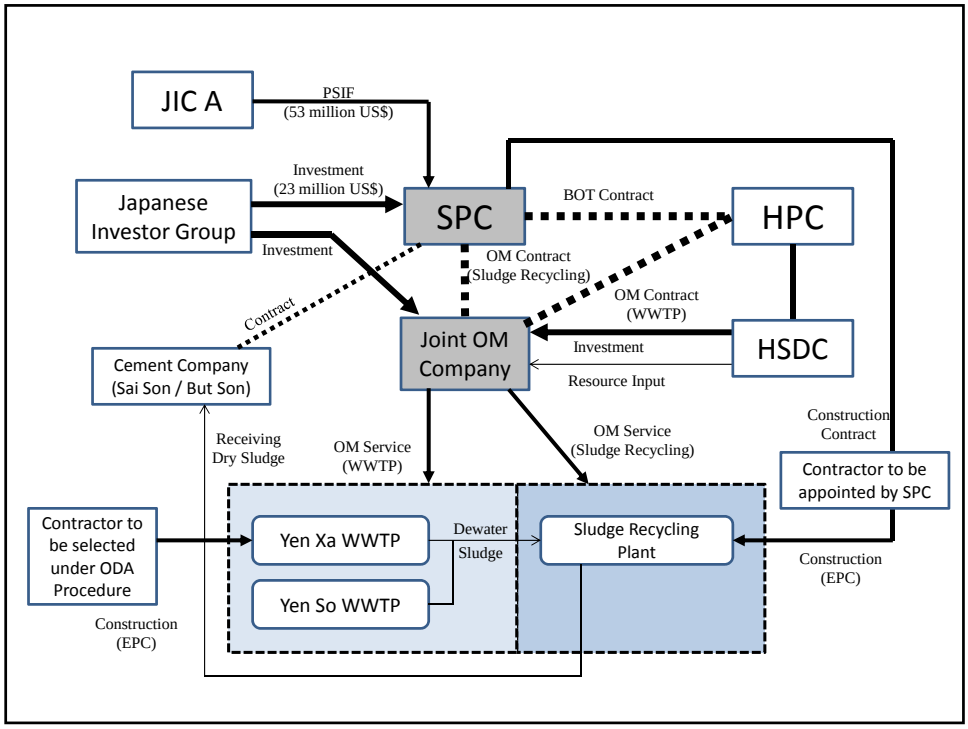
Basic Concept of the Study:

Maximization of Benefit of Both of Vietnamese and Japanese Sides

1. Benefit of Vietnamese Side
   Acquisition of ODA Loan, Reduction of Life Cycle Cost of the Projects, Technical Transfer from Japan, Development of sewerage System in Hanoi, etc
2. Benefit of Japanese Side
   Increase of Business Opportunities of Private Company

Proposed Project Scheme:

1. Establishment of SPC for BOT Project of “Sludge Recycling Facility” with Japanese Private Companies
2. Establishment of Joint Company for OM of Yen So WWTP, Yen Xa WWTP and Sludge Recycling Facility with Japanese Private Companies



Project Component and Selection of Companies for Construction and OM

	Construction Company	OM Company
1) Pipe Network	Contractor to be selected by Open tender under ODA procedure	HSDC
2) Yen Xa WWTP		Joint Company
3) Sludge Recycling Facility	SPC to be selected by procedure of BOT law	

Proposal of Japanese Private Company Participation

	Construction Stage	OM Stage
Yen So WWTP	(already constructed)	**Joint Company** to be established by HPC/HSDC and **Japanese Private Company**
Yen Xa WWTP	Contractor to be selected by Open Tender (Same **Japanese Private Company** is preferable)	
Sludge Recycling Facility	Contractor to be appointed by **SPC**, which will be established by **Japanese Private Company**	

Establishment of Joint Company

Initial Stage:
JC will carry out operation and maintenance works for the following plants and facility;
- OM of Yen So WWTP
- OM of Yen Xa WWTP
- OM of Sludge Recycling Facility

Development Stage:
- OM of other WWTP in Hanoi
- OM of WWTP in other municipalities
- Training service and engineering service for other municipalities
- Construction works

Alternatives of Share of Joint Company for Discussion

Option	VN : JP	Remarks
1	35 : 65	Japanese side has majority (Around 10 years later, Japanese share will be reduced to minority)
2	51 : 49	Vietnamese side has power to appoint legal representative of the company, and Japanese side has power of dismiss.
3	65 : 35	Vietnamese side has majority Certain important issue shall be to subject to agreement of Japanese side. Japanese side shall have right to appoint a half of BOM members.

Draft Schedule of Establishment for Discussion

January 2012
Preliminary Agreement on Establishment of JC
March 2012
Signing on Term Sheet to Decide Important Conditions (Appointment of Partner)
June 2012
Signing on Joint Venture Agreement, Charter, and OM Service Agreement
July 2012
Submission of Application for Business Registration and Investment Certificate to HAPI
August 2012
Issuance of Business Registration and Investment Certificate by HPC (Establishment of Joint Company)

QUESTIONS

1) How will you select partners of the **Joint Company**? (Could you give a direct appointment to ORIX or NOT?)
2) How do you select operators of **Yen So WWTP** and **Yen Xo WWTP**? (Could you give a direct appointment to the Joint Company or NOT?)

	Month	2008				2009				2010				2011				2012				2013				2014				2015				2016				2017				2018				2019				2020				2021			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
(1) Feasibility Study																Revised FS																																					
(2) Land Acquisition and Resettlement	24																																																			
(3) Funding Arrangement for Project	7																																																			
1) Short Listing																																																			
2) Contact & Fact Finding	3																																																		
3) Appraisal for ODA Laon	2																																																		
4) Exchange of Notes	1																																																		
5) Loan Agreement	1																																																		
(4) Selection of Consultant	6																																																		
(5) Detailed Design	15																																																		
1) Site Survey	9																																																		
2) Design Works	15																																																		
3) Preparation of Tender Documents	4																																																		
(6) Pre-construction Stage	24																																																		
1) Prequalification	4																																																		
2) Bidding Period	3																																																		
3) Evaluation and Signing of Contract	4																																																		
(7) Construction Stage	52																																																		
1) Construction Works (Yen Xa)	40																																																		
2) Operation under Gurantee Period	12																																																		
(8) Establishment of Joint Company																																																			
1) Discussion on Establishment																																																			
2) Agreement on Term Sheet for Yen So & Yen Xa																																																			
3) Establishment of JC																																																			
4) Preparation Works & Monitoring of Yen So																																																			
5) Maintenance Period (Yen So WWTP)																																																			
6) Operation (Yen So WWTP) by JC																																																			
7) Maintenance Period (Yen Xa WWTP)																																																			
8) Operation (Yen Xa WWTP) by JC																																																			
(9) BOT (Sludge Recycling Facility)																																																			
0) Preparation of Proposal and Approval																																																			
1) MOU for Implementation of BOT																																																			
2) Direct Appointment																																																			
3) Establishment of SPC																																																			
4) Contract Agreement																																																			
5) Design																																																			
6) Construction																																																			
7) Operation (foYen So)																																																			
8) Operation (foYen Xa)																																																			

First Critical point

Second Critical point

Attachment-3

Draft Proposal of Joint Company and BOT Project

(1) Project Scheme and Selection of Construction and OM Companies

The Project of Yen Xa Wastewater Treatment Plant includes the constructions of 1) Pipe Network, 2) Yen Xa Wastewater Treatment Plant and 3) Sludge Recycling Facility. It is proposed that the structures will be constructed and operated by the following companies;

Table 1-1 Selection Method of Construction and OM Companies

	Construction Company	OM Company
1) Pipe Network	Contractor to be selected by Open tender under ODA procedure	HSDC
2) Yen Xa WWTP		Joint Company
3) Sludge Recycling Facility	SPC to be selected by procedure of BOT law (Joint Company will have OM sub-contract)	

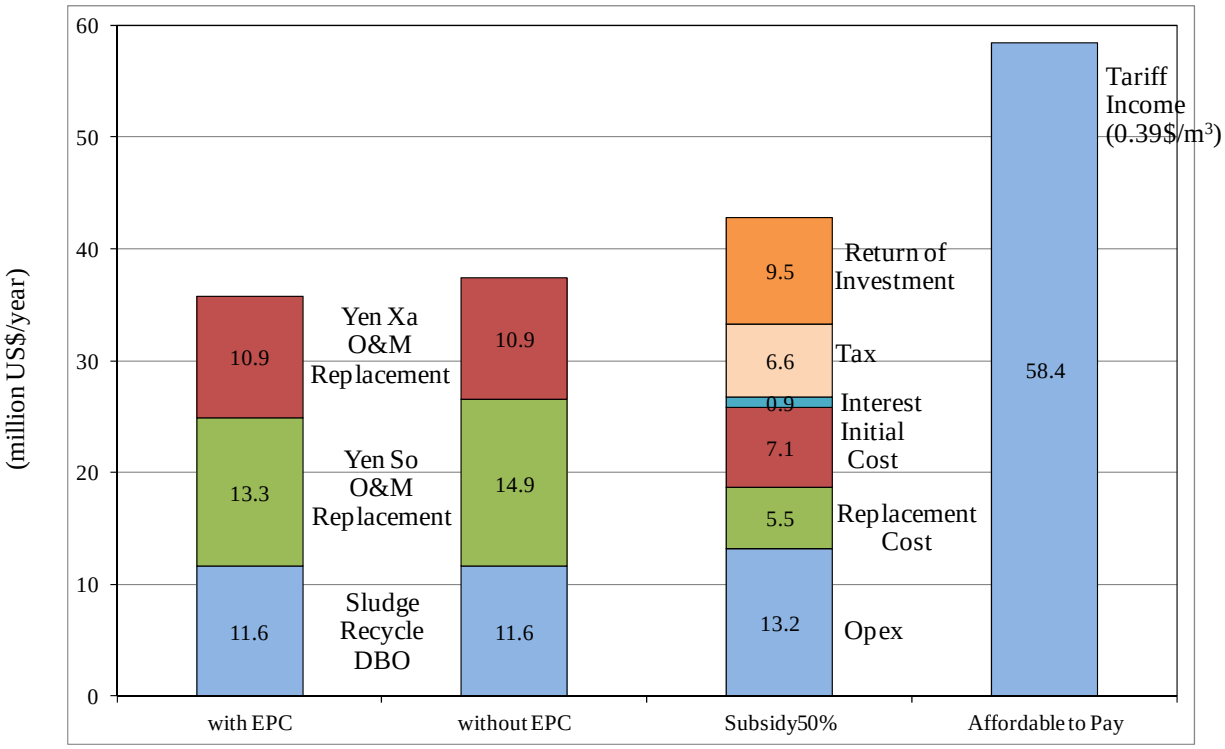
To give advantage to the Yen Xa WWTP Project for selection of ODA loan project, it is recommendable that Japanese private company will participate in OM of Yen Xa WWTP and BOT project for Sludge recycling facility. As the conclusion of the Study so far, the Study Team propose the Project Scheme as shown in Attachment-1, and propose Japanese companies participation as shown in Table 1-2.

Table 1-2 Proposal of Japanese Private Company Participation

	Construction Stage	OM Stage
Yen So WWTP	(already constructed)	Joint Company to be established by HPC/HSDC and Japanese Private Company
Yen Xa WWTP	Contractor to be selected by Open Tender (Same Japanese Private Company is preferable)	
Sludge Recycling Facility	Contractor to be appointed by SPC, which will be established by Japanese Private Company	

The service charge of above works is roughly estimated as shown in Figure 1-1. It can be mentioned as below;

- The total service charge is estimated at 37.4 million US$/year (without EPC)
- The total service charge is less than expected sewerage tariff income, which is calculated based on consideration of Affordable to Pay for residents in Hanoi (3% of household income).
- Comparing with the case 50% subsidy (50% supported by ODA loan), the total service charge is much cheaper.
- If EPC is carried out by same company (ORIX), the service charge could be reduced.



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(2) Proposal of Establishment of JOINT COMPANY

1) Necessity

It is preferable that one organization will carry out operation and maintenance of Yen So WWTP, Yen Xa WWTP and sludge recycling facility, because each operation works are closely related. In addition, high technical skill and knowledge are required for the overall operation and maintenance, so that it is proposed for HPC/HSDC to establish Joint OM Company with Japanese private companies, which have enough technical and financial skills.

The tasks of Joint Company is planned to do not only OM of WWTPs and sludge recycling facilities in Hanoi, but be developed to the field of engineering service, training service and construction works, by using their own technical skill and knowledge to be gotten.

2) Contents of Service of Joint Company

Initial Stage:

JC will carry out operation and maintenance works for the following plants and facility;

- OM of Yen So WWTP (Operation from 2018, Total capacity: 190,000 m3/day)
- OM of Yen Xa WWTP (Operation from 2014, Total capacity: 270,000 m3/day)
- OM of Sludge Recycling Facility (Operation from 2016, Total capacity: 237 m3/day of sludge)

Development Stage:

- OM of other WWTP in Hanoi
- OM of WWTP in other municipalities
- Training service and engineering service for other municipalities
- Construction works

3) Proposed Schedule of Establishment of Company

In order to have Loan Agreement of Yen Xa WWTP Construction Project in September, 2012, the following schedule shall be followed;

January 2012	Preliminary Agreement on Establishment of JC
March 2012	Signing on Agreement on Term Sheet to Decide Important Conditions (Appointment of Partner)
June 2012	Signing on Joint Venture Agreement, Charter, and OM Service Agreement
July 2012	Submission of Application for Business Registration and Investment Certificate to HAPI
August 2012	Issuance of Business Registration and Investment Certificate by HPC (Establishment of Company)

4) Rough Estimate of Service Charge

The charges for OM service are tentatively calculated as below:

Amount to be charged to HPC

・OM of Yen Xa WWTP (15.2 million US$/year, 0.202 US$/m^3)

・OM of Yen So WWTP (11.1 – 14.5million US$/year, 0.161 – 0.202US$/m^3)

Amount to be charged to SPC

・Sludge Recycling Facility の OM (3.2 million US$/year, 40 US$/m^3)

Total service charge 31 – 35 million US$ /year

Benefit around 1.6 – 1.8million US$/year (5% of service charge)

5) Share of Equity (Vietnamese and Japanese)

Required equity of the JC is tentatively estimated at 1.8 million US$, and several alternatives of share are proposed for discussion as below;

Option	VN : JP	Remarks
1	35 : 65	Japanese side has majority (Around 10 years later, Japanese share will be reduced)
2	51 : 49	Vietnamese side has power to appoint legal representative of the company, and Japanese side has power of dismiss.
3	65 : 35	Vietnamese side has majority Certain important issues shall be subject to agreement of Japanese side. Japanese side shall have right to appoint BOM members

Remarks;

VN: HPC/HSDC, JP: Japanese company group lead by ORIX

6) Participants of the Project

HPC (HSDC on behalf of HPC) will establish Joint Company with Japanese partners. If HPC select ORIX as a partner, Orix will be in charge of financial arrangement and arrangement of participants of Japanese other companies to the Joint Company.

(3) Proposal for Sludge Recycling Project (BOT)

1) Necessity of the Project

- It is required to reduce amount of landfill waste of dewatered sludge from WWTPs.
- It is required to reduce required scale of new landfill site (solid waste disposal site)
- It is required to utilize resource (sludge) effectively

2) Necessity and advantage of implementation in the form of BOT

- The lifecycle cost of the Project could be minimized. In the form of BOT, the SPC (which is established for the purpose of the Project) will try to minimize lifecycle cost of the Project, because the SPC is required to carry out design, construction, operation and maintenance as a package, so that the SPC will consider effective operation and maintenance from design stage.
- The latest technology and know-how for sludge recycling could be introduced by Japanese Private company.
- The initial investment cost could be provided by Japanese private company (the SPC). (HPC don't need to do financial arrangement for the Project.)

3) Contents of Service

The services of the BOT Project are considered as below;

- To make drying 237 m3/day of dewatered sludge, which are generated from WWTPs in Hanoi
- To reduce volume of sludge: 237 m3/day of dewater sludge (80% moisture contents) to around 60 m3/day of dry sludge (10% of moisture contents)
- To provide suitable dry sludge to cement companies as an alternative fuel of coal
-To provide reaming dry sludge for gardening of public green space, if all the dry sludge cannot be used in cement factories.

However, step wised development plan will be considered in later stage.

If all amount of dry sludge to be provided by the SPC cannot be used in the cement companies and the gardening under effort of the SPC with HPC support, HPS shall consider receiving reaming amount of dry sludge. It can be used for construction material in construction works in Hanoi. HPC shall consider providing new law for promotion of recycling of dry sludge.

4) Principal Feature of Facility and Technical

(Please see Attachement-4)

5) Service Charge

・Service Charge to HPC (11.1 million US$/year, 138 US$/m^3)
・OM cost to be charged from Joint Company (3.2 million US$/year, 40 US$/m^3)

6) Equity and Share

Construction Cost: 64 million US$
Required Fund: 76 million US$
Equity (30%) : 23 million US$
Debt: PSIF (70%) : 53 million US$

As for share of equity, ORIX will has major portion, and some Japanese companies will have remaining.

7) Consideration of Schedule and Form of Investment

It seems to take more than one year to get approval of the BOT project and make a contract with an investor for the BOT project. It means the investor can hardly be selected before September, 2012, even before March, 2013 (which is expected month for the Loan Agreement). In order to have Loan Agreement of Yen Xa WWTP Construction Project in September, 2012, it may be required to have MOU between Vietnamese and Japanses sides, which shows condition of BOT bidding with something like Japanese tied bidding.

The Study Team is considering the possibility of adopting FDI (Foreign Direct Investment) also for the sludge recycling facility project.

Sludge Recycling Facilities (BOT)

November 11th, 2011

1

(1) Necessity of Sludge Recycle

- Large amount of sludge will be generated from new construction WWTPs (Yen So, Yen Xa), and they are to be disposed to landfill sites.
- Capacities of landfill sites are very limited in Hanoi.
- It is required to reduce and recycle these sludge.

2

(2) Introduction of Sludge Recycle Method

Sewage Sludge components can be used.

80%
Organic (C,H,N,P)

20%
Inorganic (Si,Cl,Al)

Use for Green Farm	Use for Energy	Use for Construction Material
Fertilizer Soil Conditioner	Solid Fuel Methane Gas	Cement Material Brick, Aggregate

(Source: Ministry of Land, Infrastructure, Transport and Tourism, Japan)

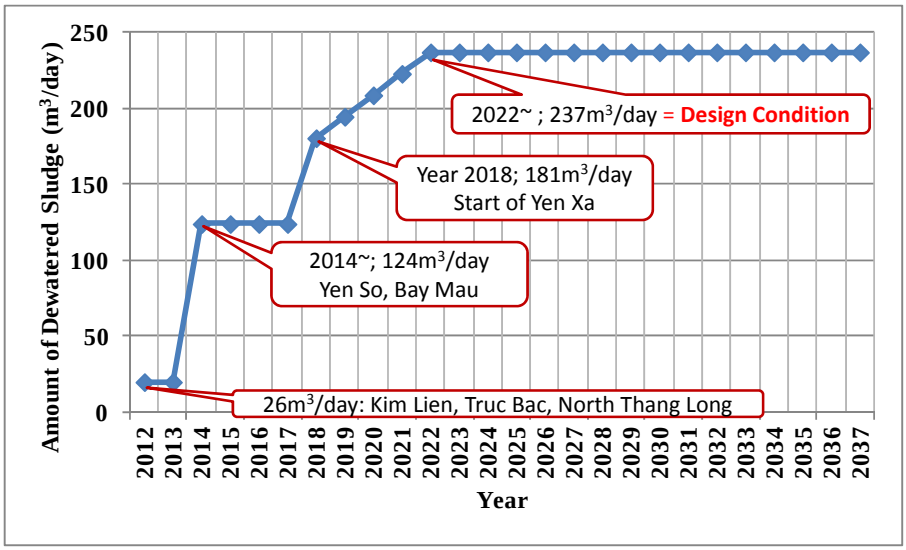
3

(3) Potential Demand of Sludge

	Power Company	Cement Company	Floriculturist
Consumption of Coal or fertilizer	4100t/day (1,500,000t/year)	950t/day (350,000t/year)	20t/day (7,000t/year)
Potential Demand	205t/day (75,000t/year) (5% Alternate Fuel)	51t/day (18,600t/year) (5% Alternate Fuel)	32t/day (11,600t/year) (50% Alternate Nitrogen of Fertilizer)

4

(4) Amount of Dewatered Sludge in Hanoi



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(5) Needs Survey of Sewage Sludge Products

	Power Company	Cement Company	Floriculturist
Current Situation & Interest	They have high interest in environmental problems.	It is difficult to procure enough coal because coal demand of China is rapidly increasing. So they have high interest in alternate fuel.	They are used to buy fertilizers from fertilizer companies. They are interested in the material leads to higher productivity.
Opinion	It is too early to use sewage sludge as a alternate fuel. It is necessary to do F/S and demonstration experiment under the Ministry of Industry.	If sludge products have acceptable quality, they can consider using sludge products proactively.	If sludge products have an advantage, they intend to try to use them. One of the floriculturist has also interested in the demonstration test in his field.
Evaluation	**Not recommendable** (Considerable for future use)	**Recommendable** as most stable consumer	**Recommendable as sub-consumers**, if sludge products have acceptable quality.

6

(6) Specification of Sludge Products

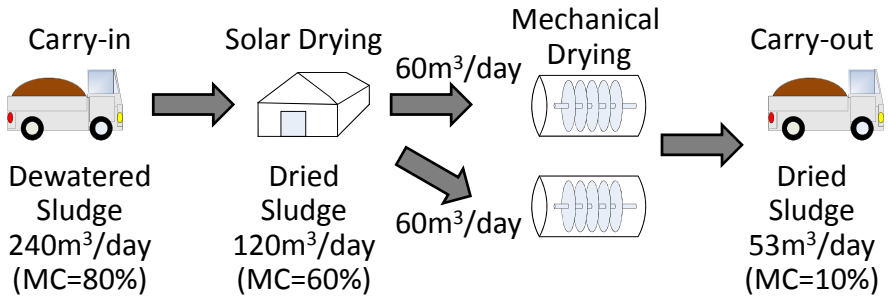
Request from Cement Companies

Item	Condition	Situation
Moisture Content	Less than 10%	Possible to be made by Mechanical Drying
Calorific Value	More than 3,000kcal/kg	Supposed to be acceptable at the existing Data. (Future confirmation required)
Exhaust Gas	Meet the Exhaust Standard	Now under testing in Butson Cement

7

(7) Sludge Drying Process

Hybrid Process of Solar Drying & Mechanical Drying

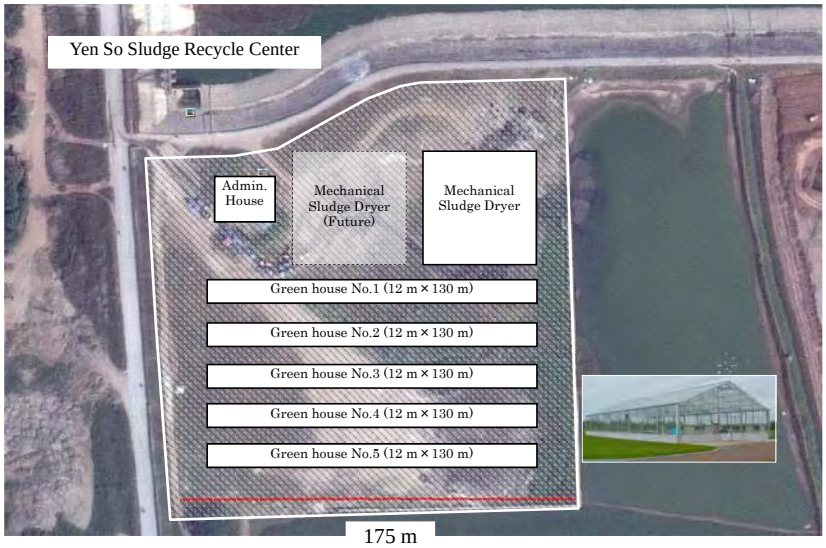


Process	Merit	Demerit
1) Solar Drying	Lowest cost, Save energy	Impossible to make MC=10%
2) Mechanical Drying	No need for extensive site	More expensive
3) Hybrid (Solar & Mechanical)	Save energy, Low cost	Little bit difficult O&M
4) Carbonization	No need for extensive site	Most expensive

(MC: Moisture Content)

8

(8) Layout Plan of Sludge Drying Facilities



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(9) Outline of Cement Companies

Item	Butson Cement Joint Stock Company	Saison Cement Joint Stock Company
Amount of Cement Production	3,000,000t/year	300,000t/year
Coal Consumption	900t/day	120t/day
Main Share Holder	Vietnam Cement Industry Corporation: 75% Asian Commercial Bank: 10% Others: 15%	State Capital Investment Corp.: 17% General Director: 10% Others: 73%

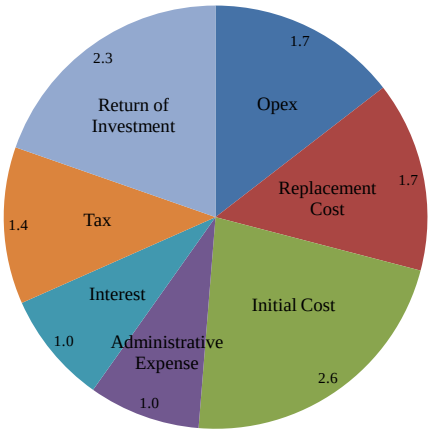
10

(10) Investment Cost and Service Charge

Investment Cost

Item	Cost (million US$)
EPC (Civil Works)	14.4
EPC (Mechanical, Electrical)	38.9
Contingency	5.3
Tax	5.9
Total	64.5

Annual Service Charge
(Total:11.6million US$)



(unit: million US$)

11

Thank you for your attention

第 5 回ワーキンググループ資料

（2012 年 1 月 10 日開催）

Agenda of Working Group Meeting on 10th January, 2012

(A) Issue of Joint Company Establishment (M. FUJII, NK)

1) Working Staff (See Attachment-1)
2) Working Progress and Schedule (See Attachment-2)

(B) Issue of BOT for Sludge Recycling Center

1) Confirmation of Major Points of Proposal in Interim Report (See Interim Report and Attachment-3) (M. Fujii, NK)
2) Outline of the Proposed BOT Project (See Attachment-4) (T. Kajiura, NK)
3) Sludge Recycling in Cement Industry (See Attachment-5) (Terunuma, Mitsubishi)
4) Remaining Issues to be solved (See Attachment-6&7) (Y. Inoue/M. Fujii, NK)

(C) Questions and Answers

1) Comments on the Interim Report
2) Questions and Answers on Presentation of the Meetings

Attachment-1	List of Working Staff (prepared)
Attachment-2	Schedule for Establishment of Joint Company (prepared)
Attachment-3	Schedule of BOT Project (prepared)
Attachment-4	Outline of the Proposed BOT Project (to be prepared by Mr. Kajiura)
Attachment-5	Sludge Recycling in Cement Industry (to be prepared by Mr. Y. Inoue)
Attachment-6	Remaining Issues to be solved (to be prepared by Mr. Y. Inoue and M. Fujii)
Attachment-7	Draft of MOU (to be prepared by Dr. Islam and M. Fujii)

APPENDIX-1

List of Working Staff (Japanese side) for Establishment of Joint Company with HSDC

Position	Name
1) Team Leader	Tomoyuki SASAKI (ORIX)
2) Sub Team Leader	Yosuke MURAKAMI (ORIX)
3) Advisor	Kenichi YAMAMOTO (ORIX)
4) Financial Issue	Takahiko INOUE (PWC)
5) Personnel Issue	Tomoyuki SASAKI (ORIX)
6) Institutional Issue (Law, Regulation)	Yoshiki TSUCHIDA (ORIX)
7) Technical Issue	Masayuki FUJII (NK)

APPENDIX-2

Tentative Schedule of Establishment of Joint Company (In case of the Loan Agreement in September 2012)

January 2012	Preliminary Agreement on Establishment of JC
March 2012	Signing on Term Sheet to decide Important Conditions (Appointment of Partner)
June 2012	Signing on Joint Venture Agreement, Charter, and O&M Service Agreement
July 2012	Submission of Application for Business Registration and Investment Certificate to HAPI
August 2012	Issuance of Business Registration and Investment Certificate by HPC (Establishment of Joint Company)

APPENDIX-3

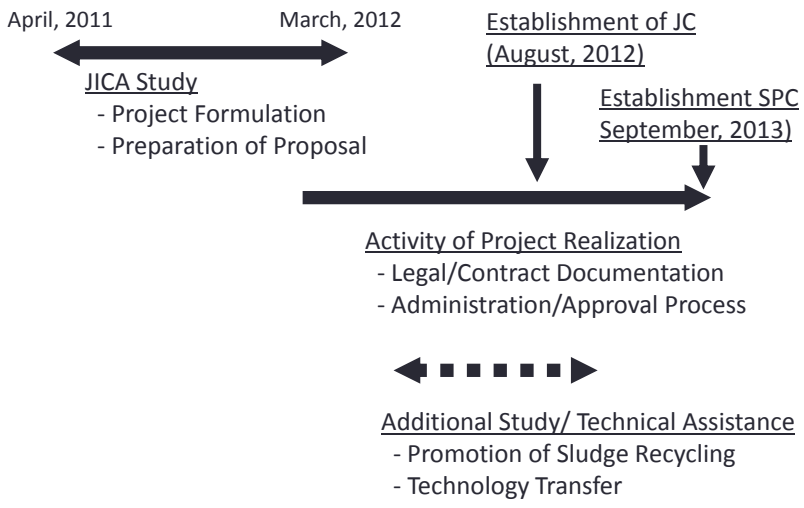
Tentative Schedule of BOT Project

January 2012	Preparation of Preliminary Proposal of BOT Project
March 2012	MOU for Selection of Investor of BOT Project (Japan Tied?)
March 2012	Preparation of Proposal of BOT Project
September 2012	Approval of Proposal of BOT Project by Prime Minister's Office
October 2012	Selection of Investor of BOT Project
August 2013	Submission of Application for Business Registration and Investment Certificate to HAPI
September 2013	Issuance of Business Registration and Investment Certificate by HPC (Establishment of SPC)
September 2013	Commencement of Feasibility Study
September 2014	Approval of Feasibility Study
September 2014	Commencement of Detailed Design
January 2015	Commencement of Construction

WORKING GROUP MEETING
(10TH JANUARY 2012)

Material for Explanation

(A) Activities up to Establishment of JC and SPC



(B) Establishment of Joint Company

The negotiation has been carried out between HSDC and the Proponent of ORIX Group, since December 2012.

List of Working Staff (Japanese side) for Establishment of Joint Company with HSDC

Position	Name
1) Team Leader	Tomoyuki SASAKI (ORIX)
2) Sub Team Leader	Yosuke MURAKAMI (ORIX)
3) Advisor	Kenichi YAMAMOTO (ORIX)
4) Financial Issue	Takahiko INOUE (PWC)
5) Personnel Issue	Tomoyuki SASAKI (ORIX)
6) Institutional Issue (Law, Regulation)	Yoshiki TSUCHIDA (ORIX)
7) Technical Issue	Masayuki FUJII (NK)

Tentative Schedule of Establishment of Joint Company (In case of the Loan Agreement in September 2012)

January 2012	Preliminary Agreement on Establishment of JC
March 2012	Signing on Term Sheet to decide Important Conditions (Appointment of Partner)
June 2012	Signing on Joint Venture Agreement, Charter, and O&M Service Agreement
July 2012	Submission of Application for Business Registration and Investment Certificate to HAPI
August 2012	Issuance of Business Registration and Investment Certificate by HPC (Establishment of Joint Company)

3

(C) BOT Project

Tentative Schedule of BOT Project

January 2012	Preparation of Preliminary Proposal of BOT Project
March 2012	MOU for Selection of Investor of BOT Project
March 2012	Submission of Proposal of BOT Project
June 2012	Approval on addition to national BOT Project List by relevant ministries
September 2012	Selection of Investor of BOT Project (Direct Appointment)
August 2013	Submission of Application for Business Registration and Investment Certificate to HAPI
September 2013	Issuance of Business Registration and Investment Certificate by HPC (Establishment of SPC)
September 2013	Commencement of Feasibility Study
September 2014	Approval of Feasibility Study
September 2014	Commencement of Detailed Design
January 2015	Commencement of Construction

4

Major Issues to be solved on BOT Project Formulation

1) **Confirmation of Acceptable Service Charge**

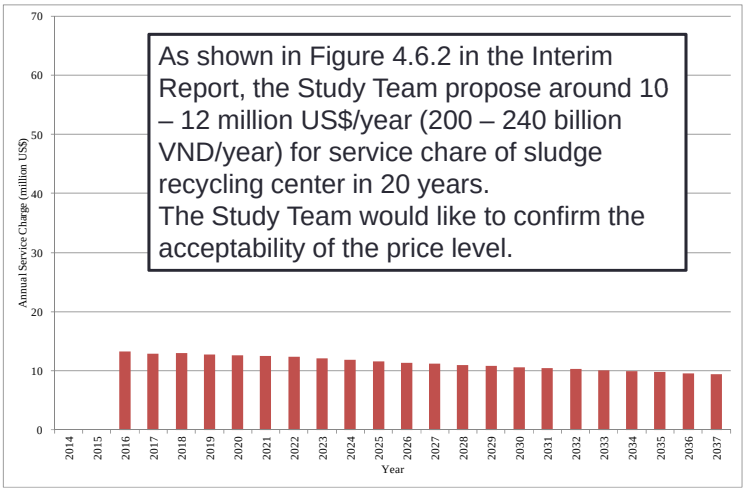
   Feasibility of BOT Project depends on level of service charge for sludge recycling

2) **Confirmation of End Use of Dry Sludge**

   Sustainability of the sludge recycling depends on efficient and effective end use of dried sludge

5

(C-1) Level of Service Charge



Service Charge to be paid by HPC for BOT of Sludge Recycling facility

6

(C-2) End Use of Dry Sludge

The study for end use of the dry sludge has been carried out.
The issue shall be solved for realization of the BOT Project

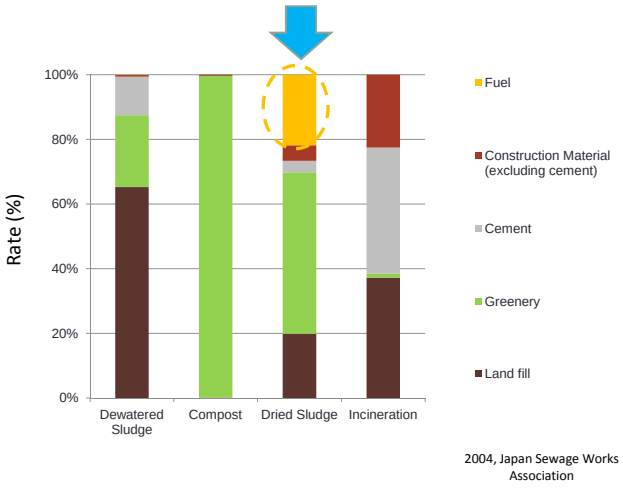
Potential Demand of Dry Sludge in Hanoi

	Power Company	Cement Company	Greenery
Consumption of Coal or fertilizer	4,100t/day (1,500,000t/year)	1,040t/day (380,000t/year)	20t/day (7,000t/year)
Potential Demand	205t/day (75,000t/year)	52t/day (18,900t/year)	32t/day (11,600t/year)
	(5% Alternate Fuel)	(5% Alternate Fuel)	(50% Alternate Nitrogen of Fertilizer)

Planning Dry Sludge Generation: 39ton/day

7

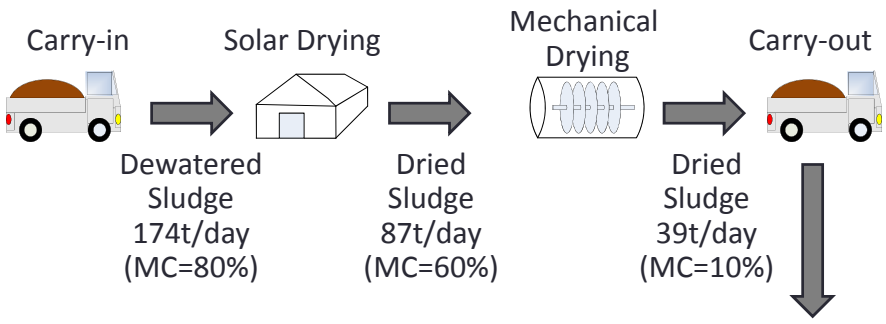
Percentage of End Use Method in Japan after Sludge Treatment



2004, Japan Sewage Works Association

2

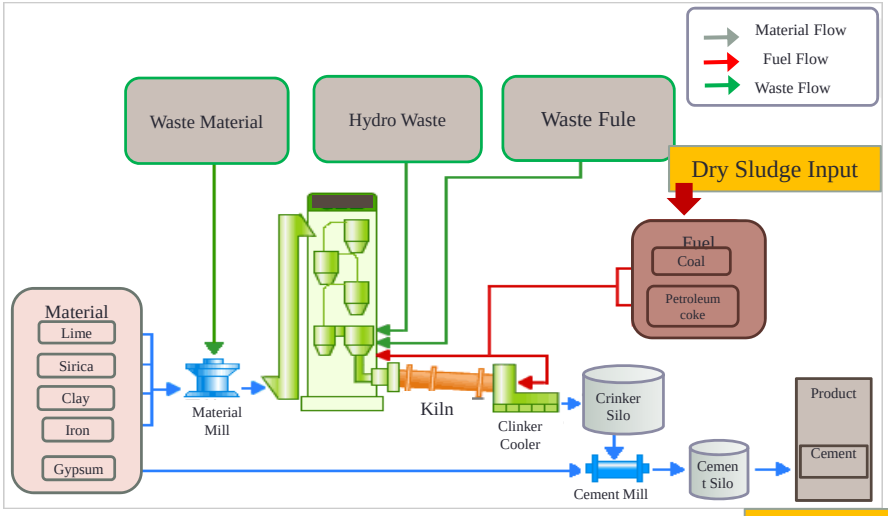
1) Proposed Sludge Drying Process under the BOT Project



- The cement companies are expected to be the major consumer of the dry sludge.
- Greenery could be another end user. (It could be managed easier under HPC. But the potential demand is limited.)

9

2) Proposed End Use of Dry Sludge in Cement Factory



However, there is still no agreement with cement company

5

Outline of Cement Companies

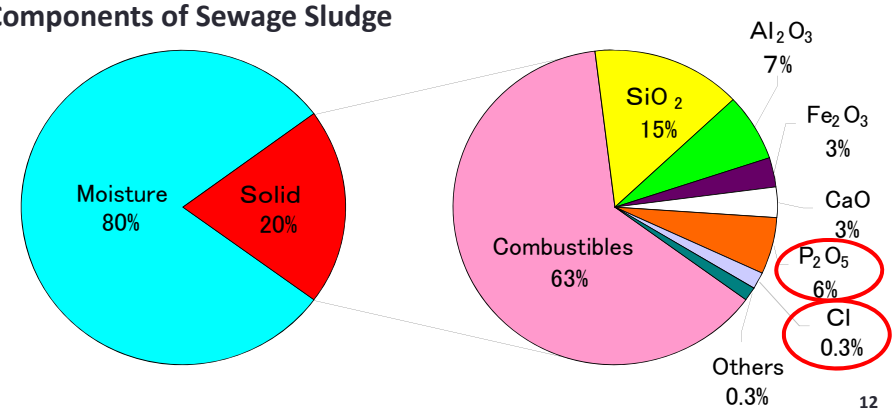
Item	Butson Cement Joint Stock Company	Saison Cement Joint Stock Company
Amount of Cement Production	3,000,000t/year	350,000t/year
Coal Consumption	900t/day	140t/day
Main Share Holder	Vietnam Cement Industry Corporation: 75% Asian Commercial Bank: 10% Others: 15%	State Capital Investment Corp.: 17% General Director: 10% Others: 73%

11

Potential Problem cased by Dry Sludge input to Cement Factory

1) Offensive Impact of Cl to Cement Production Facilities
2) Offensive Impact of P_2O_5 to Quality of Cement Production
3) Offensive Impact caused by Lack of Uniformity of Fuel Calorie
   (Normal coal: 6,300 kcal/kg , Dry Sludge : 3,000 kcal/kg)

Components of Sewage Sludge



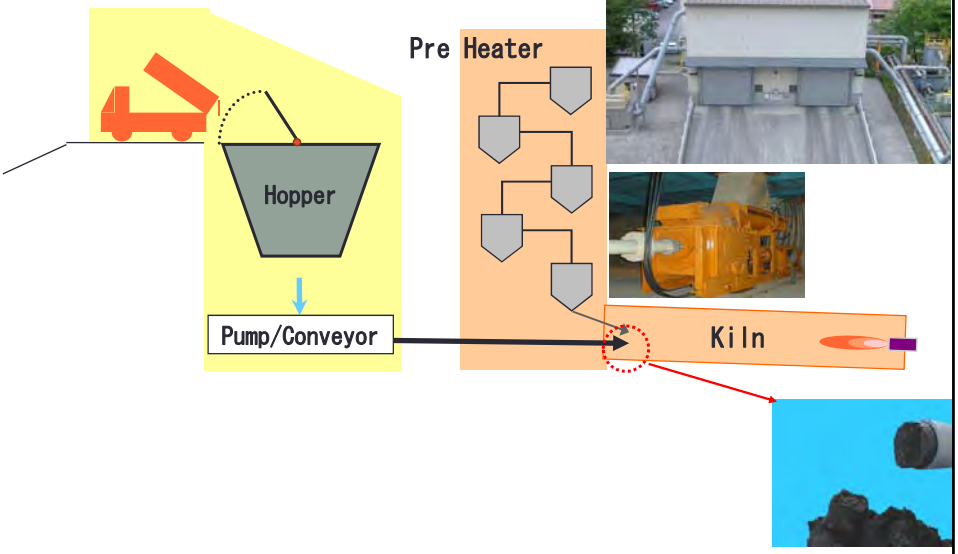
Solution of Potential Problem

1) Offensive Impact of Cl
   Considering experience in Japan, the input amount of the Dry Sludge is recommended less than 2% of cement production amount, in order to avoid offensive impact. (It is equivalent to about 20 % of coal consumed in cement factory. The Study Team proposed only 5%)

2) Offensive Impact of P_2O_5
   Considering experience in Japan, the input amount of the Dry Sludge is proposed less than 15% of cement production amount, in order to void offensive impact.

3) Lack of Uniformity of Fuel Calorie
   Suitable mixture of coal and dry sludge is very important for stable burning for suitable operation of cement production system. It is required to install a mixture facility in cement factory.

Sample of Sludge Mixture Facility



14

Issue to be solved in Short Term

1) Agreement of dried sludge use in cement industry on;
   i) How to install a mixture facility of dry sludge and coal
   ii) Free or charge of receiving of dry sludge
   iii) Capacity building on operation process
2) Confirmation of real demand of greenfly use by HPC construction projects

Activities to promote sludge recycling

- Policy making of public work sector in order to address global environmental issues/ carbon reduction
- Institutional system development of eco-product use in order to solve concerns of cement factory

15

Addressing the Issues

- The issues must be solved for smooth realization of the BOT scheme for the Sludge Processing Center
- HPC can seek Japanese technical cooperation project to address this issue

Expected components of Technical Cooperation Project on Promotion of Sewage Sludge Reuse

- Sludge fuel use technology in cement factory
- Capacity building on operation process
- Institutional mechanism of Eco-product use/ carbon reduction

16

Target Scenario in Long Term

- Development of multi user market for dried sludge to ensure fail safe end use (Power plant could be large consumer.)
- Public awareness for social better acceptance
- Policy to reward the end users by branding them as green companies

17

Achievement of the Target Scenario in Long Term

- Policy for renewable energy use
- Public awareness campaign
- Certification for eco-product reuse promotion

Dried sludge

Eco mark


Pavement (Mortar block)


Cement factory


Flower mat (Compost)

18

Sludge Recycling Facilities (BOT)

January 10th, 2012

1

(1) Necessity of Sludge Recycle

- Large amount of sludge will be generated from new construction WWTPs (Yen So, Yen Xa), and they are to be disposed to landfill sites.
- Capacities of landfill sites are very limited in Hanoi.
- It is required to reduce and recycle these sludge.

2

(2) Introduction of Sludge Recycle Method

Sewage Sludge components can be used.

80%
Organic (C,H,N,P)

20%
Inorganic (Si,Cl,Al)

Use for Green Space	Use for Energy	Use for Construction Material
Fertilizer Soil Conditioner	Solid Fuel Methane Gas	Cement Material Brick, Aggregate

(Source: Ministry of Land, Infrastructure, Transport and Tourism, Japan)

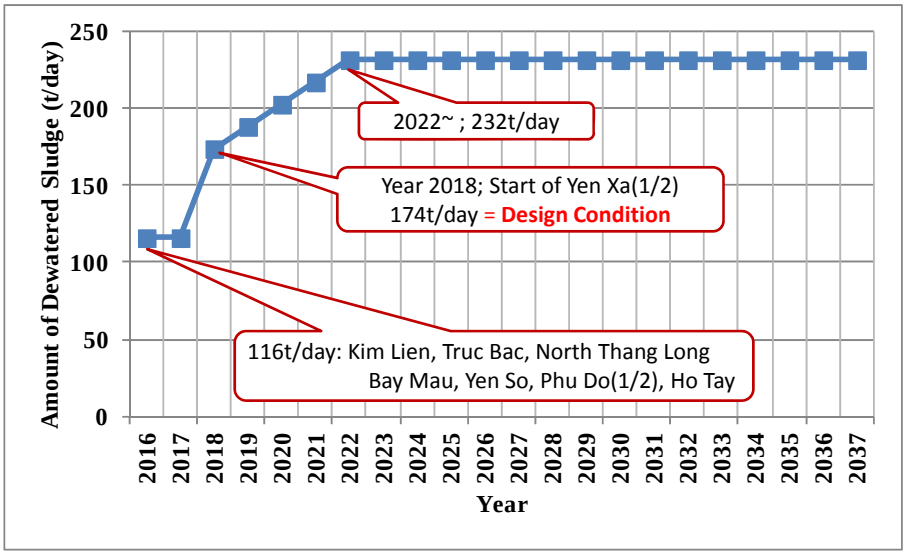
3

(3) Potential Demand of Sludge

	Power Company	Cement Company	Floriculturist
Consumption of Coal or fertilizer	4,100t/day (1,500,000t/year)	1,040t/day (380,000t/year)	20t/day (7,000t/year)
Potential Demand	205t/day (75,000t/year) (5% Alternate Fuel)	52t/day (18,900t/year) (5% Alternate Fuel)	32t/day (11,600t/year) (50% Alternate Nitrogen of Fertilizer)

4

(4) Amount of Dewatered Sludge in Hanoi



5

(5) Needs Survey of Sewage Sludge Products

	Power Company	Cement Company	Floriculturist
Current Situation & Interest	They have high interest in environmental problems.	It is difficult to procure enough coal because coal demand of China is rapidly increasing. So they have high interest in alternate fuel.	They are used to buy fertilizers from fertilizer companies. They are interested in the material leads to higher productivity.
Opinion	It is too early to use sewage sludge as a alternate fuel. It is necessary to do F/S and demonstration experiment under the Ministry of Industry.	If sludge products have acceptable quality, they can consider using sludge products proactively.	If sludge products have an advantage, they intend to try to use them. One of the floriculturist has also interested in the demonstration test in his field.
Evaluation	**Not recommendable** (Considerable for future use)	**Recommendable** as most stable consumer	**Recommendable as sub-consumers**, if sludge products have acceptable quality.

6

(6) Specification of Sludge Products

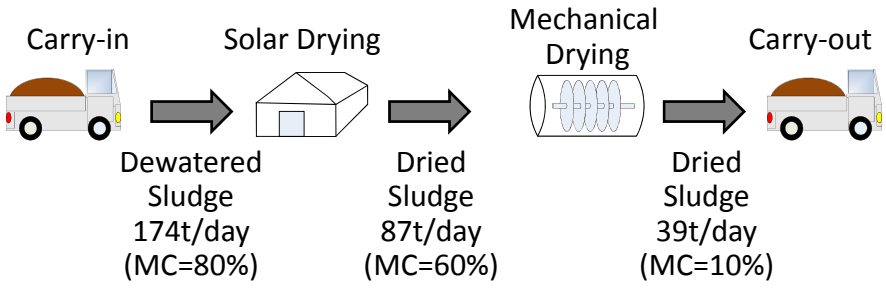
Request from Cement Companies

Item	Condition	Situation
Moisture Content	Less than 10%	Possible to be made by Mechanical Drying
Calorific Value	More than 3,000kcal/kg	Supposed to be acceptable at the existing Data. (Future confirmation required)
Exhaust Gas	Meet the Exhaust Standard	Now under testing in Butson Cement

7

(7) Sludge Drying Process

Hybrid Process of Solar Drying & Mechanical Drying

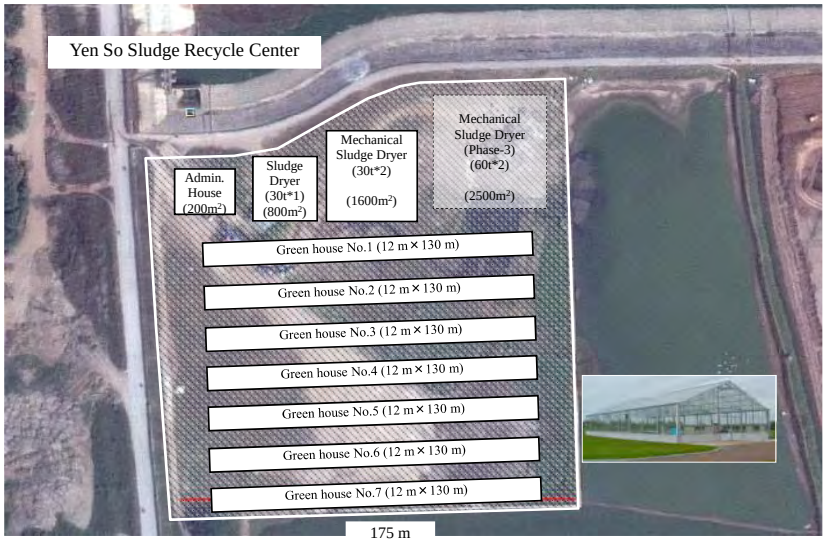


Process	Merit	Demerit
1) Solar Drying	Lowest cost, Save energy	Impossible to make MC=10%
2) Mechanical Drying	No need for extensive site	More expensive
3) Hybrid (Solar & Mechanical)	Save energy, Low cost	Little bit difficult O&M
4) Carbonization	No need for extensive site	Most expensive

(MC: Moisture Content)

8

(8) Layout Plan of Sludge Drying Facilities



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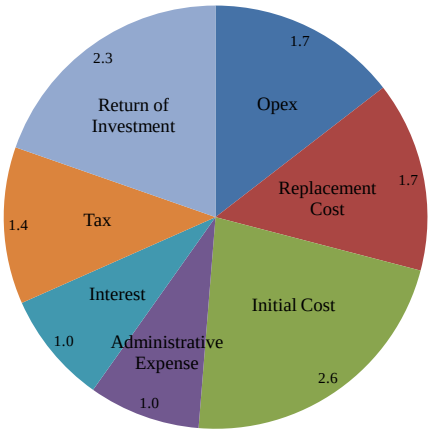
10

(10) Investment Cost and Service Charge

Investment Cost

Item	Cost (million US$)
EPC (Civil Works)	14.4
EPC (Mechanical, Electrical)	38.9
Contingency	5.3
Tax	5.9
Total	64.5

Annual Service Charge
(Total:11.6million US$)



(unit: million US$)

11

Thank you for your attention

ワークショップ資料

（2011 年 7 月 13 日開催）

13 July 2011

PPP – Work Shop Document

1) Public-Private-Partnerships (PPPs)

Mô hình đối tác Công – Tư (PPP)

JICA Study Team

(Study B)

www.pwc.com

Public-Private-Partnerships (PPPs)

July 13, 2011

PricewaterhouseCoopers Co., Ltd.

pwc

Strictly Private and Confidential

Contents

Definition of PPP

1

Definition of PPP

According to "System of National Accounts 2008", PPP is typically defined as follows:

> *Public-private partnerships are long-term contracts between two units, whereby one unit acquires or builds an asset or set of assets, operates it for period and then hands the asset over to a second unit. Such arrangements are usually between a private enterprise and government...*

* "System of National Accounts 2008" provides for the international statistical standard for the national accounts (e.g., GDP, Public debt, etc.) and adopted by the UN, World Bank, IMF, EU and OECD.)

Definition of PPP in Vietnam

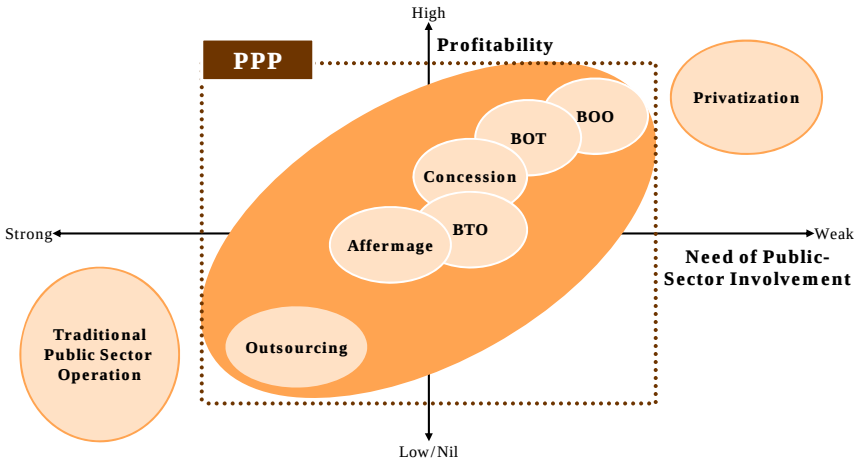
According to "Decision 71", PPP is defined as follows:

Public-private partnership investment means the form of investment in which the state and the investor coordinate to implement projects for infrastructure development or public service provision on the basis of a project contract, ...the contract signed by Authorized state agency and the investor, in which the investor is granted with the right to invest, operate the infrastructure facilities, or provide public services in a fixed period.

- PPP is generally used to include a wide range of PPP types under Decision 71.
- BOT law defines not only BOT (similar to the previous definition), but also BTO and BT .
- A Public Private Partnership is
  - -a long-term contractual relationship
  - -between the public sector and the private sector
  - -for the purpose of delivering an infrastructure asset and related services

→ *We identify an appropriate PPP scheme from a wide range of possible PPP types.*

Various models of PPPs



- **PPP can be applied to projects, which had been traditionally served by the public sector, due to low profitability and need of public sector involvements.**

Why PPP?

2

Hanoi City Budget in 2011 and Initial Project Costs

Expenditure for Hanoi City Budget 2011

	VND (billion)	JPY (billion)	%
Basic Construction	17,728	69.5	41%
Regular Expenses	21,431	84.0	49%
Others	4,454	17.5	10%
Total	43,614	171.0	100%

Initial Project Costs of Yenxa Wastewater Project

VND10,633 billion (JPY41.7 billion)

II

✓58% of annual basic construction budget

✓23% of annual fiscal budget

✓High initial investment for wastewater treatment plants amount to about 23% of annual expenditure or about 58% of annual basic construction budget of Hanoi City.

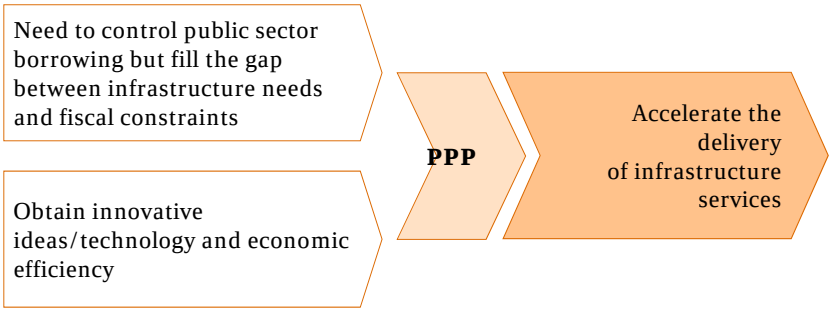
Possible Financing Gap in Hanoi

- High investment needs in Hanoi wastewater sector, but constraints in Government funds
  - Limitation in self financing of Hanoi City (ex. Bond, Fiscal budget)
  - Long-term finances is required (Project takes long time to repay funds)
- Cost increase in the maintenance of the existing and newly opening facilities

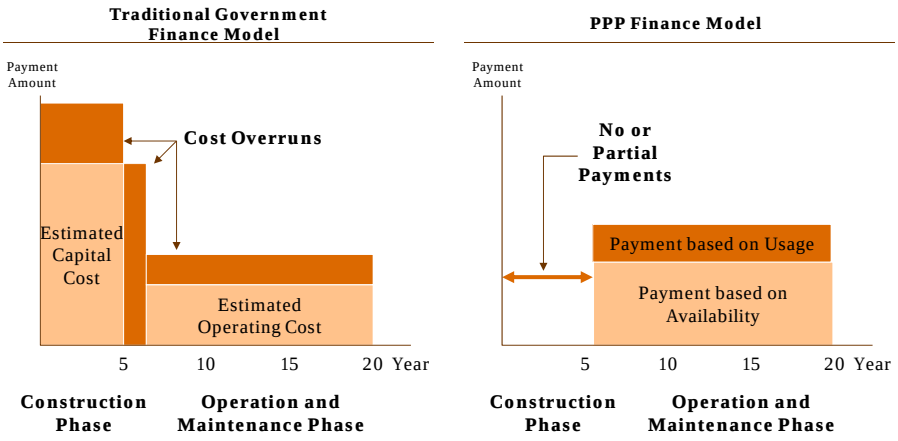
- Better **investment prioritisation** and planning through national infrastructure bodies
- Use of **private sector investment** to achieve fiscal sustainability
  - Introduction of long term project financing under the PPP scheme
- Better **management of project risks** collaborating with the private sector
  - Reduction of lifecycle costs utilizing PPP scheme

Why PPP?

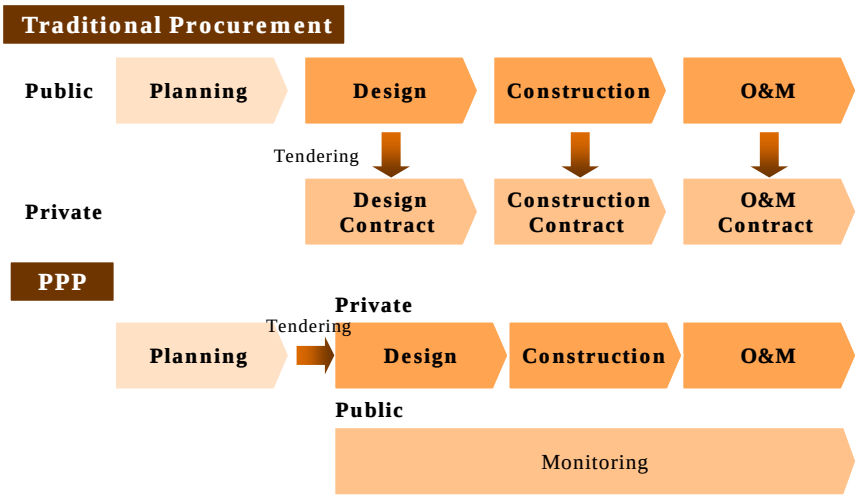
There are many different drivers of PPPs.



Traditional Government Finance vs. PPP Finance



Differences in the ways to tender



- **The private sector takes responsibility for the quality of design and construction it undertakes, and for the long term maintenance of the assets.**

Development of PPPs in Global

3

Development of PPP in Global

1 UK

Before Privatization
1. Expansion of Public Sector
2. Inefficient Public Works
3. Overemployment
4. Deterioration of Public Finance

from Privatization to PFI
1. Privatization of Public Entities
2. Maastricht Treaty (GDP3%, 60%)
3. Enlarging Private Sector
4. Advancing to PFI

PPP as Advanced Model of PFI
1. Diversification of Private Sector
2. Joint Company by Public & Private
3. Expansion of Targeted Fields

2 Latin America

Privatization by EU & USA
1. Rapid Privat. of Public Entities
2. Introduction of Excess Tariff
3. Failure of Privat. (late 90's)

Adjustment of PPP
1. Recommencement of PPP
2. Adjustment PPP to Each Country
3. Joint Company by Public & Private
4. Monitoring by GOV.

3 Japan

Privatization
1. Privatization of State Owned Companies (Rail, Tel, Tabboco)

Japanese PFI
1. Frame and Specification by GOV.

Comprehensive O&M Contract
1. Frame and Specification by GOV.

Introduction of Concession Contract
1. Changed PFI Law to involve Concession

4 Asia

Necessity of Change
1. Expansion of Public Sector
2. Inefficient Public Works
3. Overemployment
4. Deterioration of Public Finance
5. FDI for Growth

Introduction and Adjustment of PPP
1. Introduction of PPP
2. Adjustment PPP to Each Country
3. More Investment for Growth by PPP
4. Player at Mega Competition

①UK -Success of PFI

"Small Government" Policy by Margaret Thatcher

Large and inefficient government (1970's)

Started privatization first and reduced Government involvement

Gradual development of PFI (1990's) and increase in public private partnership

- Average 15-17% VFM (savings against traditional procurement) has been delivered
- 89% of PFI projects surveyed were delivered on time or early. Only 30% of non-PFI major construction projects were delivered on time and only 27% were within budget
- 77% of public sector managers using PFI stated that their projects were meeting their initial expectations
- Private sector's financing and operation were highly promoted
- Foreign Investors participated in the PPP market in UK

①UK -Evolution in PPPs

- The UK PFI has been evolved into PPP by 2000's.
- It's conditions has gained more flexibility and wider scope.

1st Generation	2nd Generation	3rd Generation	4th Generation
Rigid contracts	More flexibility	Complex partnerships	Range of contract options
Single assets	Grouped assets	Higher technology content	Greater risk aversion
Contractor finance	Independent equity	Secondary market sales	Operating businesses

1993-95 1996-2000 2001-2007 2007-2010

①UK -Characteristics of UK PFI (1) Unitary Payment for the Services

✓Public sector purchases "Services" based on Unitary Payment

- Since the public sector does not purchase assets, it will not provide payments if required output specification are not met by the private sector.
- Assets will be transferred at the end of contract termination at a market price.

✓Off-balance sheet of PPP project from Government is important

- Completion risk/Rehabilitation risk is transferred to the private sector.

①UK -Characteristics of UK PFI (2) Appropriate Risk Sharing

✓ UK has experienced few unsuccessful cases in PPP projects by successfully sharing risks with private firms.

<<Example>>

②Latin America –Privatization and PPP

✓Water sector reforms in the 1980s, resulted considerable investment needs

✓The first water PPP in the Latin America was a concession awarded in 1991 (Argentina), and the Latin America played leading role in private water operation during 1990s

✓The acute economic crisis in Argentina in 2001

✓Series of contract cancellation (half of them took place in Argentina)

- Significant noncompliance with contractual obligations by one or both sides due to the rather bullish nature of the market in the 1990s
- Substantial and socially unsustainable tariff hikes were needed to make viable the large investment required from the private operator (eg. Cochabamba, Bolivia)

✓Hybrid PPPs evolved (eg. cross-subsidies, mixed ownership, concession with public grants etc.), adjustments through more regulations and public involvements

③Japan –Grown into a Big Market

✓Japan has conducted more than 400 PFI/PPP projects since 1999 when it adopted the model.

✓For 234 projects conducted during 1999-2009, the accumulated VFM is estimated as 8.2billion USD.

✓PFI/PPP has successfully reduced projects costs, and its market has grown big in Japan.

✓Concerns about rapid change through privatization (employment issues, etc.)

✓Japanese PPP has maintained the government's involvement more than in UK <<Example>>

Japan has not transferred project-related risks to private firms as much as they do in UK. In many cases, the government takes project facilities' devaluation risk, which are taken by private firms in many PPP project in UK. Instead, the interest rates for Japanese PPP funding are often set as low as those for the government bonds.

④Asia –in Transition

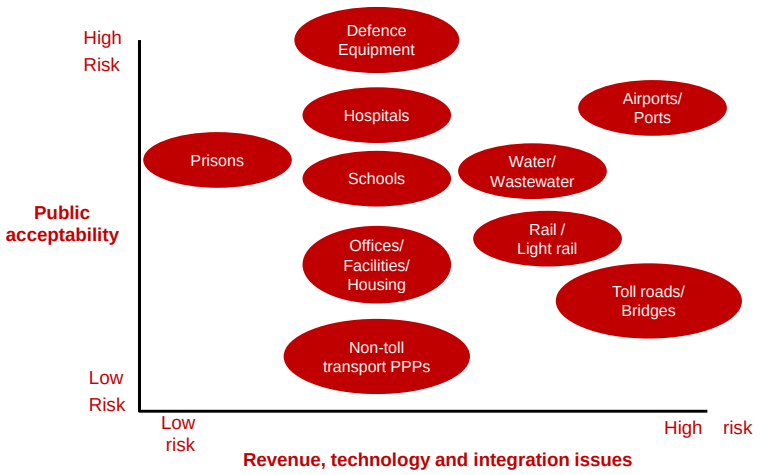
- ✓Started adoption of PPP since 2000's
- ✓Successful cases in Power and Water sectors have realized.
- ✓Lifecycle Approach including initial investments and operation and maintenance has been successfully implemented in some sectors.
- ✓Main issue is risk sharing mechanism in demand, tariff collection, land acquisition, viability gap funding etc.
- ✓Off-balancing needs of the public sector could be an issue in near future.

For those countries in transition, it is important to develop PPP models that suit their social and economic environment.

Different Types of PPP Schemes

4

Various models of PPPs



Categorization of PPPs

Based on the definition of PPPs, we categorize PPPs by three factors:

- Factor 1: Role of Public and Private Sectors
  - Who finances initial capital investments?
  - Who owns infrastructure assets?
  - Who operates infrastructure services?
- Factor 2: Source of revenues for the private sector
  - Type 1: Payment for the services from the public sector
  - Type 2: Self-sustaining PPP with user fees
  - Type 3:Combination of payment from the public sector and users
- Factor 3: Rate Setting
  - Regulated
  - Deregulated
  - Agreed formula

Categorization of PPPs
Role of Public and Private Sectors

	State Utility	BT	Affermage	BTO/ Concession	BOT	BOO	*Privati-zation*
Ownership	*Public*	Public	Public	Public	Private*	Private	*Private*
Initial Investment/ Financing	*Public*	Public	Public	Private	Private	Private	*Private*
Operation	*Public*	Public	Private	Private	Private	Private	*Private*
Accountable for service provision**	*Public*	Public	Public	Public	Public	Public	*Private*

Private Involvement/ Project Profitability — Low ⟷ High

*For contract length **Sets level of quantity and standard of service quality

✓PPP ensures provision of services to general public, but at lower cost and better quality by the use of private-sector management skills and finance capabilities

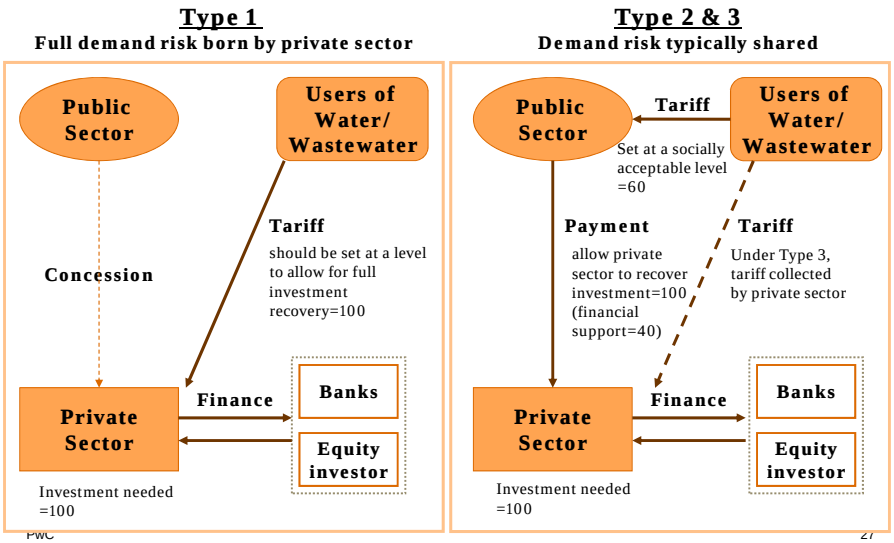
Categorization of PPPs
Source of revenue for the private sector

	Type 1	Type 2	Type 3
Tariff/User Fee Revenue	Yes	No	Yes
Payment from the Public Sector	No	Yes	If necessary

In Vietnam, BTO and BOT are generally considered as PPPs without payment from the Public Sector.

✓PPP can be structured for low profitable projects by combining tariff revenue with payment from the public sector.

How to deal with demand risk?



Categorization of PPPs
Rate Setting

When tariffs are collected by the private sector directly, there are three types of price setting.

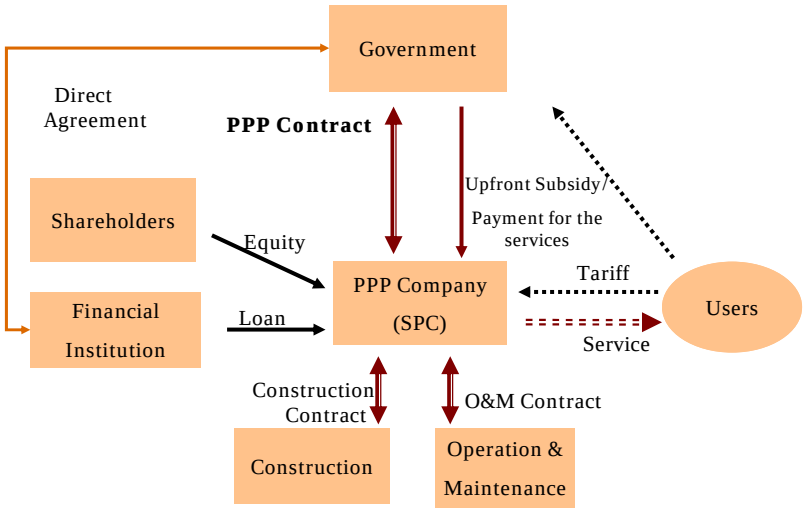
- Regulated
  - Public sector periodically regulates rate setting.
- Deregulated
  - Private sector periodically regulates rate setting.
- Defined by agreed formula between the public and private sectors
  - Rate setting is revised based on the agreed formula between the public and private sectors.

✓Tariff structure can be defined to allow private sector to initiate an innovative way to generate cashflow while public sector ensures affordable services to the general public.

Typical Contractual Framework

5

Typical Contractual Framework



Pros and Cons of PPPs for the Public Sector

6

Pros of PPPs for the Public Sector

•**Better quality of services** is realized by utilizing private sector's know-how, innovation, new technologies, and management

•The private partner designs, builds, operates and usually finances the asset (**whole life approach**) and the minimization of life cycle costs is expected

•Payments are based on **outputs not inputs,** which provides the private partner with room for innovation

•**Long term finances** is available

•**Risks can be transferred** to the private partner when the private partner is best able to manage it

•Obsolete assets/deterioration of assets are managed by the private partner

•The public partner contracts with **one integrated supplier**

Cons of PPPs for the Public Sector

•Public sector needs to have an appropriate monitoring capabilities of the private partner's performance

•Public sector needs to commit a long-term payment from its fiscal budget for the project and could result in inflexible budgets.

•Public sector needs to provide certain payments in compensation for transferring risks to the private sector.

Case Study

7

Recommendations for the Success of Yenxa Wastewater Project

- Packaging the project with initial investments, and operation and maintenance (O&M) for a long term
  - Considering financial limitation of Hanoi City, utilize private sector finances by packaging initial investment and long-term O&M will accelerate the infrastructure delivery.
  - Otherwise, Hanoi City needs to finance initial investment by its own finances, borrowing from the central government, sales of concession rights of other businesses etc.
- Appropriate risk sharing between public and private sectors
  - The essence of any long-term private financing is the identification of all key risks associated with the project and the allocation of those risks among the various parties participating in the project.
  - A risk should be assumed by the party best able to mange an control that risk.
- Minimizing lifecycle costs
  - The project agreements clearly defines payments based on outputs (not for the facility construction) and monitoring of the private partner's performance, and realizes minimising lifecycle costs.
- Well structured PPP scheme to attract international private players
  - Well structure PPP scheme with a security package for political uncertainty, clear definitions of role and responsibilities of public and private sectors, reasonable risk allocation etc. is important for international players to invest the project.

Possible Project Models for Yenxa

- The following five patterns of role sharing models between public and SPC are considered for construction of the Yenxa facilities.

	Facilities		
	Wastewater Collection	Wastewater Treatment	Sludge Treatment
Model 1	Public	Public	Public
Model 2	Public	Public	SPC
Model 3	Public	SPC	Public
Model 4	Public	SPC	SPC
Model 5	SPC	SPC	SPC

13 July 2011

PPP – Work Shop Document

2) Failures and Recover for Water Sector PPP in Malaysia, Manila, and Jakarta

Thất bại và thành công của ngành nước theo mô hình PPP tại Malaysia, Manila, và Jakarta

JICA Study Team

(Study B)

Failures and Recover for Water Sector PPP

in Malaysia, Manila, and Jakarta

July 13, 2011

Water Business Project , ORIX Corporation

Case of Malaysia

1. ***Municipal Owned & Management (previous)***
2. ***Problem of Municipal Owned & Management***
3. ***How did they innovate Privatization for their Problem?***
4. ***Result of Privatization (factor of failure)***
5. ***How did they restructure after the failure?***
6. ***Lesson learned***

Reference:
Council of Local Authorities for International Relation CLAIR REPORT NUMBER203

1. Municipal Owned & Management

- ***Sewage Works Before 1993***
  - There were 144 local governments owned and managed about 6,100 wastewater treatment plants.
  - 4,900 plants（almost 80% of all) were fully broken down or in ghastly quality.
  - Sludge was merely treated only 1% of all the amount.

2. Problem of Municipal Owned & Management

- ***Municipal finance***
  - They were shortage of finance for Sewage works
    Because Municipalities had to address other rapid urbanization.
- ***Lack of human resources***
  - They didn't have enough number of qualified Engineers for both construction and maintenance at all.
- ***Low level of tariff collection rate***
  - Municipalities could not collect enough tariff for Sewage Works
    Because people could not realize its benefit.

3. How did they introduce Privatization for Problems?

～In case of sewerage service～

- *Act and Institutional design*
  - In 1993, they put Sewerage Service Act 1993 into effect.
    (EPU established the legal framework and ICP formulated the structure)
  - FedGovt took over authorities of Sewerage Service from all municipalities.
  - Under MHLG, FedGovt set up Sewerage Services Department as the regulatory body.
  - It grants license and supervises facilities planning and other works.
  - Also, it made only one BOT contract for all over the country with the Indah Water Konsortium (hereinafter IWK) that was a consortium of existing 7 operators (such as United Utilities).
  - The reason why FedGovt introduced IWK scheme was because they expect IWK to give impartial service to people over the country regardless of big regional differences.

- ***Summary of BOT scheme between FedGovt and IWK***
  - Method：BOT
  - Term： 28year (from1994 to 2022)
  - Area： All over the Country
  - Business contents：
    Rehabilitation and OM of waste water treatment plants (about 4,900), OM of existing pipes (about 6,900km) and building of new pipes (about 6,900km), sludge treatment of septic tanks (about1,200mil. units) etc.
  - Improvement of service: mark below

types		privatization previous	privatization after
Large Local GOV(49)	connected to pipes	45%	85%
	unconnected	44%	45%
	residual	11%	–
Small Local GOV(95)	connected to pipes	10%	30%
	unconnected	52%	70%
	residual	38%	–

  - Cross-Subsidy Principle: “HouseHold” ⇦ “Industry, Public, Commerce”
    (C-S scheme made it possible for people in rural area to have Sewage.)
  - IWK must get FedGovt approval to modify tariff structure.

4. Result of Privatization (factor of failure)

～In case of sewerage service～

- ***Tax and Tariff***
  - Before privatization, people thought that tariff for sewerage was included in Assessment Tax. Then, people are very reluctant to pay new sewerage tariff because they felt new tariff was additionally put on or double-bill.
- ***Approval for Tariff modification***
  - IWK couldn't set up an appropriate tariff due to political interest.
- ***Indirect Benefit***
  - Different from Water Service, people can’t realize sewerage services beneficially that much.
  - So, people didn’t want to pay sewerage tariff.
    (※water and sewerage tariff were collected separately at that time.)
- ***Lack of PR activities***
  - IWK and FedGovt did not have enough PR activities for benefit and necessity of sewerage services and tariff before and after the commencement of its operation.

⇨ After 6 years operation, IWK bankrupted in fact.

5. How did they restructure after the failure?

～ *In case of sewerage service* ～

- ***Re-nationalization***
  - FedGovt (MFI) purchased all IWK Assets and took over Debt in June 2000.
  - Nevertheless, IWK can't recover the expected business result.
  - Finally, FedGovt subsidized about 1.5 hundred million RM annually.
    (As the time of 2008, 2.5 hundred million RM was estimated for 2009)
  - In 2008, integral collecting of water and sewage tariff
    (It's one of the effects of Water Service Industry Bill Act 2006)
- ***Current Status***
  - In 2006, Malaysia introduced many important policies for the restructuring of water sector.
  - Now, IWK have been restructuring on along the line with above policies.
  - In January 2009 Runhill Utilities (one of the infrastructure company listed on BursaMalysia Securities) was entrusted with FS for the integration of water and waste water service in JohorBahru and Pasir Gudang.

6. Regulatory Body for Ensuring Sustainability

～ *Thinking-over of Water Sector Privatization* ～

- Regulatory Body

  ⇒ Responsibility for setting tariff level and service standards

	Tariff setting	Licensing	Regulations	Approval	Supervision of Operation
SPAN	-Planning	-Reception & Evaluation of License -Embodiment of Licensing Standards by Minister	-Drawing up Regulations	-Approval for Project Plan -Advice for Tariff setting	-Monitoring -Instruction for Improvement
WAMCo				-Funding to Capex	
Ministry	-Decision	-Setting up of Licensing Standards -Approval of License	-Enforcement		

(All above are based on)

Water Services Industry Bill Act 2006
National Water Service Commission Act 2006

(bring the effects below)

7. Lesson learned

- Assets light (No Debt & Capex can extract profit)
  ⇒ Proper Subsidy for initial investment is necessary
- Tariff Escalation (Necessary but should be Modest)
- Single Bill (for sewerage and water supply servicies)
- Strengthening PR activity
  (Ex. Annual Report, Water Industry Report on HP)

abbreviation

- BOT Build-Own-Operation
- EPU Economic Planning Unit
- FedGovt Federal Government
- ICP Inter-departmental Committee on Private
- MHLG Ministry of Housing and Local Government
- MFI Minister of Finance Incorporated
- OM Operation Maintenance
- SPAN Suruhanjaya Perkhidmatan Air Negara

Case of Manila

1. Flow until privatization (Issues)

2. Detail of Concession Contract

3. MWSI vs. MWCI (Point of Failure or Success）

5. Negative cycle toward Bankruptcy

6. Revenue water flow rate

7. Lesson learned
～ Verification toward Success ～

Flow until Privatization

・MWSS（Metropolitan Waterworks and Sewerage System) was established for operation of Waterworks and Sewerage in1982.

《Issues》

・Low income and high cost
（high rate of leakage, collection business inefficiency, labor cost increase)

・Lack of budget, Inefficient operation and maintenance

・Deterioration of service level

・Nonpayment and difficulties of price increase due to above issues.

Privatization

・**August,1997 From the point of competition, 2 Private companies started their operation.**

East Area: Manila Water Company (MWCI)
West Area: Maynilad Water Services (MWSI)

Details of Concession contract

- Tender's composition shall be "domestic operator" and "international operator"
- Concession contract for 25 years
- Concession fees shall be appropriated for the MWSS's foreign currency debt repayment and No subsidy from the national Gov.
- Water supply for all over the service areas within 10years
- Non revenue water rate from 56% to 32% for 10years
- Fulfillment of 24hour's water supply within 3years
- Water-supply service shall be provided for the poorest
- 80% coverage of sewerage system within 25 years
- 7.5BIL(USD) capital expenditure during the contract terms and 4BIL(USD) payment of income tax
- Substantial price hike is prohibited for ten years
- MWSS-RO as the supervisor of Concessionaires

MWSI vs. MWCI

MWSI	MWCI
• Old urban area (90% of Asset)	• newly-developed urban area (10% of Asset)
• Large foreign currency debt equivalent to transferred Asset	• small foreign currency debt equivalent to transferred Asset
• No budget for capital expenditure	• Enough budget for capital expenditure
⇩	⇩
• Deterioration of facilities much faster than in normal situation	• Improvement of revenue water rate
• Deterioration of revenue water rate	⇩
⇩	• ***Success Story of PPP until now !***
• ***Bankrupt even in the next year !***	
• Re-Nationalization in 2004	

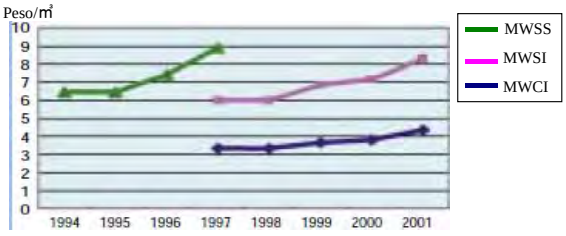
Negative Cycle of MWSI

< Change of revenue water rate > Source:Foundation Fukuoka Asian urban studies place

		1997	1998	1999	2000	2001	2002	2003	2004	2005
給水人口(人)	MWSI	4300000	4310000	4770000	5250000	5540000	5560000	5700000		
	MWCI	3000000	3130000	3560000	3760000	3940000	4080000	4400000		
普及率(%)	MWSI	59	59	64	70	82	84	84		85
	MWCI	66	66	72	74	89	90	90		90
給水量(c.m./d)	MWSI					2347000	2362000	2320000	2279000	2168000
	MWCI					1635000	1615000	1601000		
有収水量(c.m./d)	MWSI					797000	741000	718000	707000	691000
	MWCI	440000	584000	645000	706000	758000	751000	767000	825000	864000
新規接続数	MWSI	467328	468747	518399	571282	602434	443245			
	MWCI	325527	340037	390950	408894	427755	604814			
有収率(%)	MWSI	37	40	32	34.5	34	31	31	31	32
	MWCI	37	44.8	47	49	48	46	49.3	56.8	64.5
一接続一日給水量(c.m./con/da	MWSI					1.38	1.23	1.19	1.14	1.08
	MWCI					2.13	1.76	1.53	1.49	1.36
1000接続当り職員数(人/000co	MWSI	6.8				4.2	4.2	4.1	4	3.8
	MWCI	6.3				4.4	4.2	4	3.7	3.4

Revenue water rate

<Change of Water Tariff>



Source: Japanese PFI society,UTCE corporation

Lesson learned

- **Foreign currency debt shall be manageable level**

～Verification toward Success～

Trial Case 1

Change of foreign debt　9：1 ⇒ 6：4
(6:4 is the proportion of actual served population)

⇒ **failure……**

Trial Case 2

Foreign debt 6：4 + Same revenue water rate as MWCI

⇒ ***Current-account Surplus !!!!***

Case of Jakarta

1. Failure of Water Service Privatization

2. CPI hike far beyond Tariff increase

3. MWSI vs. MWCI (Point of Failure or Success）

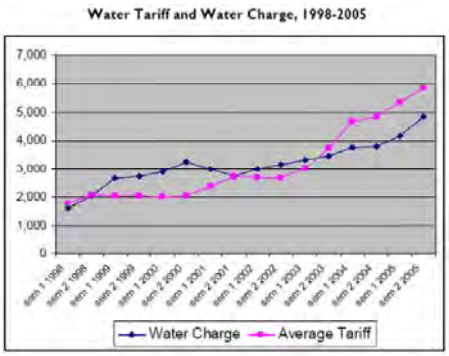
5. Negative cycle toward Bankruptcy

6. Revenue water flow rate

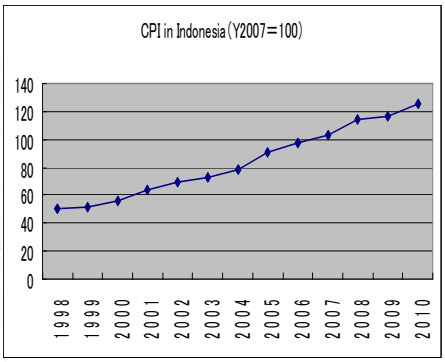
7. Lesson learned
～Verification toward Success ～

Reasons for the failure of water service privatization

- 2 concessionaires of operating water service in DKI Jakarta had heavy debt burden in foreign currency caused by plunge of the local currency rate in the Asian currency crisis.
- Automatic tariff adjustment every 6 months (ATA) brought about frequent tariff increases, mainly backed by CPI rise of Indonesia.
- But, tariff increases had been restrained below CPI rises.
- Tariff change had been political issue. 2 concessionaires had asked for tariff increase to Governor of DKI Jakarta.
- JWSRB (regulatory body) didn't have right for determination of tariff change. Governor of DKI Jakarta had it.
- Consequently, 2 concessionaires couldn't invest necessary capital expenditure timely for fulfillment of technical targets. (Coverage Ratio, Volume sold, UfW,・・・)



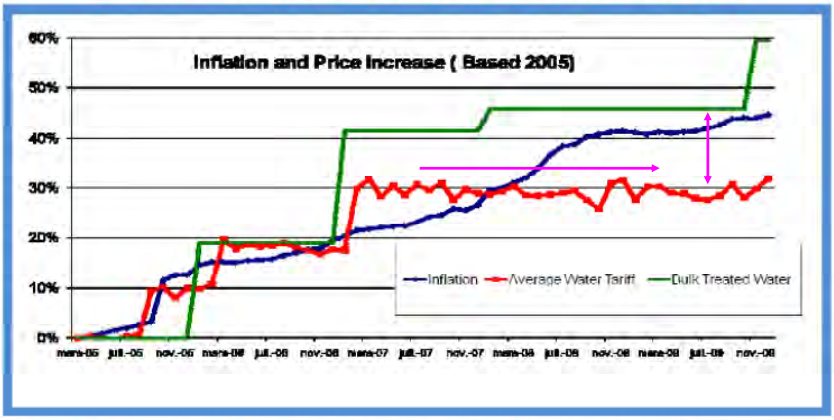
(Source: CURRENT SITUATION OF JAKARTA WATER PRIVATIZATION)



(Source: Drawing up by IMF Data and Statistics)

- Tariff increased since privatization by 18% in 1998, 35% in 2001 and **40% in 2003**)
- CPI increased **by 156%**

Comparative evolution of CPI index, Average Water Tariff and Bulk Treated Water



NB: Bulk Water increased by 34% during the period in which the Water Tariff has remained unchanged

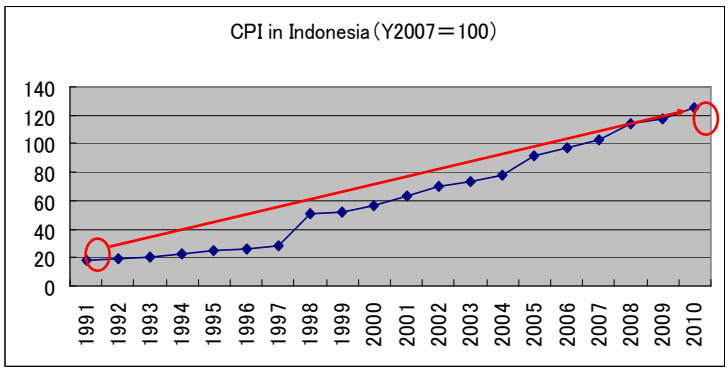
- Without enough tariff, Project is no longer feasible!

(Source: PT PALYJA's comments on KRuHA statements in its submission to the UN Independent Expert on the Right to Water and Sanitation that concern the Water concession contract for the West Zone of Jakarta)

- They cannot introduce appropriate Tariff Decision System even now.
- Water service do not have any symptom of improvement.

⇒ ***Nothing about Sewage Works !***

For that period: Available land gone, Construction cost higher & higher



(Source: Drawing up by IMF Data and Statistics)

Lesson learned

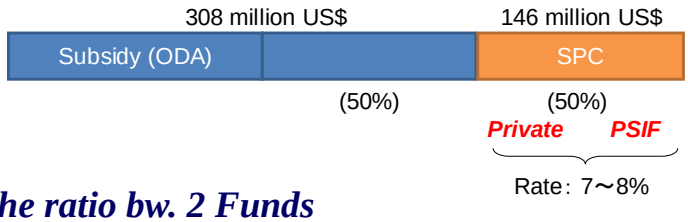
- *To avoid political interest*
  Tariff Decision by neutral Regulatory Body
- *To avoid revenue & expenditure gap*
  Proper Tariff Adjustment Mechanism
- *To avoid construction cost hike*
  & easy Land Acquisition
  Construction as early as possible

Proposal through the Study

- ***Immediate Construction & Sustainability 1 = Funds***

⇒*Maximizing Advantage of JICA PSIF through Private together with ODA Loan*

Pipe Network	Wastewater Treatment Plant + Sludge Recycling Facility
Public	PPP
162 million US$	291 million US$

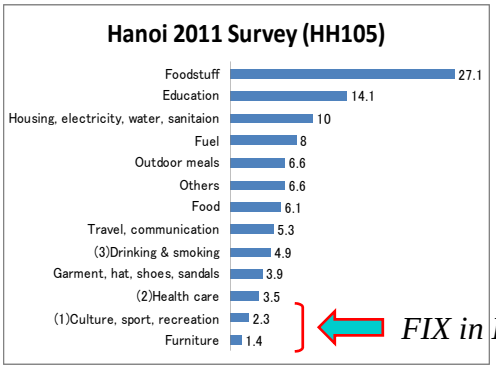


⇒***The ratio bw. 2 Funds to be decided by Tariff Level & Availability of Ordinal Account of HPC***

Proposal through the Study

➢ ***Immediate Construction & Sustainability 2 = Tariff***

⇒ ***Affordability*** *for people is most important!*

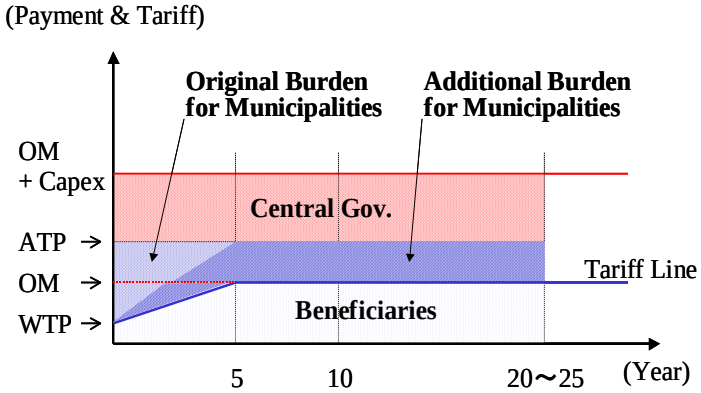


⇒ ***For Water & Sewerage: Ceiling 5% for HH Exp.***
Setting up in HH Exp. Map:
Avoid Gap against CPI hike & Easy Understanding

Proposal through the Study

➢ ***Immediate Construction & Sustainability 3 = Cost Sharing***

⇒ ***Central Gov shall subsidy Excessive Part.***



⇒ ***People should pay up to ATP (around 2% of HH Exp.)***
Municipality's burden depends on Ordinary Account

Thank you for your attention!!

http://www.orix.co.jp/grp/en/

13 July 2011

PPP – Work Shop Document

3) Institutions & Finance of Sewerage Works

Các thể chế và tài chính của các Công trình thoát nước thải

The Introduction of Yokohama PPP Project

Giới thiệu về Dự án PPP Yokohama

JICA Study Team

(Study B)

HANOI CITY: PPP Work Shop

- **Institutions & Finance of Sewerage Works**

- **JICA Study Team**
  - **Y. Inoue, Nippon Koei Co., Ltd.**

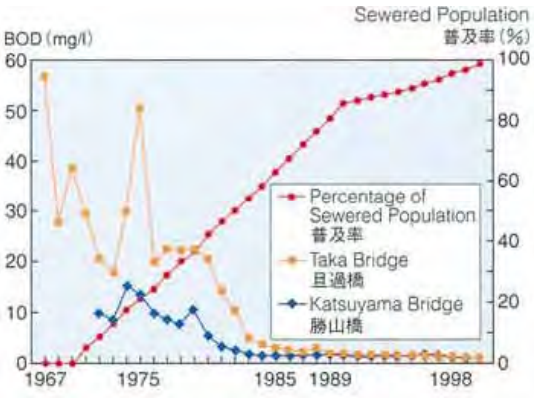
- **July 13th, 2011**

- Part 1 : Overview of individual features on finance & institutions
- Part 2 : Learned from finance/management capacity development
- Part 3 : Recent activities in sewerage works

Part 1：
Overview of individual features
on finance & institutions

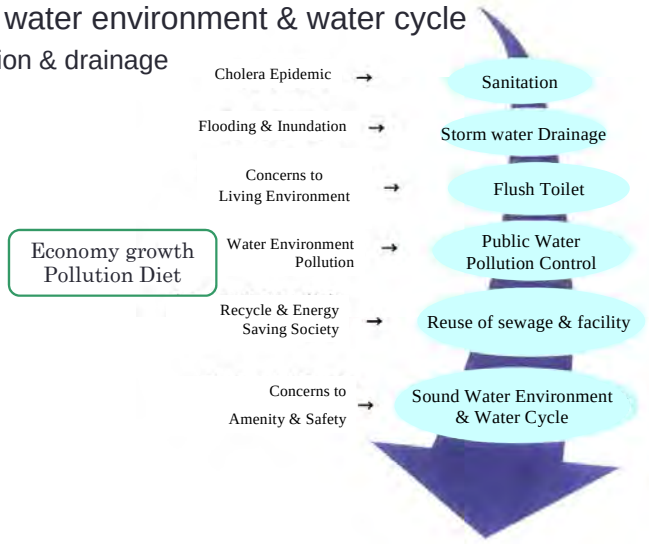
Role of Sewerage System (1)

Sewerage system development & pollution control contribute to water environment restoration

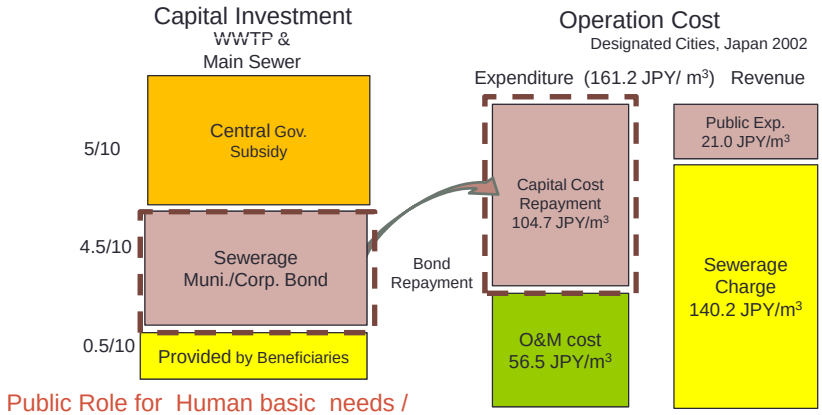


Role of Sewerage System (2)

- Change to water environment & water cycle from sanitation & drainage



Finance : Capital and O&M Cost Resources



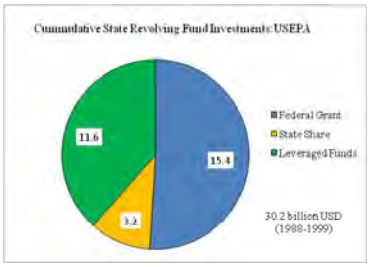
Public Role for Human basic needs / Infrastructure
Central Gov. (Subsidy) + Municipal Gov.

Private Role for housing environment
Tax(City Planning & Beneficiary + Sewerage charge

Sewerage project is operated as an independent cooperate account of municipality government.

Finance: US-EPA (1)
in wastewater management

- 1956 Water Pollution Control Act Amendment
- 1972 Federal Water Pollution Control Act
- 1987 Clean Water Act



Subsidy rate

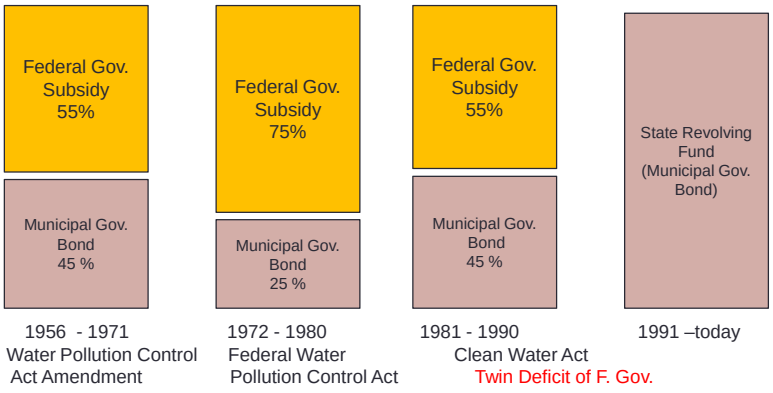
- 55%(1956) – 75%(1972) – 55%(1981)
  Driving force of WWTP installation

Clean Water State Revolving Fund

- 1991-1998 USD 30 billion(States 16.6 %, Federal 83.3%)
- FY2000 USD 1.325 billion
- Interest rate 0 – market rate(Ave.3%) Repayment period 20 years
  Financial self-independence (SRF replaced form subsidy)

Finance: US-EPA (2)

Change of Financial Support of Federal Gov.



PPP Projects in Japan (1)

For cost reduction through technology & know-how of PPP

- Bio-gas reuse and electricity & heat supply
- Sewage sludge reuse for fuel

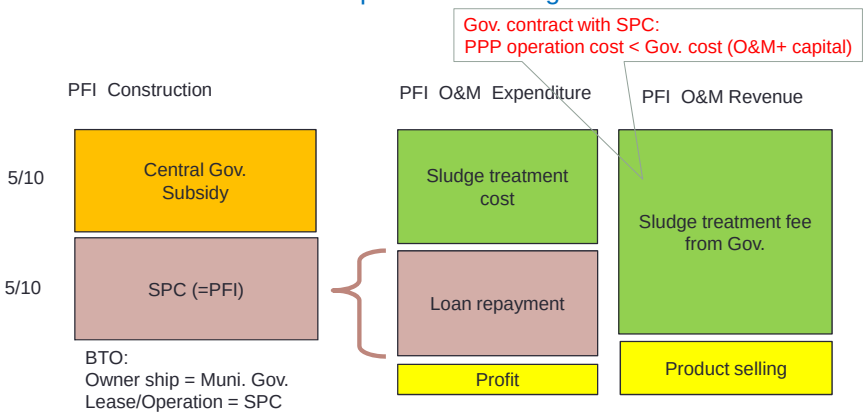
7 operations
7 constructions & bidding

No.	Project	Business	Product	User	Operation stars	Contract Term year
1	Yokohma City South WWTP	Exscabated soil reuse plant	Back-filling soil	Construction project	2004	10
2	Tokyo Morigasaki WWTP	Bio-gas reuse	Heat & electricity	WWTP	2004	20
3	Osaka Tumori WWTP	Bio-gas reuse	Heat & electricity	WWTP	2007	20
4	Tokyo East WWTP	Sludge fuel	Carbonized	coal power	2007	20
5	Yokohama City North WWTP	Bio-gas reuse	Heat & electricity	WWTP	2009	20
6	Miyagi Lower Abukumagawa WWTP	Sludge fuel	Dried pellet	Pulp & paper	2009	
7	Kurobe City WWTP	Sludge fuel	Dried pellet	bio-mass boiler	2010	15
8	Hiroshima West WWTP	Sludge fuel	Carbonized	coal power	2012	20
9	Kinuura East WWTP	Sludge fuel	Carbonized	coal power	2012	20
10	Kumamotoshi South WWTP	Sludge fuel	Carbonized	coal power	2012	20
11	Osakashi Hirano WWTP	Sludge fuel	Carbonized	coal power	2014	20
12	Chibaken Teganuma WWTP	Sludge fuel	Carbonized	coal power	2015	20
13	Saitamaken Arakawaugan WWTP	Sludge fuel	Carbonized	coal power	2015	20
14	Yokohama City South WWTP	Sludge fuel		coal power	2016	20

PPP Projects in Japan (2)

Financial resources

Japanese Sewerage PPP = BTO



Local Gov. off-set s capital investment into SPC “out of debt”
Central Gov. Subsidies for cost reduction of public service
SPC provides capital cost and know-how for construction & OM

PPP Projects in Japan (3)

Public Sector Responsibility

Law approval ---------- Role of facility ownership

- Land Acquisition & Stake-holder approval
- Sewerage Law
- Supporting to Building Law Approval
- Supporting to other relevant laws

Application of Subsidy to Central Government

- Aim is to decline service cost on public

Monitoring of operation

- Sustainability of public service

Sharing “Responsibility of public service” & “Cost reduction” with SPC

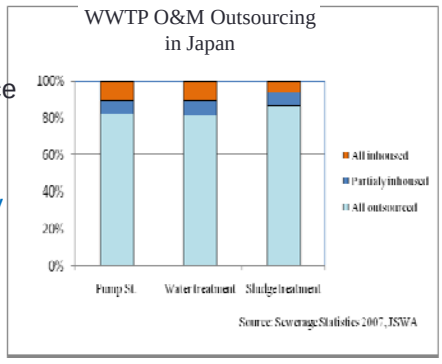
O&M outsourcing of Wastewater Treatment Plant

Out-sourcing is prevalent in whole filed.

In-house staff focuses to

- Water quality management
- Storm water pumping station
- Monitoring outsource performance

- Business wastewater monitoring
- Customer information & tariff levy



Back ground of O&M Out-sourcing

Facilities and O&M staffs increased
as result of sewerage system development

- Restriction on establishing new public organization
- Private sectors' capacity development
  with introducing private sector know-how
- Man power cost increased and low performance
  due to personnel immobility in public sector

Local Gov. focuses on services with regulatory power,
as Customer information, Water quality monitoring, tariff collection, etc.

Part 2:
Learned from finance/management capacity development

Learned from Capacity Development (1)

- Oosaka City in 1930s
  - Urbanization & Needs of sewerage development
    - ⇒ Financial shortage of construction & O&M
    - ⇒ "Finance of Sewerage" introduces Beneficiary Tax of City Planning Act and Sewerage User Charge
- Activated Sludge WWTPs started operation

  Tokyo, Nagoya, Toyohashi
  Gifu, Kyoto, Osaka
- Beneficiaries Tax

  Charge to area of property (m^2)
  Levied at public notice of treatment area (one time)

Blackish water & forming in1960s

Learned from Capacity Development (2)

- Economic growth in 1960s Tokyo Olympic Game 1964
- Pollution Diet 1970 for Institutional Reform

  "Rapid increase urban population and lack of adequate legal system" are improved to modern sewerage Institution System.

  - Environmental Pollution Control Law & EWQ Standards
  - Emergency Measures Law for Construction of Sewerage Systems & 5-years Sewerage Development Program
  - Sewerage Act Amendment for Comprehensive Basin-wide Planning Sewerage Systems and Regional Sewerage System
  - Central Gov. Subsidy Rate increased
  - Japan Sewage Works Agency (Sewage Works Center) as project implementation, technical development, training

Conclusion on financing and institutions

Beginning stage of Sewerage Works until 1960s

- Municipality Gov. financed sewerage project.
- In-house O&M staffing started due to public service.

Urbanization & industrialization brought serious water pollution and storm water inundation issues.

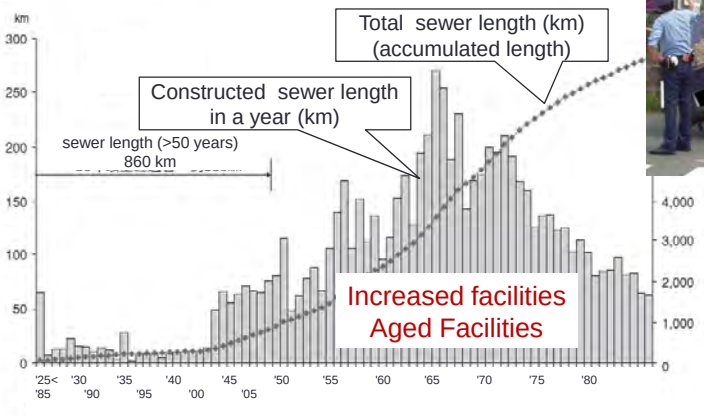
Modified to Present Sewerage Works

- Water pollution control is designated to national policy matter
- Sewerage system admitted as national basic infrastructure
- Financially enforced through high economic growth in 1960s
- Private sector built capacity

Part 3：
Recent activities in sewerage works

Facility Management

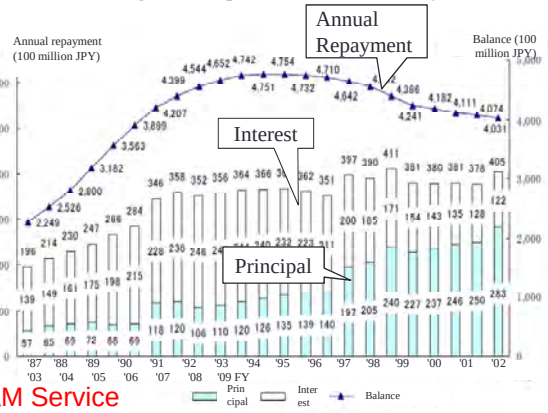
Accumulated facilities requires OM cost & management
Ordinal OM to prevent serious accident



Financial Reform of Sewerage Works

- Financial Perspective
- Sustaining service level
- Enhancing performance
  - Cost reduction
  - Human development
  - PI(Performance Indicator)
    - Public relation
- External resources:
  - Regional management
  - PPP & Comprehensive O&M Service

Change of Corporation Bond, K-City



Public Relation

Objectives

- Understanding role of sewerage system & water environment
- Awareness for financing sewerage works

Activities

- Seminar & site visit
- Recommendation to Gov.

Aqua-supporter Workshop

Sludge Digestion Tank

Aqua –supporter Site Visit

PI (Performance Indicator)

Aims

- Management tool to evaluate the efficiency of performance
- Quantitative comparative assessment of performance.

International Water Association (IWA)

- “Performance Indicator for Water Supply Services” in 2000
- “Performance Indicator for Wastewater Services” in 2003

Japan Sewage Works Association

- “Guideline for Improving O&M of Wastewater Systems”, 2007

PI (Performance Indicator)

Context of Information

- Understanding characteristics: Project outline, Staff number, Total budget, etc.
- Project characteristics: Service area, served population, Wastewater flow rate, etc.
- District characteristics: Climate, Receiving water criteria, etc.

PI : 5 Categories & 56 Items

- 1 Operation (sewer) 7: Aging ratio, Inspection ratio, OM cost per m, etc.
- 2 Operation (WWTP) 12: Aging ratio, Electricity consumed ratio, etc.
- 3 User service 17: WQ compliance, Sewer accident, Claim, etc.
- 4 Management 13: : Unit revenue water, Balance, Wastewater treatment cost,
- 5 Environment 7: BOD load reduction ratio, Sludge recycle ratio, CO_2 reduction

PI (Performance Indicator)

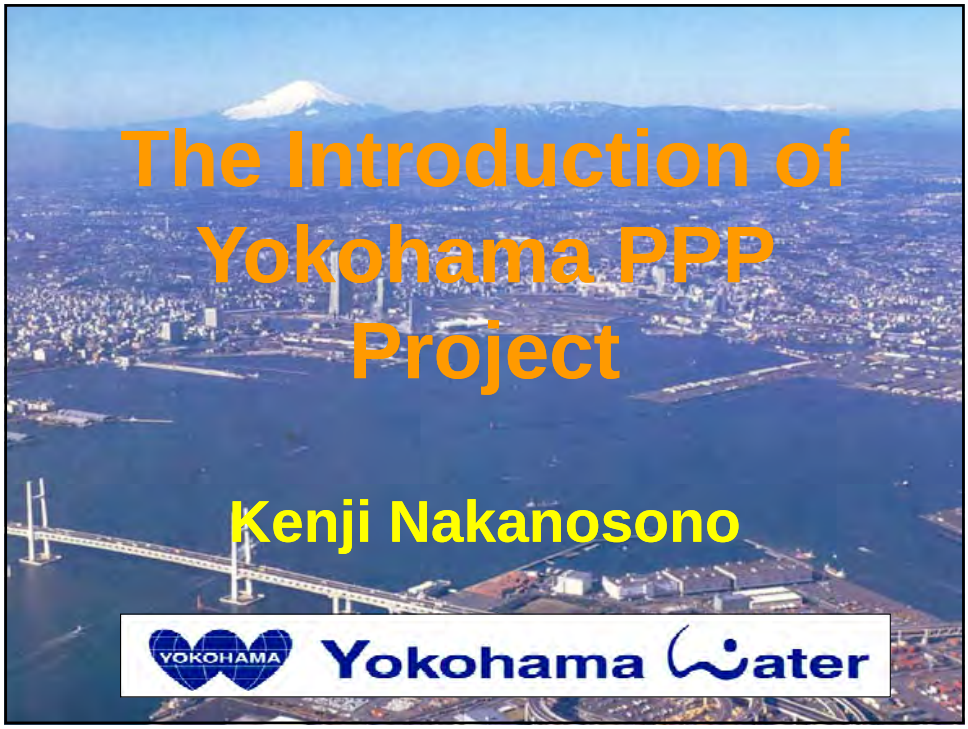
Category	Performance Indictor (PI)	Calculation Formula	Improvement
4. Management (13 items)			
M10	Unit revenue water per person per day	(Annual revenue water / number of days) / Served population	↑
M20	Accounted-for water	Annual accounted-for water / Total treated wastewater x 100	↑
M30	Current balance	Gross earning / Total	
M40	Transfer ratio (profitable earning)	Transfer / Profitable e	
M50	Transfer ratio (capital earning)	Transfer / Capital ear	
M60	Unit revenue	Total revenue / Total	
M70	Unit wastewater treatment cost	Wastewater treatment water	↓
M80	Unit wastewater treatment cost (O&M)	Wastewater treatment cost (O&M) / Total accounted-for water	↓
M90	Unit wastewater treatment cost (capital)	Wastewater treatment cost (capital) / Total accounted-for water	↓
M100	Cost covering ratio	Service charge revenue / Wastewater treatment cost x 100	↑
M110	Cost covering ratio (O&M)	Service charge revenue / Wastewater treatment cost (O&M) x 100	↑
M120	Cost covering ratio (capital cost)	Service charge revenue / Wastewater treatment cost (capital) x 100	↑
M130	Working accidents (per 1 million m^3 treated wastewater)	Number of accidents which caused 4 days of absence or more / Total wastewater treated x 1,000,000	↓

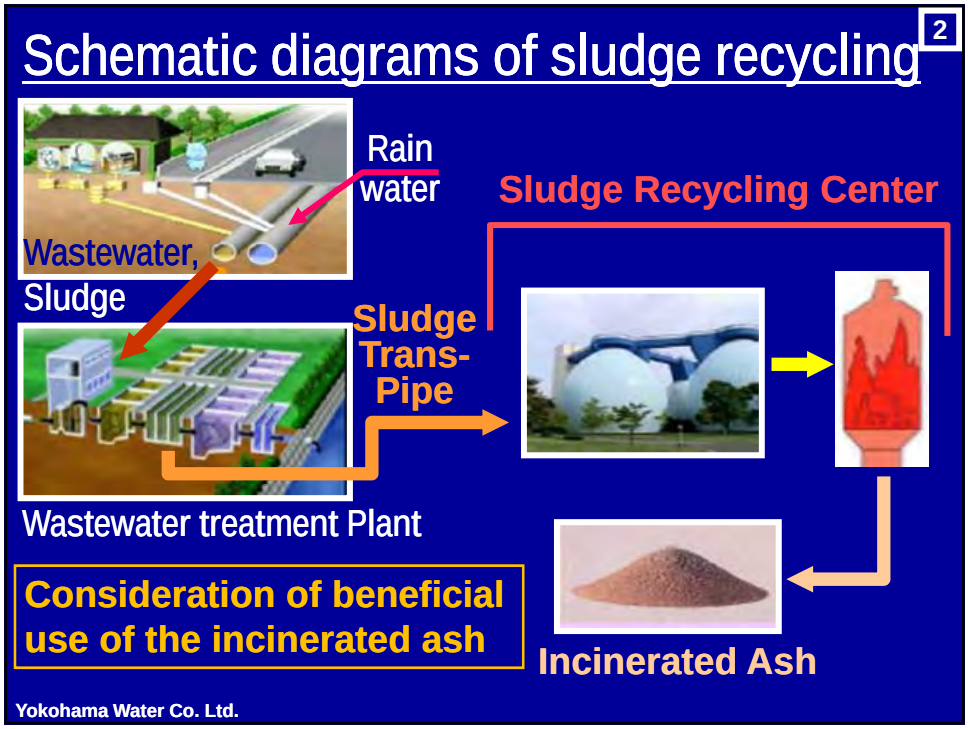
Ex. of PI
M10: Unit revenue water per person
M30: Current balance
M70: Unit wastewater treatment cost
M100: Cost covering ratio

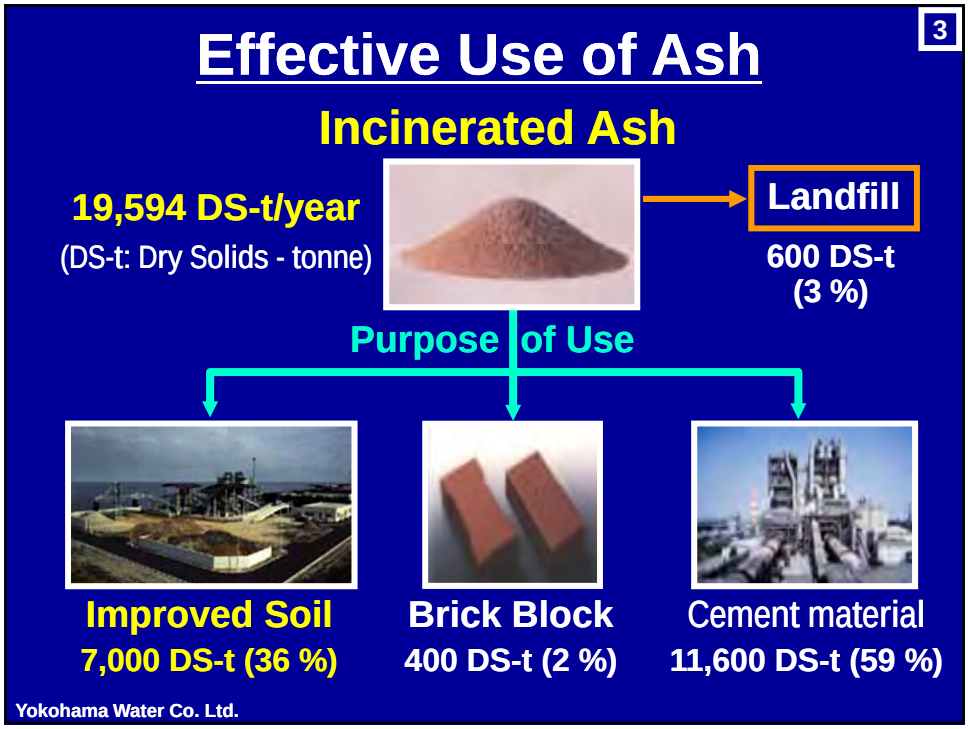
Conclusion

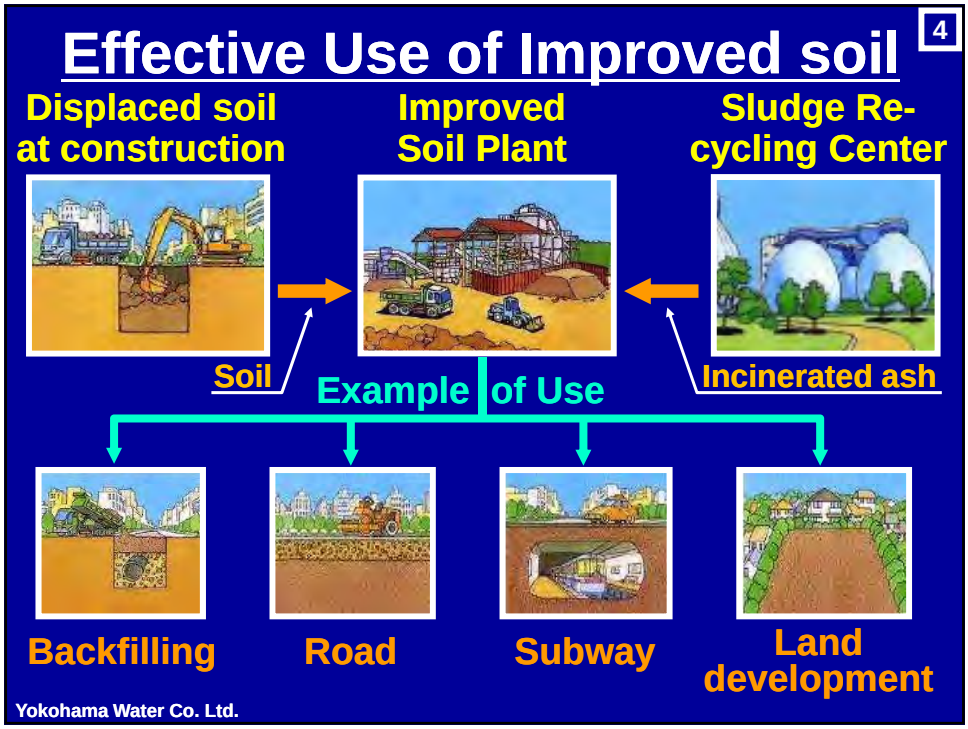
- Responsibility of Public Sector
- Capacity Building on Wastewater Management
- PPP contributes to best practice

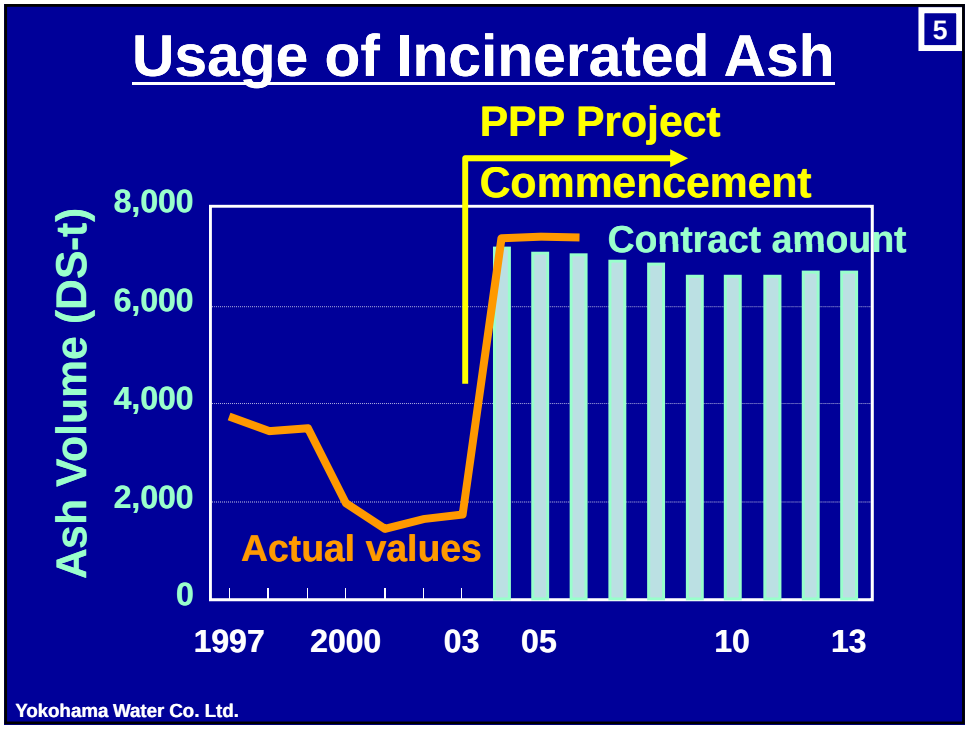
Thank you

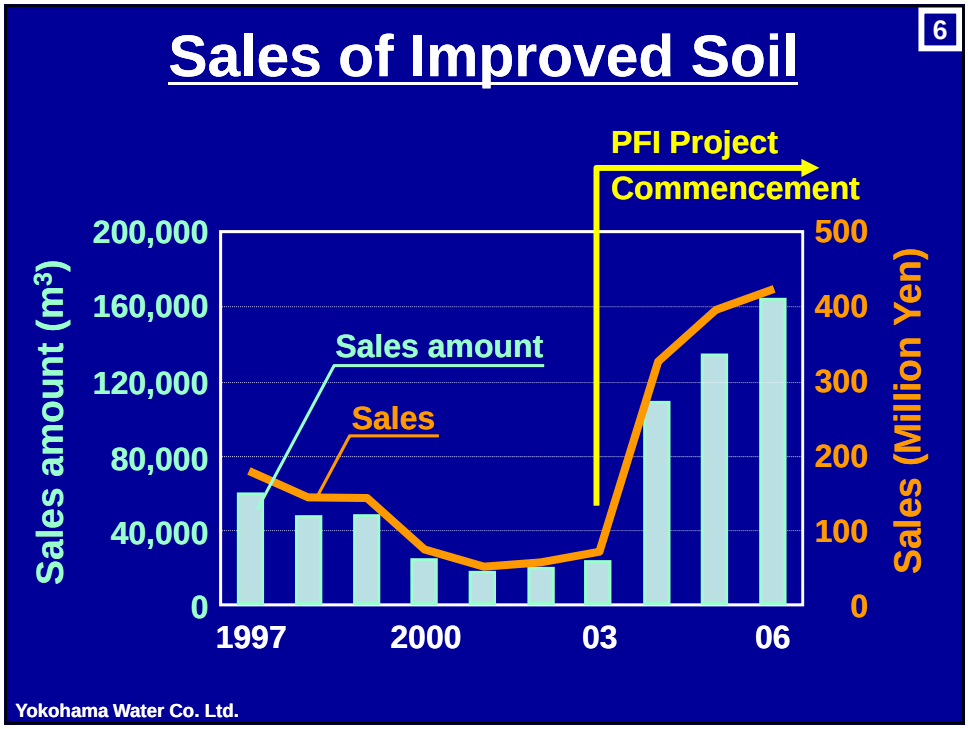

The Introduction of Yokohama PPP Project
Kenji Nakanosono
YOKOHAMA
Yokohama Water


Schematic diagrams of sludge recycling
2
Rain water
Wastewater, Sludge
Sludge Recycling Center
Sludge Trans-Pipe
Wastewater treatment Plant
Consideration of beneficial use of the incinerated ash
Incinerated Ash
Yokohama Water Co. Ltd.


3
Effective Use of Ash
Incinerated Ash
19,594 DS-t/year
(DS-t: Dry Solids - tonne)
Landfill
600 DS-t
(3 %)
Purpose of Use
Improved Soil
7,000 DS-t (36 %)
Brick Block
400 DS-t (2 %)
Cement material
11,600 DS-t (59 %)
Yokohama Water Co. Ltd.

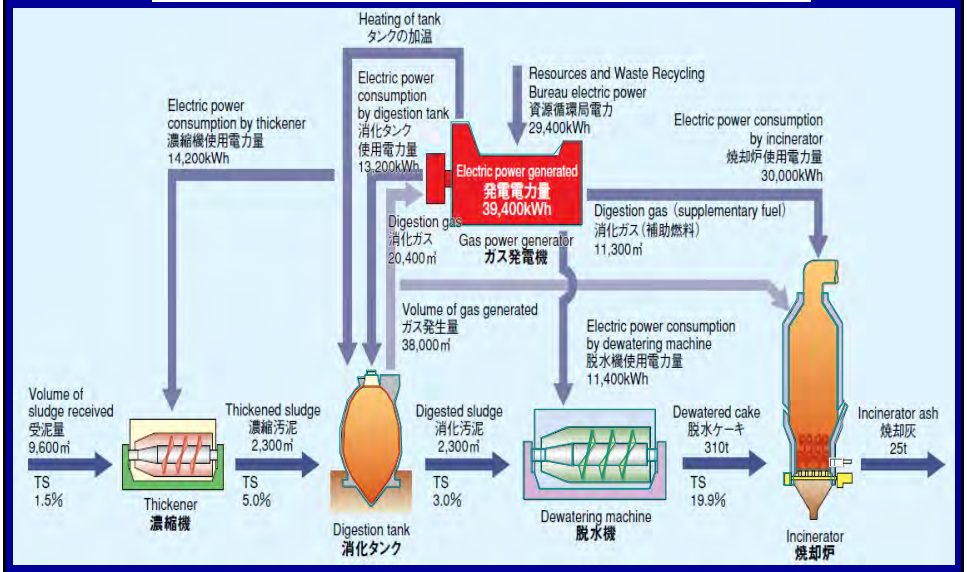

4
Effective Use of Improved soil
Displaced soil at construction
Improved Soil Plant
Sludge Re-cycling Center
Soil
Example of Use
Incinerated ash
Backfilling
Road
Subway
Land development
Yokohama Water Co. Ltd.


5
Usage of Incinerated Ash
PPP Project
Commencement
Contract amount
Actual values
Ash Volume (DS-t)
8,000
6,000
4,000
2,000
0
1997
2000
03
05
10
13
Yokohama Water Co. Ltd.


6
Sales of Improved Soil
PFI Project
Commencement
Sales amount
Sales
Sales amount (m³)
200,000
160,000
120,000
80,000
40,000
0
500
400
300
200
100
0
Sales (Million Yen)
1997
2000
03
06
Yokohama Water Co. Ltd.

Treatment Flow in Plant

7



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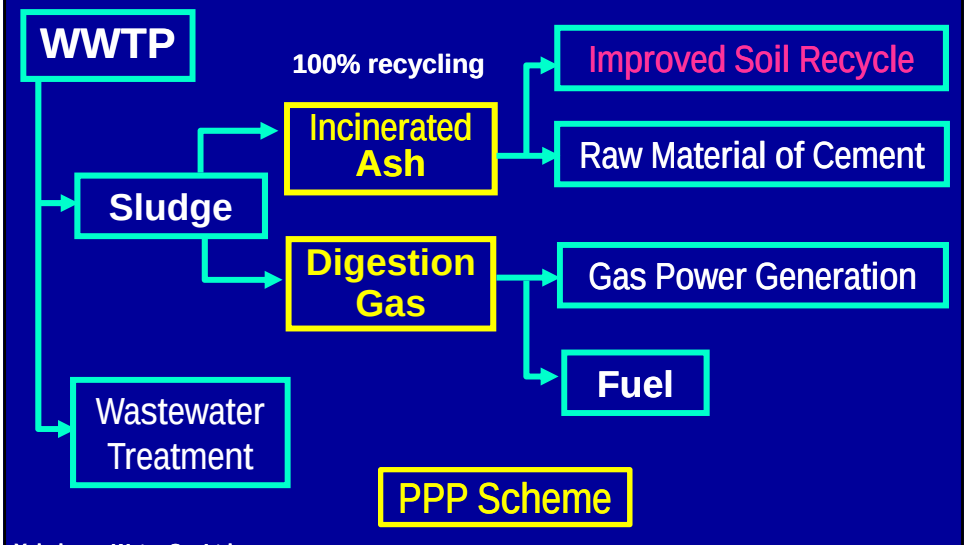
Yokohama's PPP Schematic

8

Wastewater Treatment Plant



Yokohama Water Co. Ltd.

APPENDIX-D

PPP 事業の提案書（案）
エンサ下水処理場整備事業
（2011 年 7 月提出）

Draft Proposal of PPP Scheme

for

Project of Yen Xa Wastewater Treatment Plant

July 2011

NIPPON KOEI CO., LTD
ORIX CORPORATION
NIHON HELS CORPORATION
PRICEWATERHOUSECOOPERS CO., LTD
YOKOHAMA WATER CO., LTD

(1) Summary

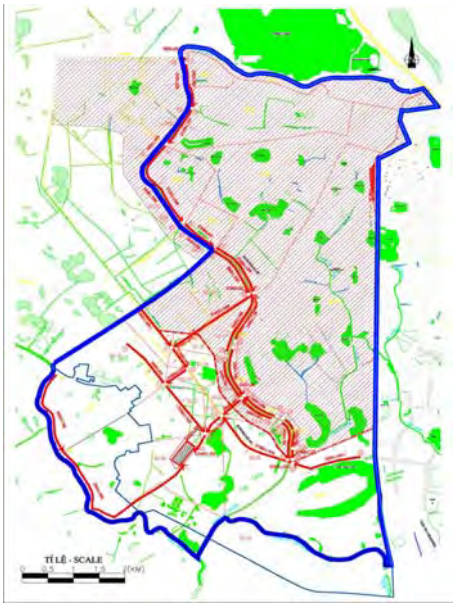
Outline Project

The outline of the Project is as below;

Table 1-1 Design Condition of the Project

Service Population	900,000
Service Area	Around 4,900 ha
Wastewater Treatment Capacity	270,000 m^3/day
Wastewater Treatment Process	Conventional Activated Sludge Process
Sludge Treatment Process	Thickening followed by Dewatering
Sludge Recycle Process	Solar Drying + Mechanical Drying
Treatment Capacity	270,000 m^3/day

Image of Yen Xa Wastewater Treatment Plant



Service Area

Table 1-2 Preliminary Cost Estimate of the Project

(million US$)

	EPC	Contingency (10%)	VAT	Total
1) Pipe Network	184.2	18.4	20.3	**222.9**
2) Wastewater Treatment Plant	233.8	23.4	25.7	**282.9**
3) Sludge Recycling Facility	32.6	3.3	3.6	**39.5**
Total	**450.6**	**45.1**	**49.6**	**545.3**

（The attachement-1 shows the details of cost estimate）

Summary of Proposal in the Progress of the Study

The summary of the proposal in the progress report is as below;

1） Private sector (SPC) would be responsible for construction and management of Yen Xa wastewater treatment plant and sludge recycling facility. Around 50 % of the fund for the investment cost would be provided from Japanese ODA Loan as the central government subsidy, and the remaining fund will be provided by SPC. JICA PSIF is planned to provide 70 % of the remaining fund with remarkably low interest to SPC. (refer to Figure S1 and S2)

2） Public Sector would be responsible for construction and management of pipe network. Private company, which may be SPC, would be in charge of the construction under supervision of Public sector. Around 80 % of the investment cost would be provided from Japanese ODA Loan as the central government subsidy. (refer to Figure S1 and S2)

3） The sewerage tariff shall be increased up to 0.245US$/$m^3$ (5,150VND/m^3), which could cover the operation and maintenance cost (including replacement of mechanical and electrical equipments in 20 years). The tariff would be increased gradually over 10 years since the commencement of the operation of Yen So Treatment Plan (by 5 years after completion of the construction works of Yen Xa). The proposed tariff level is around 10 times of current sewerage tariff, which is same as current water tariff level. As shown in Figure S1, required expenditure from HPC general account is estimated at around 25.8 million US$/year (542 billion VND/year) after the increase of tariff, which is 2.6 % of HPC ordinary account budget in 2011: 1,000 million US$/year (21,400 billion VND/year). (refer to Figure S2)

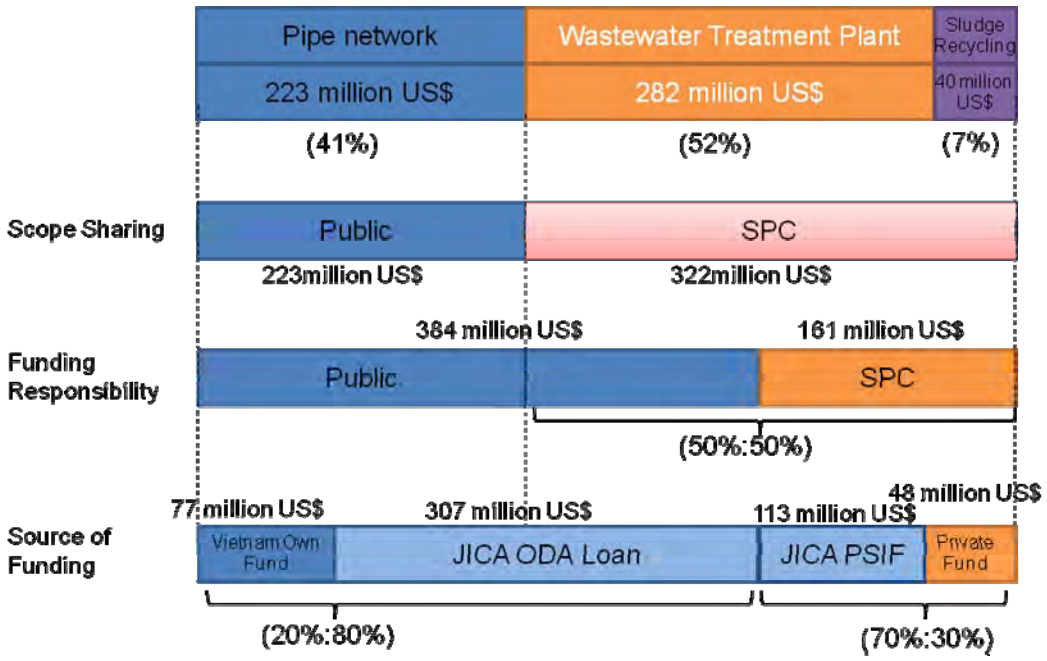


Figure S1 Scope Sharing and Funding Sources of the Project

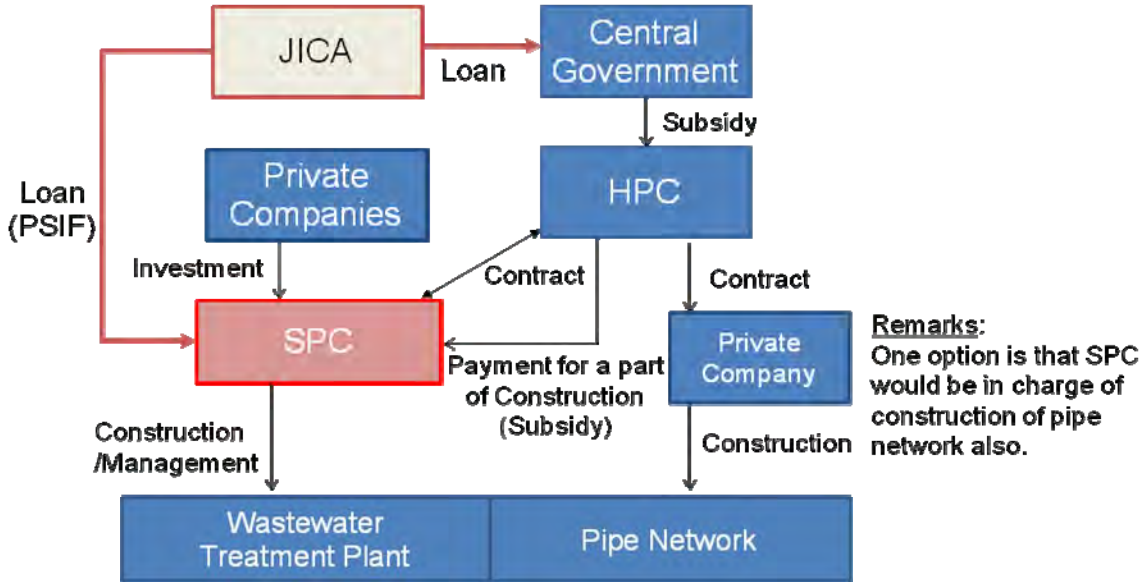


Figure S2 Draft Organization Chart of PPP Scheme for Construction of Yen Xa WWTP

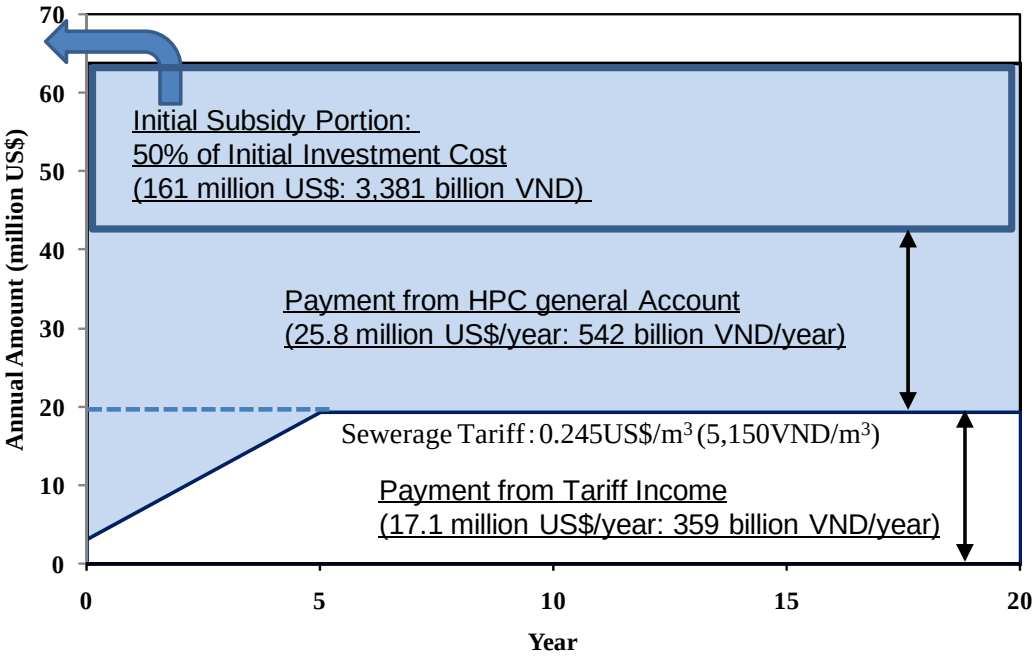


Figure S3 Allocation of Required Cost to Each Source for Yen Xa WWTP

The Study Team prepared the proposal above by following steps of consideration on the appropriate role and cost sharing among sewerage users, the municipality, and the central government, which is described below.

1st Step: Consideration to the suitable tariff level for sewerage users

The suitable sewerage tariff is tentatively proposed at 0.245US$/$m^3$ (5,150VND/m^3), which could cover the operation and maintenance cost (including replacement of mechanical and electrical equipments in 20 years).

2nd Step: Consideration to the affordable financial expenditure for the municipality

The affordable level is tentatively proposed around 25.8 million US$/year (542 billion VND/year), which is 2.6 % of HPC ordinary account budget in 2011: 1,000 million US$/year (21,400 billion VND/year)

3rd Step: The central government shall subsidy the remaining cost after the fulfillment of burden sharing by sewerage users and the municipality

As the conclusion, it is proposed to provide 100% subsidy for pipe network construction and 50 % subsidy for construction cost of wastewater treatment plant and sludge recycling facility, of which total cost is estimated around 384 million US$ (8,064 billion VND).

In case that the sewerage tariff level and/or the HPC yearly expenditure proposed above have to be lower, required subsidy should be increased. In order to fix above each step, internal discussions of HPC are required.

(2) PPP 5 Models

The Project is divided into three portions, "Pipe Network", "Wastewater Treatment Plant" and "Sludge Recycling Facility". JICA Study Team provided PPP 5 Models for alternative study to select portions to be carried out by private sector.

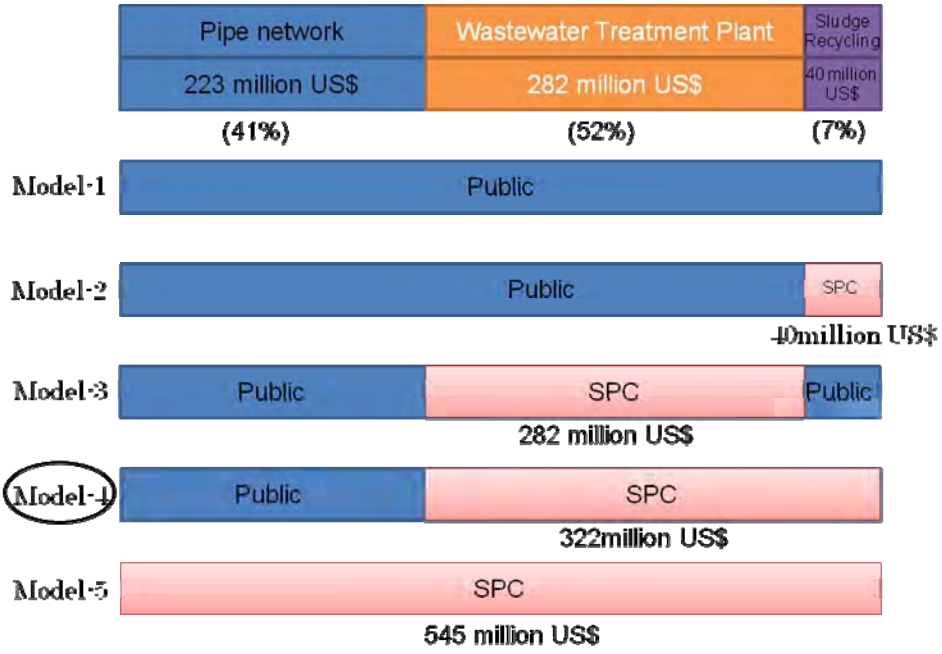


Figure 2-1 Scope Sharing and Costs of PPP 5 Models

In the progress of the Study, The Study Team proposed Model-4 as the best option for the PPP scheme of the Project, because of the following reasons;

1) The policy of Vietnamese Government does not prefer to use public funds for all of the initial investment cost of the Project. In order to reduce amount of public debts, and introduce effective management of private sector, it is preferred to use certain amount of private fund for the initial investment.
2) The construction and management of pipe network portion is not suitable for private sector. The pipe network has not only function of wastewater collection, but also has function of rainwater drainage for keeping safety life in Hanoi. In addition, private sector can hardly to control road traffic and road condition during construction stage, and can hardly utilize their know-how and technologies during operation period in the field.
3) On the other hand, effectiveness of wastewater treatment is highly depending on technology and know-how to be applied, private sector is expected to contribute effective construction and management. It is expected to reduce total life cycle cost and safety operation by using competent private companies for construction and management.
4) HPC hopes private participation in the field of construction and management of sludge recycling facility by using high technology and know-how with long term experience, particularly in Japan.

(3) Alternatives of Sources of Initial Investment Cost

Table 3-1 shows alternatives of funding source for initial investment cost of sewerage system development in Hanoi. As shown in Figure 2-1, a huge amount of investment cost is required for implementation of the Project. It supposed to use some of sources for the project implementation.

Table 3-1 Alternatives of Sources of Initial Investment Cost

Funding Source for Initial Investment		Interest (US$ basis)
Public Funding Source		
1	Central Government Subsidy (including Funding by ODA Loan: 2.75-3.50%)	-
2	HPC Development and Investment Budget *18,249 billion VND (871 million US$) in 2011	-
3	Municipality Bond	7-10%
4	Loan from Central Government	No data
Private Funding Source		
1	Private Investment (including benefit and risk hedge cost)	12-18%
2	Private Investment with JICA PSIF Loan (Private Sector Investment Fund: 4-5%)	5-10%

Major sewerage and drainage projects in Hanoi have been constructed by using the central government subsidy. The central government provided grand for all of initial investment cost of the major projects to HPC. However, it is generally discussed that the central government won't provide 100 % grant in the field of sewerage in future. The Study Team intends to propose new funding model for sewerage system development in Hanoi by using PPP scheme and JICA funds.

1） In order to reduce future HPC expenditure for repayment of investment cost, it is recommended that HPC would pay a part of initial investment cost by using central government subsidy and/or HPC general account. However, in this Study, HPC general account was not considered as a funding source for the initial investment, because of low possibility.

2） As other of public funding sources, issue of municipality bond and loan from central government are considerable. However, it is said that municipality bond with long repayment period could hardly be issued by HPC at the present. If so, the municipality bond is not suitable for long term funding for infrastructure development. As for the loan from central government, information is not available so far. In progress of the Study, both funding sources have not been considered.

(In USA/Japan, the central government established funds for providing low interest loan to municipalities for sewerage system development. So far, this type of fund is not established nor considered in Vietnam.)

3） It seems so difficult to provide enough public funding sources to cover all of the initial investment cost of the Project. The Study Team considered that utilization of private finding source is indispensable for implementation of the Project.

4） In private investment scheme, financing cost shall include cost of risk hedge and benefit of private company. Financing cost in private investment is therefore higher than the cost of public funding. The Study Team considers using JICA PSIF and Japanese ODA loan for the Project.

5） The idea is that HPC would provide a part of initial investment cost (construction cost) of the Project by using Japanese ODA loan ad central government subsidy. The remaining investment

cost would be provided by private sector (SPC) using private investment fund and JICA PSIF. SPC would manage, operate and maintain Yen Xa WWTP in 20 years, and recover his expenditure for the investment cost by service charge that HPC would pay to SPC.

(4) Consideration of Ratio of Subsidy for Investment Cost

Figure4-1 shows 5 alternatives of subsidy ratio for initial investment cost in case of PPP Model-4. In the Decision 71, it is stipulated that “State participation portion” (subsidy) shall not exceed 30 % of total investment cost. However, the Study Team intends to study on various possibilities, because sewerage project is supposed to be applicable to exceptional sectors of the decision.

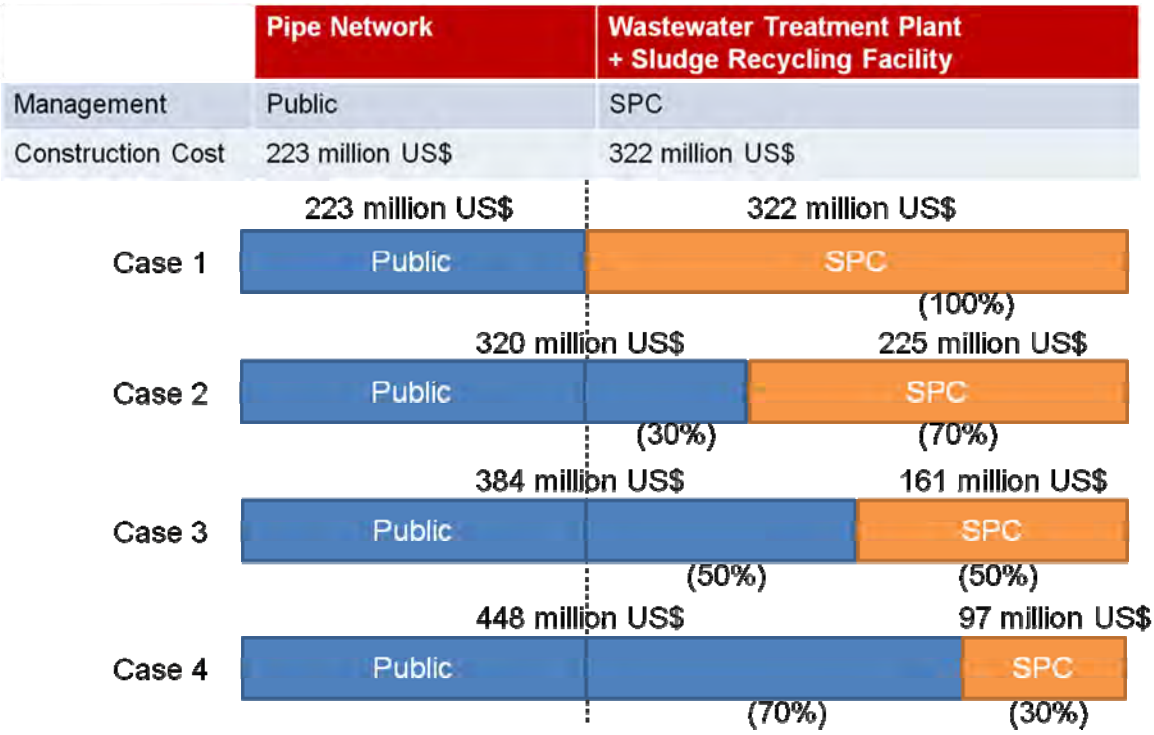


Figure 4-1 Alternatives of Subsidy Ratio for Initial Investment Cost

The plans of expenditure for the Project are prepared in the following two conditions;,

Expenditure Plan-1 (Case-1): SPC construct WWTP by using funds SPC provide. HPC doesn’t pay for the investment cost during construction stage. During 20 years operation period, HPC pay for service charge, of which amount SPC could recover his expenditure for the initial investment cost (including interest, benefit and risk hedge cost) and OM cost.

Expenditure Plan-2 (100% Subsidy): HPC (or central government) provide full amount of investment cost at construction stage without loan. During construction, HPC pay for only OM cost.

Figure 4-2 shows two expenditure plans in 4 years construction period and 20 years of operation period. If government subsidy can be spent for full initial investment cost at initial stage, yearly required payment during operation period can be reduced drastically. The Study Team intends to propose suitable subsidy ratio, through financial analysis.

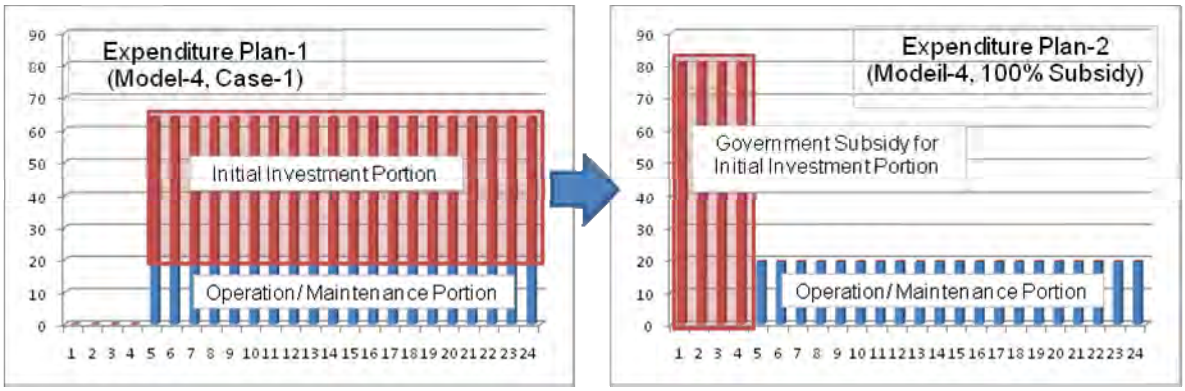


Figure 4-2 Expenditure Plans with/without Government Subsidy

(5) Financial Analysis

For sources of repayment and operation/ maintenance cost of sewerage system in Hanoi, only "sewerage tariff income" and "HPC general account" are valid. It means that a part of the initial investment cost would be paid by central government subsidy and the remaining would be paid by private finance at the initial stage, and repayment to the private finance and operation and maintenance cost shall be prepared by using "sewerage tariff income" and "HPC general account" during operation period.

In order to establish PPP scheme of the project, it is important to study on balance of "Subsidy ration of initial investment cost", "Amount of sewerage tariff income with suitable tariff level" and "Possible expenditure from HPC general account". The Study Team is carrying out a financial analysis as described below.

In case of Model-4 with Expenditure Plan-1 as shown in Figure 4-2, HPC shall provide around 63 million US$/year for the repayment and operation and maintenance to SPC. If the financial source is only tariff income in service area of Yen Xa WWTP, sewerage tariff should be 0.81 US$/$m^3$ (17,000 VND/m^3). It is equivalent of around 40 times of current sewerage tariff level, or around 4 times of current water tariff level. The average monthly household income is around 365US$ (7,641,000 VND), and the average monthly water consumption is estimated at around 17 m3/day. The expenditure of sewerage tariff from household is estimated at 14US$/month (294,000 VND/month), which is around 3.8% of the household income. Generally, total expenditure of water and sewerage tariff could not be more than 3-4%. It is almost impossible that sewerage tariff come to 3% level.

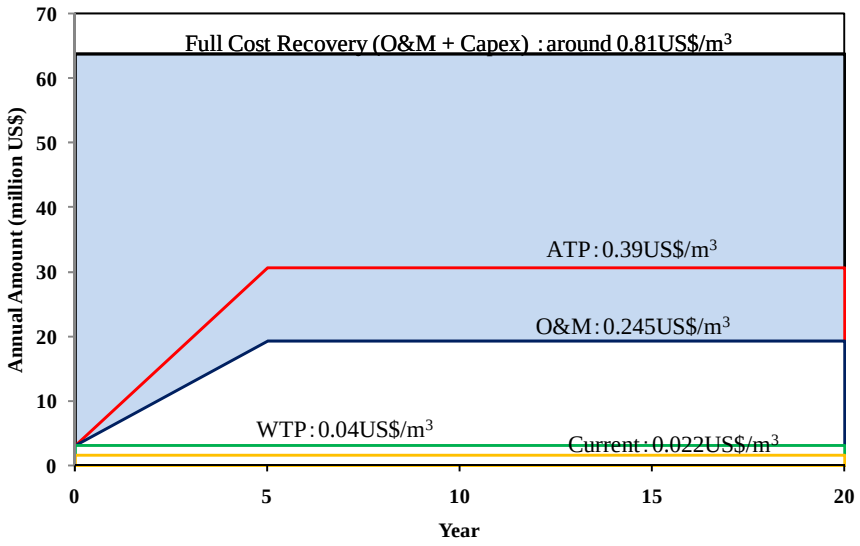


Figure5-1 Alternatives of Sewerage tariff level and Required Annual Payment

The financial analysis of PPP Model-4 is carried out by 12 cases (3 patterns of sewerage tariff x 4 types of subsidy ratio). Figure 4-1 shows 4 types of subsidy ratio, and 3 patterns of sewerage tariff are explained as below;

Sewerage Tariff Level (3 Patterns)

1) Willingness-To-Pay Level: 0.04 US$/$m^3$ (840 VND/m^3)
   Average Monthly Charge to Household : 0.68 US$/month (14,300 VND/month), which is equivalent to 0.19% of the average household income in Hanoi
2) Operation and Maintenance Cost Recovery Level: 0.245 US$/$m^3$ (5,150 VND/m^3)
   Average Monthly Charge to Household: 4.2 US$/month (87,600 VND/month), which is equivalent to 1.16% of the average household income in Hanoi
3) Affordable-to Pay Level : 0.39 US$/$m^3$ (8,190 VND/m^3)
   Average Monthly Charge to Household : 6.6 US$/month (138,600 VND/month), , which is equivalent to 1.80% of the average household income in Hanoi

Table 5-1 Basic Assumption for Water Tariff Setting in the Study

Items	Assumption
Average Household Income	91.7 million VND/year (7.64 million VND/month) 4,378 US$/year (365 US$/month)
Average Persons per Family	3.94
Average Water Consumption	17 m3/family/month (143 L/p/day)

Basic conditions of financial analysis are shown in Table 5-2.

Table 5-2 Basic Conditions of Financial Analysis

Items	Assumptions
Currency for Calculation	US $
Period of Analysis	Construction Period: 4 years Operation Period: 20 years
Loan Repayment Period (PSIF)	The same as “Operation Period”
Loan Interest Rate (PSIF)	5%
Equity Return Rate (IRR)	15%
Income Tax Rate*	25 %
Value Added Tax Rate*	10 %
Debt to Equity Ratio*	Debt (PSIF) 70%, Equity 30%
Government Subsidy	No repayment/ no interest
Sewerage Tariff	Target Tariff: 0.04 US$ /m^3, 0.245 US$ /m^3, 0.39 US$ /m^3 Increasing up to target tariff level from 0.04 US$ /m^3 (840 VND /m^3) in 5 years

The results of the financial analysis on 12 cases are shown in Attachment-1

The result of Subsidy 50% and Sewerage Tariff 0.245 US$/$m^3$ (5,150 VND/m^3) is shown in Figure 5-2

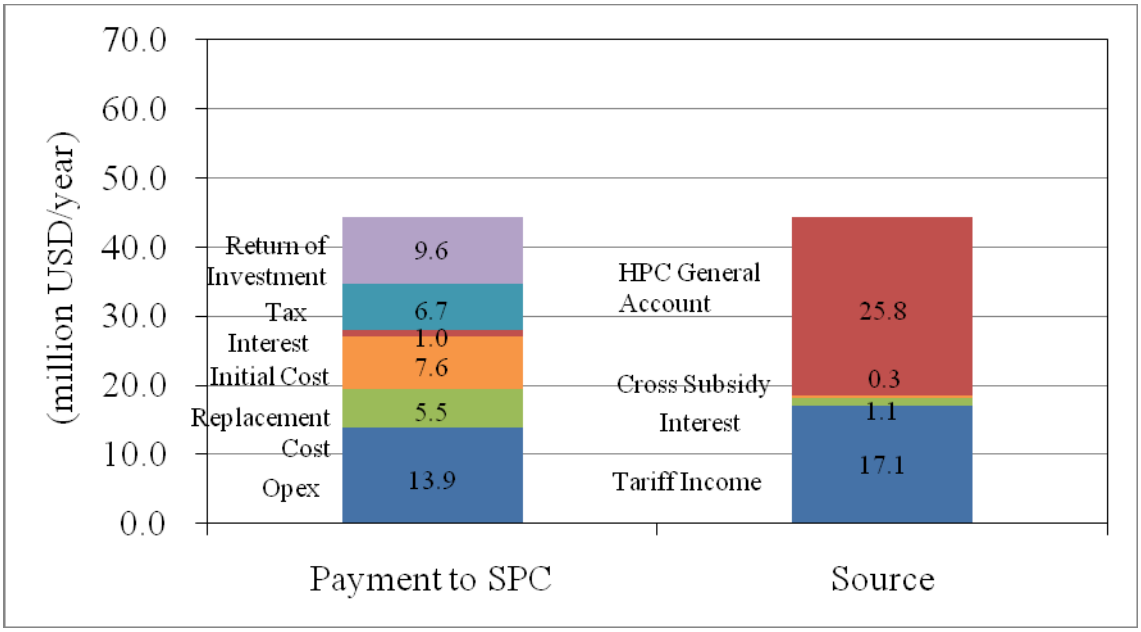


Figure 5-2 Result of Financial Analysis (PPP Model-4, Case-3 with Tariff 0.245 US$/$m^3$)

Table 5-3 explain output items of the financial analysis.

Table 5-3 Output Items of Financial Analysis

Items	Assumptions
Payment to SPC	
1) Return of investment	The sum of the dividend to be paid to the equity investors. This includes the return portion only and does not include principal (i.e., originally invested) portion of the investment.
2) Tax	The sum of income tax and value added tax to be paid by SPC during operation period.
3) Interest	The sum of the interest expenses to be paid by SPC for PSIF loan. The amount does not include the principal portion of the PSIF.
4) Initial Cost	Repayment of Initial construction cost and related expenses to be paid by SPC during construction period.
5) Replacement Cost	Replacement cost (i.e., additional capital expenditure) to be paid by SPC during operation period.
6) Opex	Operating expenses to be paid by SPC during operation period.
Financial Source	
1) HPC General Account	Annual expenditure by HPC to SPC to compensate for the shortfall of revenue items “Tariff Income”, “Interest” and “Cross Subsidy”, to provide the payment amount to SPC above. This is assumed to be paid during the operation period.
2) Cross Subsidy	Cross subsidy from other territories in Hanoi. If sewerage Tariff of 0.245 US$/$m^3$ is materialized, some WWTPs in charge of other territories could generate excess cash flow. Such excess cash flow is assumed to be paid to this project as a kind of “territorial” cross subsidy.
3) Interest	Interest income from the deposit of SPC in banks.
4) Tariff Income	SPC’s Income which corresponds with the amount assumed to be paid by citizens to use Yen Xa WWTP as sewage tariff.

Table 5-4 shows rough estimate of required yearly expenditure from HPC general account for each case

Table 5-4 Required Yearly Expenditure from HPC General Account for Each Case

	Subsidy: 0%	Subsidy: 30%	Subsidy: 50%	Subsidy: 70%
VND 840 /m^3 (US$ 0.04/ m^3) Willingness-to-Pay (0.2% of household Income)	59.4 (1,247)	47.8 (1,004)	40.0 (840)	32.1 (671)
VND 5,150 / m^3 (US$ 0.245/ m^3) Management Cost Recovery (1.1% of household Income)	45.2 (949)	33.6 (706)	25.8 (542)	18.0 (378)
VND 8,190 / m^3 (US$ 0.39/ m^3) Affordable-to-Pay (1.8% of household Income)	38.8 (814)	27.2 (571)	19.3 (405)	11.5 (241)
				(million US$/year) (billion VND/year)

(6) Conclusion and Recommendation in Progress Stage

As the progress report, the Study Team recommends Model-4 Case-3 as the best option.

1) Private sector (SPC) would be responsible for construction and management of Yen Xa wastewater treatment plant and sludge recycling facility. Around 50 % of the fund for the investment cost would be provided from Japanese ODA Loan as the central government subsidy, and the remaining fund would be provided by SPC. JICA PSIF is planned to provide 70 % of the remaining fund with remarkably low interest to SPC. (refer to Table 7-1)
2) Public Sector would be responsible for construction and management of pipe network. Private company, which may be SPC, would be in charge of the construction under supervision of Public sector. Around 80 % of the investment cost would be provided from Japanese ODA Loan as the central government subsidy. (refer to Table 7-1)
3) The sewerage tariff shall be increased up to 0.245US$/$m^3$ (5,150VND/m^3), which could cover the operation and maintenance cost (including replacement of mechanical and electrical equipments in 20 years). The tariff will be increased gradually over 10 years since the commencement of the operation of Yen So Treatment Plan (by 5 years after completion of the construction works of Yen Xa). The proposed tariff level is around 10 times of current sewerage tariff, which is same as current water tariff level. As shown in Figure S1, required expenditure from HPC general account is estimated at around 25.8 million US$/year (542 billion VND/year) after the increase of tariff, which is 2.6 % of HPC ordinary account budget in 2011: 1,000 million US$/year (21,400 billion VND/year).

Figure 6-1 shows allocation of required expenditure for the Project to each source. Figure 6-2 shows yearly expenditure plan of HPC in Model-4, case-3.

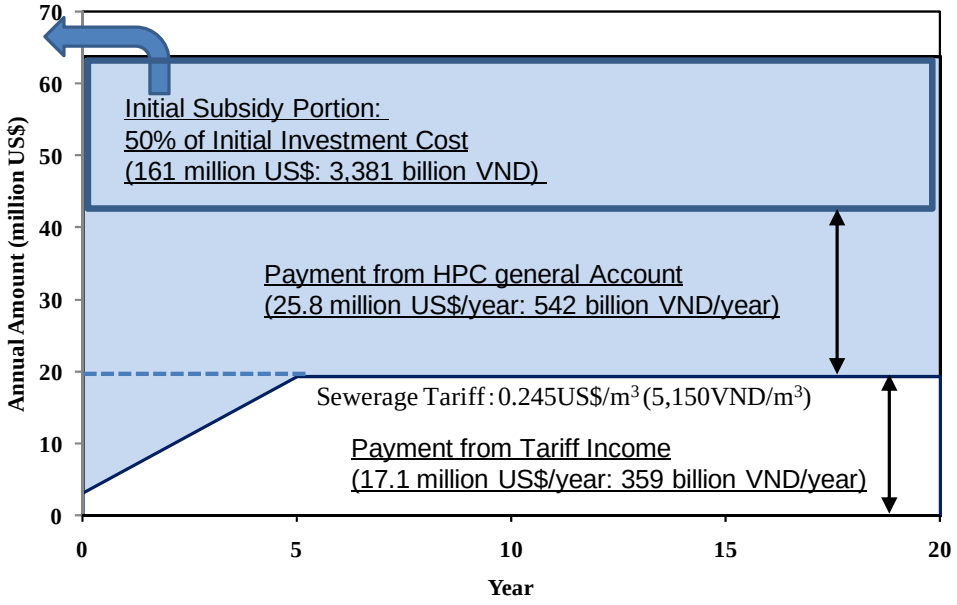


Figure 6-1 Allocation of Required Cost to Each Source for Yen Xa WWTP

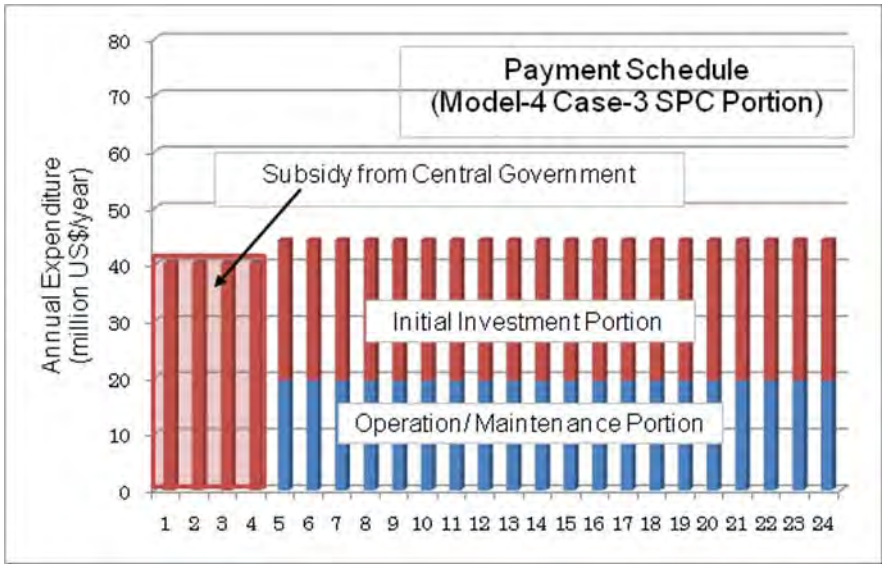


Figure 6-2 Expenditure Plan of HPC (Model-4 case-3)

(7) Draft Proposal of Hanoi PPP Model and Funding Source

There are many project examples in China, Korean, Taiwan and Mexico, that private sector (SPC) has constructed and managed WWTP by using private funds under the contract with a municipality.

Figure 7-1 shows the image of organization chart of PPP scheme of construction of WWTP. In all cases, SPC has received service charges from municipality (not from end users) under the contract.

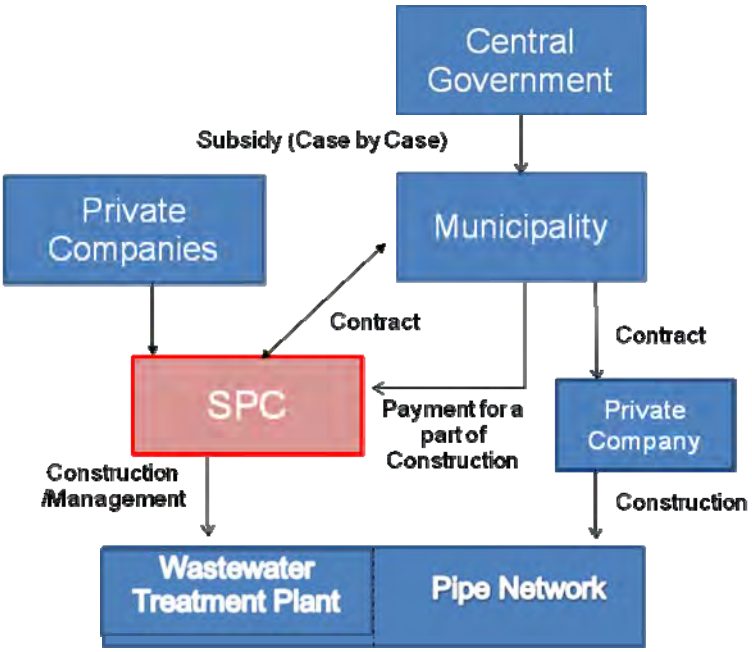


Figure 7-1 Sample of Organization Chart of PPP Scheme for Construction of WWTP

Figure 7-2 shows the draft organization chart of PPP scheme for the project of Yen Xa WWTP. In order to reduce financing cost of the Project, it is proposed that JICA ODA loan would be provided to the central government for source of public funding for the public portion and SPC portion of the Project, and JICA PSIF would be provided to SPC. Table 7-1 shows rough estimate of funding amount from each source for the initial investment of the Project..

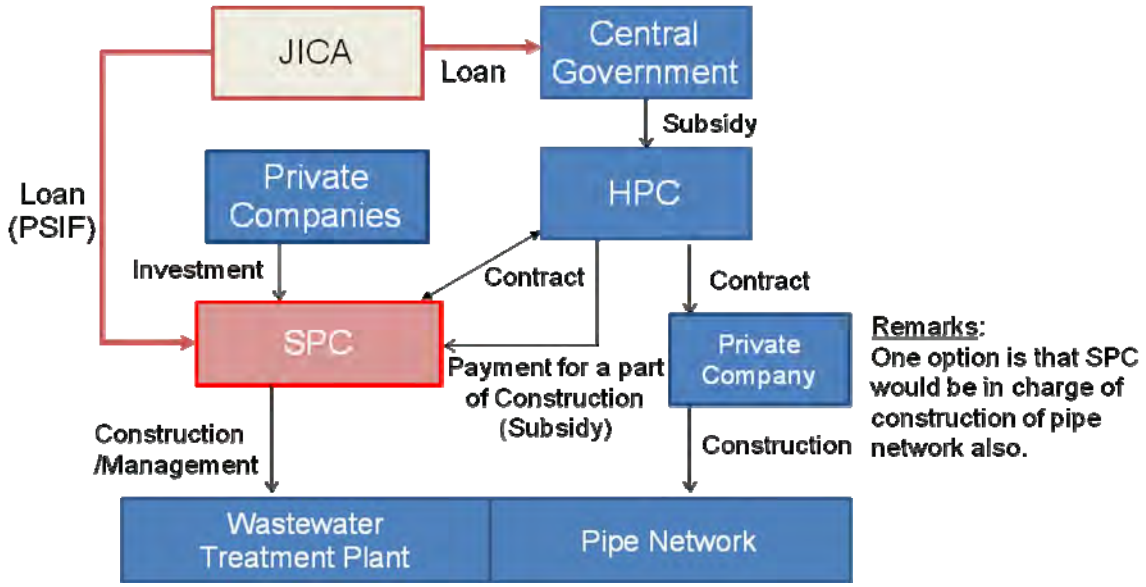


Figure 7-2 Draft Organization Chart of PPP scheme for construction of Yen Xa WWTP

Table 7-1 shows the draft proposal of funding source and required amount for overall the Project

Table 7-1 Draft Proposal of Funding Source for Overall Project

(PPP Model-4, Case-3)

(million US$)

	Public Fund (Central Government Subsidy)		Private Fund		Total
	Vietnam Own Fund (20%)	JICA ODA Loan to Central Government (80%)	JICA PSIF to SPC (70%)	Private Investment (30%)	
Public Portion (Pipe Network)	44.6	178.3	-	-	**222.9**
SPC Portion (Wastewater Treatment Plant, and Sludge Recycling Facility)	32.2 ⟷	129.0 ⟷ 161.2 (50%)	112.8 ⟷	48.4 ⟷ 161.2 (50%)	**322.4**
Total	**76.8**	**307.3**	**112.8**	**48.4**	**545.3**

Remarks: It is assumed that JICA ODA loan would provide 80 % of public fund for the Project.

Attachment-1 Cost Estimation of Initial Investment Cost

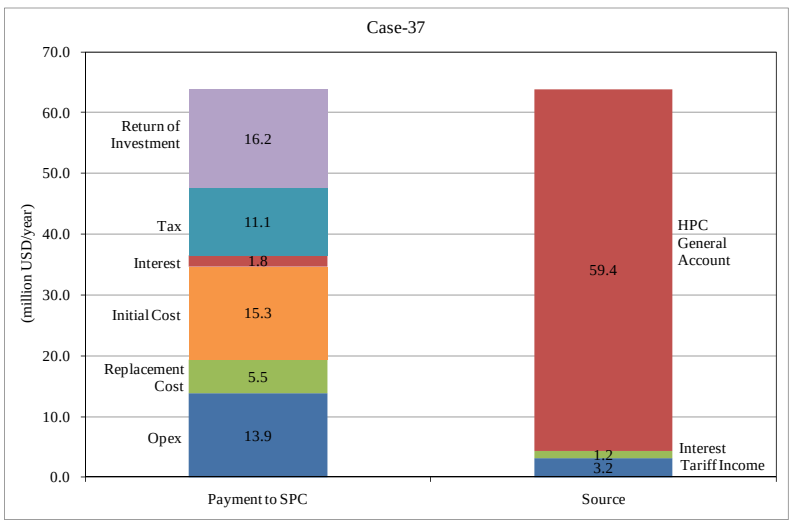
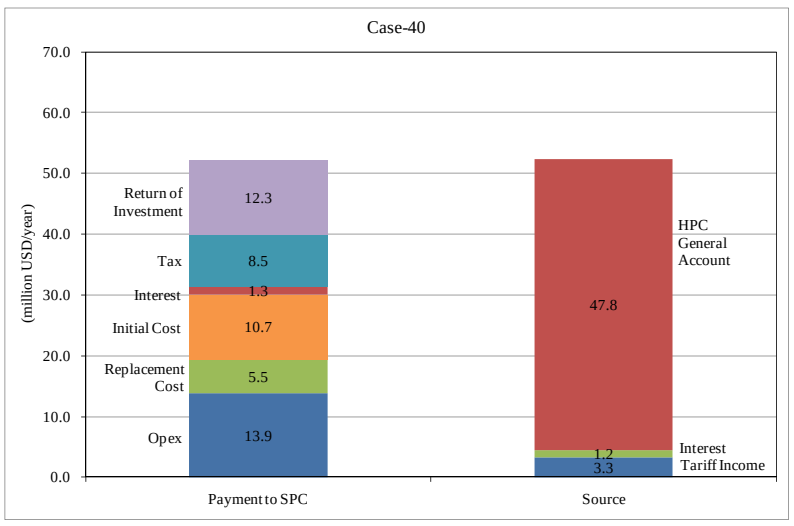
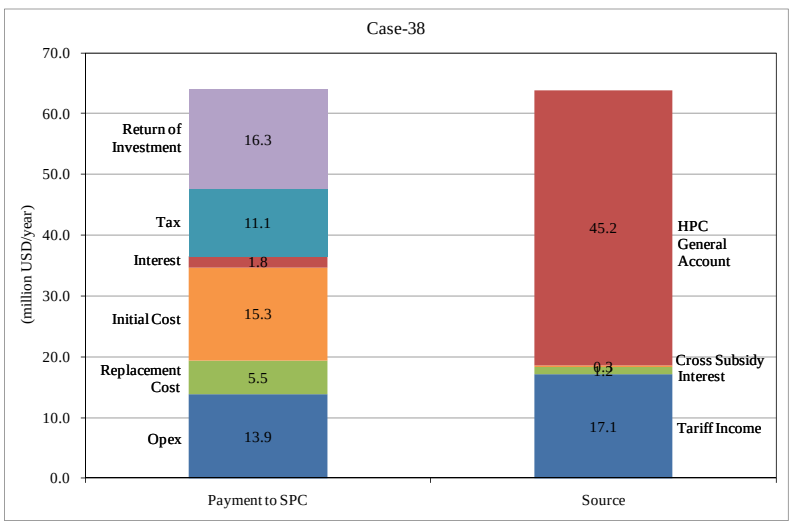
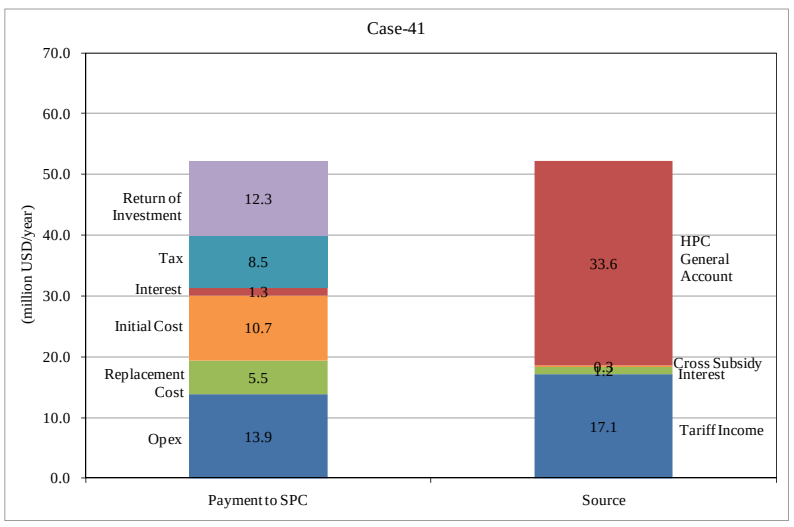
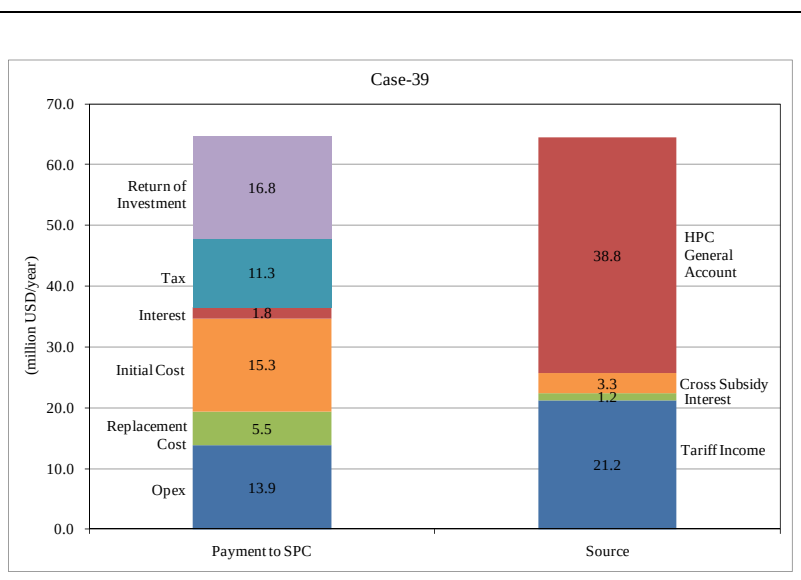
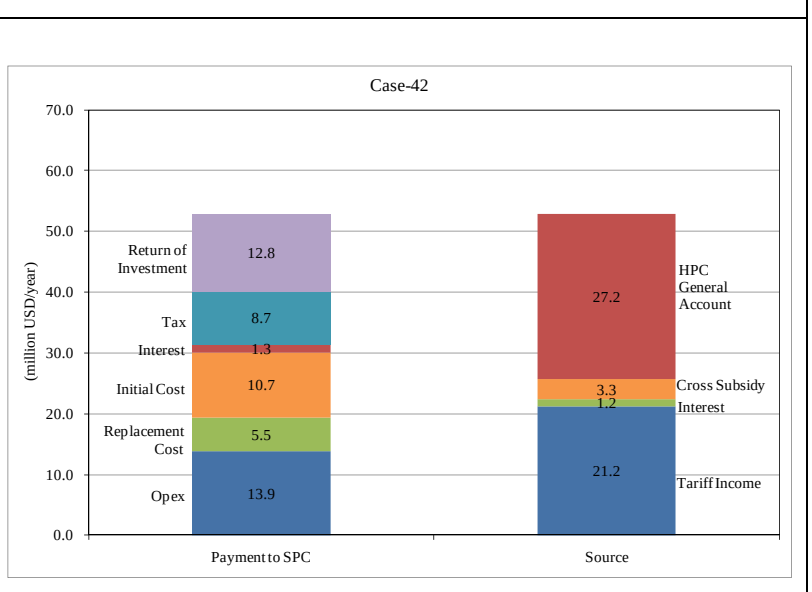
(Not Discoled)

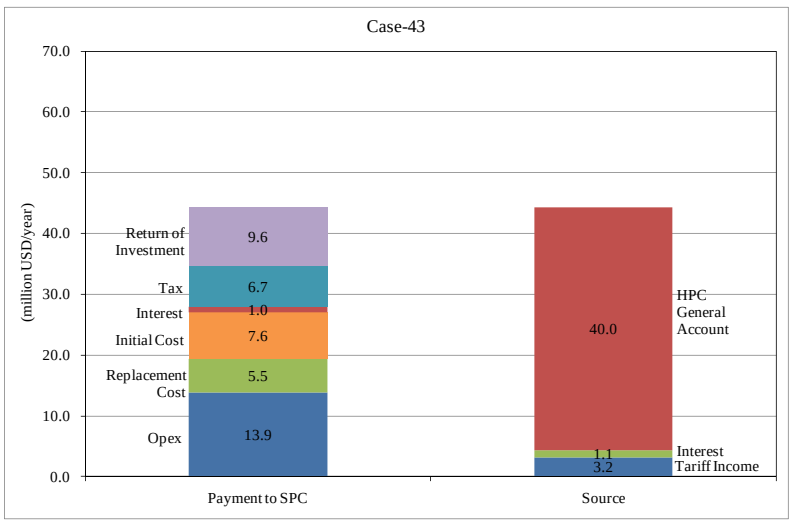
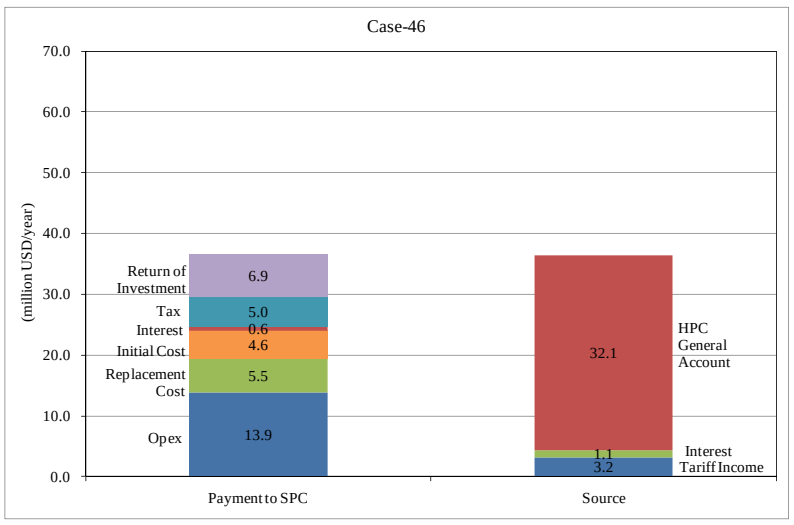
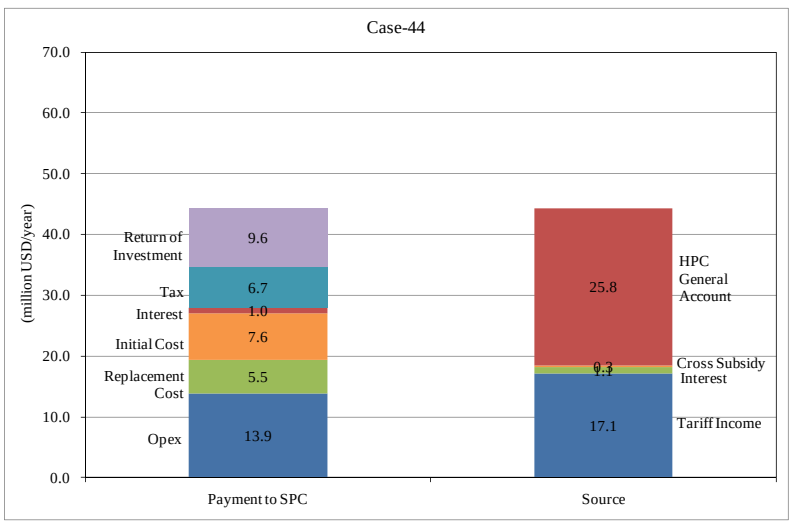
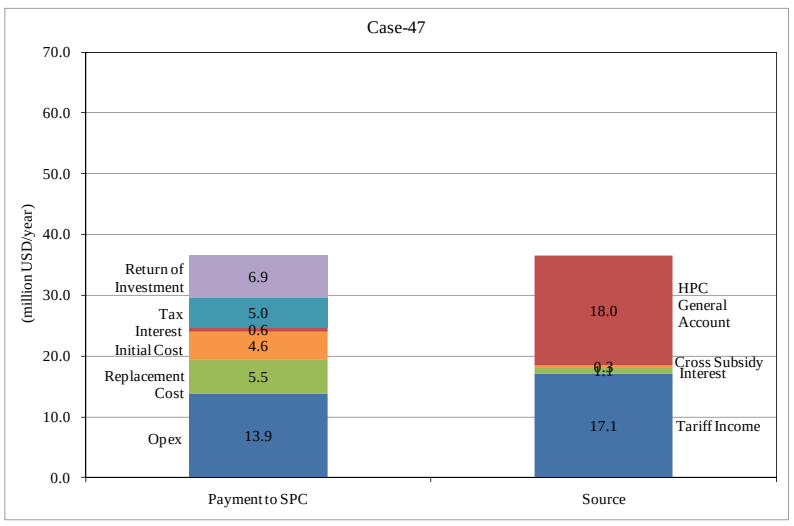
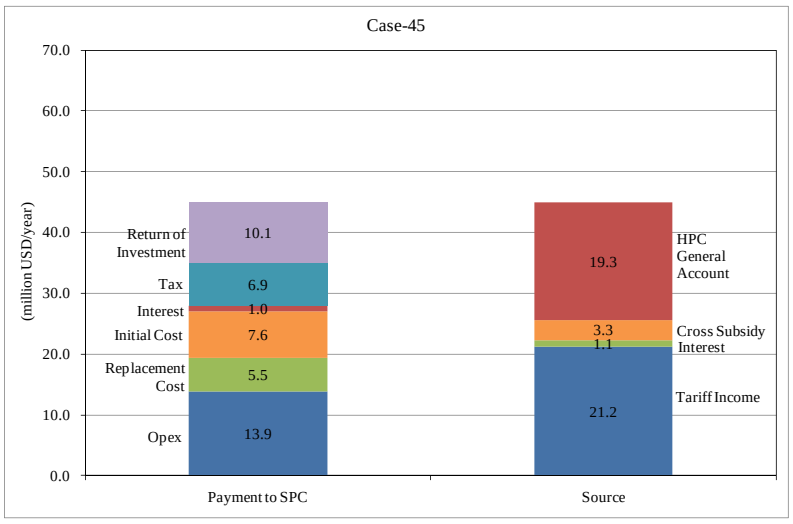
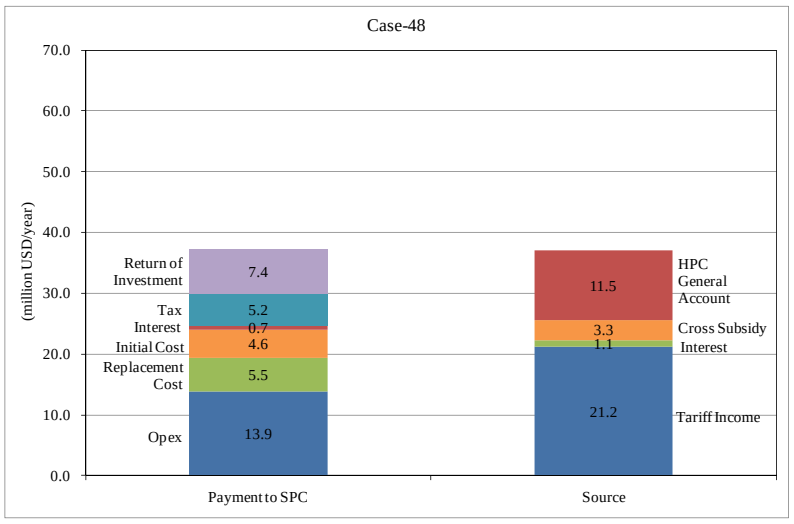
Appendix-2: Results of Financial Analysis (Model-4)

Model

Pipe	WWTP	Sludge Recycle
Public	SPC	SPC

Cash Flow (US$MM) 2011 Price

Tariff	0% Subsidy	30% Subsidy
US$ 0.04/m^3 VND 840/m^3 (0.19%) WTP		
US$ 0.245/m^3 VND 5,150/m^3 (1.16%) O&M		
US$ 0.39/m^3 VND 8,190/m^3 (1.80%) ATP		

Tariff	50% Subsidy	70% Subsidy
US$ 0.04/m^3 VND 840/m^3 (0.19%) WTP		
US$ 0.245/m^3 VND 5,150/m^3 (1.16%) O&M		
US$ 0.39/m^3 VND 8,190/m^3 (1.80%) ATP		

APPENDIX-E

本邦研修報告書

平成24年2月20日

ベトナム国ハノイ市エンサ下水処理場整備事業
準備調査（PPPインフラ事業）にかかる
研修報告書

幹部研修：2011年9月28日～2011年10月7日

実務者研修：2011年10月12日～2011年10月25日

横浜ウォーター株式会社

別紙5:打合簿

打 合 簿

平成24年2月20日

監督職員
業務主任者　永井康敏

案件名：　ハノイ市エンサ下水処理場整備事業準備調査(PPPインフラ事業)

打合項目	打合内容及び結果
研修員受入業務完了の確認及び支出金額の報告について	平成23年3月17日に締結した業務委託契約書〔付属書Ⅱ〕特記仕様書第6条ー(2)ーキに定める招聘の実施については、受注者がこれを適切に履行したことを両者で確認した。 なお、当該業務にかかる経費については、全体業務の契約金額精算報告書提出後に、別途JICAによる精算確定を受けることとする。(当該業務にかかる経費の一部は別添の通り) 記 1.　研修実施内容及び同行者の有無 別添「研修実績報告書」及び「研修工程実績表」のとおり 2.　講義、見学、各種検討会の実施実績 別添「研修工程実績表」のとおり 3.　研修教材用の原稿執筆実績 別添「契約に含まれる国別研修【別紙1】および【別紙2】」のとおり 4.　同行者、講師、検討会参加者に係る旅費・交通費の明細 別添「契約に含まれる国別研修【別紙1】および【別紙2】」のとおり 別添:研修実績報告書 研修工程実績表 契約に含まれる国別研修

研 修 実 績 報 告 書

平成24年2月17日

独立行政法人国際協力機構
契約担当役 小寺清 殿

受託機関 横浜ウォーター株式会社
代表者 代表取締役
五十川 健郎 印

1 案件の概要

(1)案件名(和文／英文): ハノイ市エンサ下水処理場にかかる幹部研修
Training of Sewerage Management for Hanoi People Committee (Executive Class)

(2)研 修 期 間: 2011 年 9 月 28 日から 2011 年 10 月 7 日まで

(3)研 修 員 人 数: 6名

2 研修内容

(1)研修全体概念図

ハノイ市において始まったばかりの下水道事業に関し、我が国の優れた下水道技術、事業経営手法を導入し、ハノイ市エンサ下水処理場のPPP事業のためのアクションプランが策定される。

↓

1. ハノイ市と横浜市環境創造局(本研修を弊社と連携して実施している団体)とがハノイ市の抱える問題点についてディスカッションをおこない、双方が理解する。
2. 我が国の自治体の有する下水道運営・管理ノウハウ(水質管理、浸水対策、下水道料金制度を含む)等を学ぶことを通じて、研修員の課題解決に向けた考察、討議等を行う。
3. 我が国の自治体の有する下水道運営、管理ノウハウ(水質管理、浸水対策、下水道料金制度を含む)等に関して、講義のみならず下水道施設等の視察を通して実際の取り組み状況を効果的に学び、研修員の課題に向けた考察を行う。
4. 研修を通して習得した技術等と自国技術等の比較分析により、自国の現状と課題について把握することにより、自国の社会資本への導入・応用が可能となるよう理解を深める

↓

議論した改善策に基づき、ハノイ市の下水道運営改善に向けた政策の提言などの取り組みが開始される。

(2)日程表

別添資料－1 の通り

(3)カリキュラム構成

別添資料－1の通り

3 案件目標の達成度

(1) 案件目標

－案件目標:ハノイ市において始まったばかりの下水道事業に関し、我が国の優れた下水道技術、事業経営手法を導入し、ハノイ市エンサ下水処理場のPPP事業のためのアクションプランが策定される。

－指 標:研修実施後の期待充足度では 5 点評価中 4 点以上と評価している。

－達 成 度 :研修員 6 名中全員が 4 点以上と評価しており、目標は達成された。

	← ← 達成			未達成→ →		無回答	平均点
	5 点	4 点	3 点	2 点	1 点		
期待充足度	4 人	2 人	0 人	0 人	0 人	0 人	4.7

(2) 達成度測定結果

ア. クエスチョネア集計結果

	←十分達成できている				達成していない→	無回答	平均点
	5 点	4 点	3 点	2 点	1 点		
研修実施前	0 人	2 人	2 人	0 人	0 人	2 人	3.5
研修実施後	4 人	2 人	0 人	0 人	0 人	0 人	4.7

イ. ディスカッション

(ア)キックオフ・ディスカッション

研修員と環境創造局職員、水道局職員及び横浜ウォーター職員が参加してディスカッションを行い、双方の下水道事業の状況確認を行った。確認項目は、事業概要、公共用水域の水質の状況、分合流方式の採用状況、使用料徴収方法、PR等である。

上記確認事項を基に横浜市側からハノイ市が抱える現状の問題点に関しアドバイスを行った。アドバイスを行った主な項目は下記の通りである。

・下水道に求められる役割の歴史的変遷について
・合流式下水道の改善について
・下水処理方式の選定について
　特に標準法、回分法の選定について
・高度処理について
・汚泥の集約処理及び有効利用について
・浸水対策について
・下水道の経営について
・下水道使用料の徴収について

(イ)ファイナル・ディスカッション

今回の研修の成果について、研修員と環境創造局職員、水道局職員及び横浜ウォーター職員が参加してディスカッションを行った。研修員から下記のような感想、意見があった。

・日本の下水処理技術が高度に発達していることを理解した。
・日本では幼い頃から環境教育に取り組んでおり、環境に対する意識が高い。
　自国でも下水道を始めゴミ処理などの環境に対する啓蒙活動に取り組みたい。
・日本では事業が計画的に実施されている。
・日本ではエネルギーの相互利用、汚泥のリサイクルなどの技術が進んでいる。
・今回の研修で修得したことを、自国の政策に取り組むよう提言していきたい。

4 研修案件に対する所見

(1)研修デザイン

研修員がハノイ市の幹部であることから、我が国及び横浜市下水道事業の全体像を把握できるよう一週間の研修期間を設定した。研修期間に対する研修員の評価は 4.2 であり、研修員の期待に添った期間設定ができたと考える。

(2)研修内容

今回の研修は、我が国及び横浜市下水道事業の全体像の把握を主眼に設定した。評価会において研修員からもう少し具体的な話、例えば下水処理場建設計画時の課題、資金調達、財源の確保、運営トラブル対応などについて聞きたかったとの意見があった。これらの点については次年度以降改善に取り組みたい。

(3)研修の効果を高める工夫

横浜市を始め、札幌市、苫小牧市の下水道処理施設を視察した。これらの視察では横浜市では行っていない汚泥のコンポスト施設などを視察した。これにより研修員は幅広く下水処理技術に関する知見を修得できたと考える。

横浜市北部下水道センターでは、水処理施設および汚泥処理施設に加えて隣接する資源循環局鶴見工場で廃棄物焼却施設を見学し、汚泥処理施設や廃棄物焼却施設で発生する熱や電気を水処理施設で利用するとともに、下水処理水を相互に機械の運転や事務所の清掃に再利用している状況を確認した。こうすることにより、研修員は下水道技術に対する知見を深めるばかりでなく、環境負荷削減に対する認識をより深めることができたと考える。

(4)研修運営体制

横浜市環境創造局に主たる講義を依頼し研修を行った。同局は下水汚泥焼却灰の有効利用で我が国初の PFI 事業に取り組むなど、先進的な事業を行っており、ハノイ市の下水道事業展開に向け有意義な講義をすることができたと考える。

5 次年度へ向けた改善点及び提案

(1)評価会における要望事項

下水処理場建設計画時の課題、資金調達、財源の確保、運営トラブル対応、環境教育の実施内容などをカリキュラムに加えてほしいとの要望があった。これらの要望については、環境創造局と調整の上、可能なものから取り入れるようにしたい。

添付資料

(1)研修日程 別添資料-1

(2)研修員リスト 別添資料-2

(3)テキストリスト 別添資料-3

(4)クエスチョネア集計票 別添資料-4

研 修 写 真 集（1/2）

環境創造局政策調整部長挨拶（9/29）

横浜市の下水道事業について（9/29）

日本&横浜の下水道事業概要（9/30）

JICA 表敬訪問(9/30)

札幌市創成川処理場視察（10/3）

苫小牧市コンポスト工場視察（10/4）

北部水再生・汚泥資源センター視察（10/5）

北部水再生・汚泥資源化センター視察（10/5）

研 修 写 真 集 (2/2)

北部水再生・汚泥資源化センター視察(10/5)

改良土センター視察 (10/5)

資源循環局鶴見工場視察(10/5)

資源循環局鶴見工場視察(10/5)

ファイナルディスカッション（１０／５）

終了式集合写真(10/5)

研修工程実績表　ハノイ市エンサ下水処理場　整備事業準備調査　経営者研修コース

2013/2/19

月日	曜日	時刻			形態	研修内容	講師又は見学先担当者等		研修場所・移動行程	講義内容	備考
							氏名(敬称略)	所属先及び職位			
9月28日	水					来日					
9月29日	木	09:30	～	12:00	講義	オリエンテーション		JICA	JICA横浜		
		13:30	～	16:00	討議	横浜市の下水道事業について意見交換会 （横浜市のPFI事業をメインテーマに）	政策課　大狭間誠 下水道設備課　芦澤補佐 下水道設備課　佐光職員	政策課 下水道事業調整課 下水道設備課 下水道施設管理課	関内中央ビル 3B協議室	意見交換小テーマ 〇横浜市について、横浜市の財政について 〇業務委託、PFI手法による能力増強	
9月30日	金	09:30	～	10:50	講義	日本の下水道及び横浜市下水道事業の概要	大狭間誠	政策課	関内中央ビル 3B協議室		
		11:00	～	12:00	講義	横浜市の下水道経営	増田潤	下水道事業推進課	関内中央ビル 3B協議室		
		13:30	～	16:00	訪問	JICA表敬訪問		JICA	JICA横浜		
10月1日	土					休日					
10月2日	日					移動日					
10月3日	月	09:00	～	13:00	視察	札幌市創成川処理場・水再生プラザ視察	原　洋隆				
10月4日	火	09:30	～	12:00	視察	苫小牧市西町下水処理センター視察	徳光和男				
10月4日	火	13:00	～	15:50	視察	苫小牧市勇払下水処理センターコンポスト工場視察	山下　実				
10月5日	水	09:00	～	10:30	視察	北部第二水再生センター	前田賢二	北部下水道センター（水再生）	北部第二水再生センター	適切なリン・窒素の除去=高度処理の運転管理、水質改善、光ファイバーによる遠隔監視、中央監視システムの実施、上部利用について	
		10:40	～	12:00	視察	北部汚泥資源化センター	及川隆仁	北部下水道センター（汚泥）	北部汚泥資源化センター	転・維持管理、マニュアルについて、下水道資源の有効利用	
		13:30	～	15:00	視察	資源循環局　鶴見工場	福田裕	資源循環局鶴見工場	資源循環局鶴見工場	処理水、汚泥との資源利用、ふれーゆへの熱量利用	
10月6日	木	09:30	～	12:00		研修評価会準備		JICA	JICA横浜		
		13:30	～	16:00	討議	下水道事業運営について意見交換	大狭間誠 増田潤 古川聡	政策課 下水道事業推進課 経理経営課	JICA横浜		
10月7日	金					離日					

ハノイ市エンサ下水処理場整備事業準備調査（PPPインフラ事業）にかかる研修テキストリスト
経営者研修コース

資料番号	資料名
1	横浜市の下水道
2	下水汚泥は資源の宝庫
3	下水道事業中期経営計画2011概要版
4	北部汚泥資源化センター　消化ガス発電設備整備事業
5	改良土プラント　PFI事業　パンフレット
6	日本の下水道及び横浜市の下水道概要
7	下水道事業の経営

集計年月日2011／10／6

クエスチョネア集計／Questionnaire

研修コース名	ハノイ市エンサ下水処理場にかかる幹部研修
受入期間	2011/9/28 ～ 2011/10/7
対象人	6 名

Ⅰ. 研修コース評価 Evaluation of the training course

1. 設定された到達目標とニーズの適合について

Did you find the course objectives appropriate according to the needs of your country or organizatio

← appropriate				inappropriate →	X
5	4	3	2	1	
3	3	0	0	0	0

回答が1、2の場合、改善を要す点 If your answer is 1 or 2, what kind of improvement should be

2. カリキュラム評価 Evaluation of the curriculum

(1) 研修プログラムで最も有益であった研修項目

Please name the most beneficial subject in the training program.

・各下水処理場や横浜環境創造局での視察と質疑応答 (Ms.トゥアン) (Ms.ヒエン) (Mr.ナム)
・汚泥集中処理場での視察。(Mr.ミン)
・横浜環境創造局での視察と質疑応答や各下水処理場での視察、札幌市の下水道科学館での視察。(Mr.クオン)
・水再生技術や高度処理技術／汚泥処理技術や排出資源の有効活用 (Ms.オアン)

(2) 今後追加すべき研修項目

Please write the subject that should be added to the training program.

・下水処理場の計画過程や計画的な運営内容／下水処理場整備の計画・投資・建設過程における課題等／下水使用量徴収の課題／環境教育の実施内容(Mr.クオン)

(3) 今後削除すべき研修項目

Please write the subject that should be eliminated from the training program.

3．研修期間について Did you find the duration of the program appropriate?

← appropriate				inappropriate →	X
5	4	3	2	1	
2	3	1	0	0	0

回答が1、2の場合、その理由 If your answer is 1 or 2, please describe the reasons.

4．講師の講義プレゼンテーションについて

What is your evaluation of the presentation by the lecturers in the program?

← good				poor →	X
5	4	3	2	1	
3	3	0	0	0	0

回答が1、2の場合、その理由 If your answer is 1 or 2, please describe the reasons.

5．テキスト、研修機材、講義施設について

What is your evaluation of the textbooks, training equipment, and lecture facilities of the program?

	← good				poor →	X
	5	4	3	2	1	
テキスト／ **textbooks**	3	3	0	0	0	0
研修機材／ training equipment	5	0	0	0	0	1
講義施設／ **lecture facilities**	5	0	0	0	0	1

回答が1、2 の場合、その理由 If your answer is 1 or 2, please describe the reasons.

6．研修運営管理について

What is your evaluation of the general administration and management of the training program?

	← good				poor →	X
	5	4	3	2	1	
JICA	4	2	0	0	0	0
受入機関／ training institution	4	2	0	0	0	0
コーディネーター／ coordinator	5	1	0	0	0	0

7．期待充足度 Did the training meet your expectations?

← satisfied				unsatisfied →	X
5	4	3	2	1	
4	2	0	0	0	0

回答が1、2の場合、その理由 If your answer is 1 or 2, please describe the reasons.

8. 到達目標達成度 Evaluation of level of objective accomplishment

(1) 到達目標1 Objective 1

ハノイ市の適正な下水処理の促進

到達目標1の達成度 Did you achieve objective 1?

	← 十分達成できている fully achieved			達成していない → unachieved		X
	5	4	3	2	1	
研修実施前／ before the traininbg	0	2	2	0	0	2
研修実施後／ after the training	4	2	0	0	0	0

回答が3、4、5の場合、今回の研修で得た情報・知識は、業務に活用可能か。

If your answer is 3,4,or, 5, do you find the information and knowledge obtained through the training program useful to your job in your country?

← 十分活用できる very useful			活用できない → not useful		X
5	4	3	2	1	
5	1	0	0	0	0

回答が4、5の場合、業務おける具体的な活用内容及び方法

If your answer is 4 or 5, please describe how it applies to your job.

・ハノイ市の下水処理整備に適切な投資を選定する業務に活用。(Ms.トゥアン)
・エンサ処理場整備事業や将来には集中汚泥処理場整備事業に応用したい。(Ms.ヒエン)
・下水処理場の運営業務や汚泥処理研究に応用したい。(Mr.ミン)
・エンサ処理場整備事業の促進。具体的には財源確保の方策作り。(Mr.クオン)
・本研修で汚泥の処理方法や排出資源の有効活用方法を修得できた。ハノイ市の汚泥処理における政策提言に活用したい。(Ms.オアン)
・ハノイ市の大規模な下水処理場整備事業の促進に活用したい。(Mr.ナム)

回答が1、2の場合、その理由 If your answer is 1 or 2, Please describe the reasons.

Ⅱ.その他 Others

1. JICAのブリーフィングについて　What is your evaluation of JICA's briefing?

← good				poor →	
5	4	3	2	1	X
3	2	1	0	0	0

回答が1、2 の場合、その理由 If your answer is 1 or 2, please describe the reasons.

2. ジェネラルオリエンテーションについて　What is your evaluation of the general orientation?

← good				poor →	
5	4	3	2	1	X
2	3	0	0	0	1

回答が1、2 の場合、その理由 If your answer is 1 or 2, please describe the reasons.

3. 日本の印象　What kind of impression of Japan did you get through your stay here?

← good				poor →	
5	4	3	2	1	X
6	0	0	0	0	0

(1)回答が1、2 の場合、その理由 If your answer is 1 or 2, please describe the reasons.

(2)回答が4、5 の場合、その理由 If your answer is 4 or 5, please describe the reasons.

・環境保護意識や排水・ごみ資源の活用振り。(Ms.トゥアン)
・関係機関・個人の熱心的な対応で良いインパクトが残る。また、日本人の環境保護意識の高さに感心した。(Ms.ヒエン)
・先端的な技術が導入されていること。日本人は意志が高く、ベトナム人に親近的である。(Mr.ミン)
・日本や日本人に非常に良い印象を覚えている。本研修の関係者も非常に親切であった。日本は近代的な工業先進国だありながら環境保護政策も充実している。(Ms.オアン)
・日本人の仕事に対する姿勢 (Mr.ナム)

4. その他コメント　Any other comments

・ベトナムのリーダーは環境保全の意識を向上し、政策・予算・人材育成等の計画立案に適切に対応すべき。(Ms.トゥアン)
・合理的で切実な要望を応えた今回の研修を調整していただいた関係機関に感謝し、研修中に同行していただいた各個人にもお礼を申し上げたい。ハノイ市にとって下水処理分野は新しい領域であるため、日本の豊富な経験を学ぶ本研修は非常に有益だった。今後ともこのような研修を引き続き継続していただきたい。(Ms.ヒエン)

研 修 実 績 報 告 書

平成24年2月17日

独立行政法人国際協力機構
契約担当役 小寺清 殿

受託機関 横浜ウォーター株式会社
代表者 代表取締役
五十川 健郎 印

1 コース概要

(1)案件名(和文／英文): ハノイ市エンサ下水処理場にかかる実務者研修
Training of Sewerage Management for Hanoi People Committee (Engineer Class)

(2)研 修 期 間: 2011 年 10 月 12 日から 2011 年 10 月 25 日まで
(3)研 修 員 人 数: 7 名

2 研修内容

(a)研修全体概念図

ハノイ市において始まったばかりの下水道事業に関し、我が国の優れた下水道技術、事業経営手法を導入し、ハノイ市エンサ下水処理場のPPP事業のためのアクションプランが策定される。

↓

1. ハノイ市と横浜市環境創造局(本研修を弊社と連携して実施している団体)とがハノイ市の抱える問題点についてディスカッションをおこない、双方が理解する。
2. 我が国の自治体の有する下水道運営・管理ノウハウ(水質管理、浸水対策、下水道料金制度を含む)等を学ぶことを通じて、研修員の課題解決に向けた考察、討議等を行う。
3. 我が国の自治体の有する下水道運営、管理ノウハウ(水質管理、浸水対策、下水道料金制度を含む)等に関して、講義のみならず下水道施設等の視察を通して実際の取り組み状況を効果的に学び、研修員の課題に向けた考察を行う。
4. 研修を通して習得した技術等と自国技術等の比較分析により、自国の現状と課題について把握することにより、自国の社会資本への導入・応用が可能となるよう理解を深める

↓

議論した改善策に基づき、ハノイ市の下水道運営改善に向けた具体的な取り組みが開始される。

(b)日程表
別添資料－1 の通り

(c)カリキュラム構成
別添資料－1の通り

3 研修コースに対する所見

(a－1)講義

横浜市環境創造局に主たる講義を依頼し研修を行った。同局は下水汚泥焼却灰の有効利用で我が国初の PFI 事業に取り組むなど、先進的な事業を行っており、ハノイ市の下水道事業展開に向け有意義な講義をすることができたと考える。

－案件目標:ハノイ市において始まったばかりの下水道事業に関し、我が国の優れた下水道技術、事業経営手法を導入し、ハノイ市エンサ下水処理場のPPP事業のためのアクションプランが策定される。
－指 標:研修実施後の期待充足度では全員が 5 点と評価している。
－達 成 度 :研修員 7 名中全員が 5 点と評価しており、目標は達成された。

	← ← 達成				未達成→ →	無回答	平均点
	5 点	4 点	3 点	2 点	1 点		
期待充足度	7 人	0 人	0 人	0 人	0 人	0 人	5

（a－2） 達成度測定結果

ア． クエスチョネア集計結果

	←十分達成できている				達成していない→	無回答	平均点
	5 点	4 点	3 点	2 点	1 点		
研修実施前	1 人	3 人	0 人	3 人	0 人	0 人	3.3
研修実施後	5 人	2 人	0 人	0 人	0 人	0 人	4.7

(b)討論・実習・演習・発表

(ア)キックオフ・ディスカッション

研修員と環境創造局職員、水道局職員及び横浜ウォーター職員が参加してディスカッションを行い、双方の下水道事業の状況確認を行った。確認項目は、事業概要、公共用水域の水質の状況、分合流方式の採用状況、使用料徴収方法、PR等である。

上記確認事項を基に横浜市側からハノイ市が抱える現状の問題点に関しアドバイスを行った。アドバイスを行った主な項目は下記の通りである。

・下水道に求められる役割の歴史的変遷について
・合流式下水道の改善について
・下水処理方式の選定について
　特に標準法、回分法の選定について
・高度処理について
・汚泥の集約処理及び有効利用について
・浸水対策について
・下水道の経営について
・下水道使用料の徴収について

(イ)ファイナル・ディスカッション

今回の研修の成果について、研修員と環境創造局職員、水道局職員及び横浜ウォーター職員が参加してディスカッションを行った。研修員から下記のような感想、意見があった。

・日本の下水処理技術が高度に発達していることを理解した。特に、高度処理、汚泥処理が参考になった。
・日本では環境に対する意識を高める工夫が行われている。ハノイでも参考にしたい。
・日本では汚泥処理、下水処理が段階的に技術の応用がされていて参考になった。
・日本ではエネルギーの活用、汚泥のリサイクルなどの技術が進んでいる。
・ハノイは標高が低い。ポンプ場を設置しないと雨水排水が難しい。日本の技術をどのように導入すればよいか研究したい。

(c)見学

横浜市を始め、京都市、大阪市の下水道処理施設を視察した。京都、大阪では横浜市の処理方法と異なる処理法（3W法など）を採用している施設を視察した。研修員は幅広く下水処理技術に関する知見を修得できたと考える。

(d)研修期間・配列・密度

①研修期間

研修員がハノイ市の下水道実務技術者であることから、我が国及び横浜市下水道事業の具体的事例を把握できるよう二週間の研修期間を設定した。研修期間に対する研修員の評価は 4.9 であり、研修員の期待に添った期間設定ができたと考える。

②研修内容・密度

今回の研修は、我が国及び横浜市下水道事業の具体的事例の把握を主眼に設定した。評価会において研修員から下記のような要望があった。

・運転の実務に関わる職員から経験談などを聞く機会を設けてほしかった。

・PPPの枠組みなどについての講義をしてほしかった。
これらの点については次年度以降改善に取り組みたい。

4 研修員

(a)研修参加への意欲・受講態度

自国の下水道をよりよくしようとする態度がうかがわれ、日本の下水道技術・制度などを熱心に吸収しようとしていた。受講態度は良好であった。

なお、研修員から以下のような指摘があった。

①今回の研修の内容は現状のベトナムに導入するには難しいものもあった。
②実際の運転実務に関わる職員からの経験談などを聞く機会を設けてほしかった
③PPPの枠組みなどについての講義をしてほしかった

また、研修員は下水道使用料金徴収方法、下水処理の効果のPR方法、市民の環境意識を高める工夫などに関する関心が高かった。

これらの指摘や関心の高い事項について環境創造局と調整を図り、取り組みのできる事項から順次研修に取り入れていきたい。

5 研修成果の活用

(a)研修で得られた成果について

横浜市環境創造局に主たる講義を依頼し研修を行った。同局は下水汚泥焼却灰の有効利用で我が国初のPFI 事業に取り組むなど、先進的な事業を行っており、研修員は下水道技術・制度など広範囲に知見を修得したと考える。

(b)成果の活用方法について

研修から得られた知見に基づき、ハノイ市の下水道運営改善に向けた具体的な取り組みが開始されるものと考える。

ファイナル・ディスカッションでは、研修員から日本の下水道技術を高く評価する発言が多くあった。今後も継続的に研修を実施することによりさらに日本の下水道技術・制度の活用が広まると考えられる。

6 研修環境

別添資料－1の通り

添付資料

(1)研修日程 別添資料-1

(2)研修員リスト 別添資料-2

(3)テキストリスト 別添資料-3

(4)クエスチョネア集計票 別添資料-4

(5)研修員評価表 別添資料-5

研 修 写 真 集 (1/3)

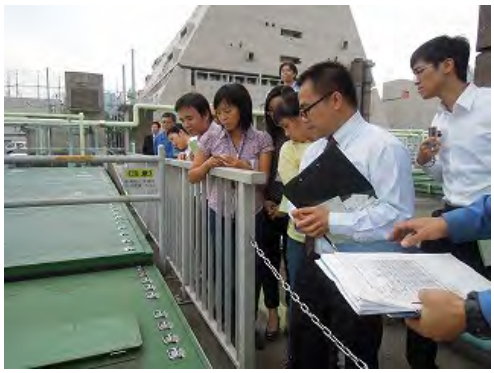
環境創造局課長挨拶(10/13)

キックオフ・ディスカッション(10/13)

キックオフディスカッション(10/13)

日本及び横浜の下水道概要講義(10/14)

神奈川水再生センター視察(10/14)



神奈川水再生センター(10/14)

1. 京都市鳥羽水環境保全センター視察(10/17)

琵琶湖疏水視察(10/17)

研 修 写 真 集 (2/3)

大阪市津守下水処理場視察　3W 講義(10/18)

大阪市津守下水処理場視察(10/18)

北部第二水再生センター視察 (10/19)

北部第二水再生センター視察」(10/19)

北部汚泥資源化センター視察(10/19)

北部汚泥資源化センター視察(10/19)

北部汚泥資源化センター視察(10/19)

高度処理について講義(10/20)

研 修 写 真 集 (3/3)

管渠の維持管理について講義(10/20)

新羽末広幹線建設現場視察(10/21)

平戸永谷川調整池視察(10/21)

ファイナル・ディスカッション (10/24)

閉講式(終了証授与)(10/24)

閉講式:修了証授与 (10/24)

研修工程実績表　ハノイ市エンサ下水処理場 整備事業準備調査　実務者研修

2013/2/19

月日	曜日	時刻			形態	研修内容	講師又は見学先担当者等		研修場所・移動行程	講義内容	備考
							氏名(敬称略)	所属先及び職位			
10月12日	水					来日					
10月13日	木	09:30	～	12:00	講義	オリエンテーション		JICA	JICA横浜		
		13:30	～	16:00	討議	横浜市の下水道事業について意見交換会 （下水道管きょの維持管理をメインテーマに）	高瀬行廣 川島清隆 高橋浩二 城間菊次 大狭間誠	政策課 管路保全課 管路整備課	関内中央ビル 3B協議室	意見交換小テーマ 〇公共下水道管きょの改良、修繕、清掃等の維持管理(管路保全課) 〇公共下水道台帳の作成（日常及び将来の保守・補修）	
10月14日	金	09:30	～	10:50	講義	日本の下水道及び横浜市下水道事業の概要	大狭間誠	政策課	関内中央ビル 3B協議室		
		11:00	～	12:00	講義	横浜市の下水道経営	増田　潤	下水道事業推進課	関内中央ビル 3B協議室		
		13:30	～	16:00	視察	神奈川水再生センターにおける運転維持管理	鈴木延吉	神奈川水再生センター	神奈川水再生センター	下水処理区域、水処理の仕組み、運転に費やす職員や勤務体制、運転維持管理の方法について、対応マニュアルについて、流入水量や水質特性、管理状況把握に必要なデータの取得について	
10月15日	土					休日					
10月16日	日					移動					
10月17日	月				視察	京都市鳥羽水環境保全センター視察・琵琶湖疏水視察	片山博王				
10月18日	火				視察	大阪市津守下水処理場視察	白井久順				
10月19日	水	09:30	～	12:00	視察	北部第二水再生センター	前田賢二	北部下水道センター（水再生）	北部第二水再生センター	適切なリン・窒素の除去=高度処理の運転管理、水質改善、光ファイバーによる遠隔監視、中央監視システムの実施、上部利用について、運転維持管理の方法について、マニュアルについて	
		13:30	～	16:00	視察	北部汚泥資源化センター	及川隆仁	北部下水道センター（汚泥）	北部汚泥資源化センター	運転・維持管理、マニュアルについて、下水道資源の有効利用	
10月20日	木	09:30	～	12:00	講義	横浜市の高度処理について	中村英二	下水道水質課	JICA横浜		
		13:30	～	16:00	講義	下水道管きょの維持管理基準について	川島清孝	管路保全課	JICA横浜	公共下水道管きょの改良、修繕、清掃等の維持管理に係る計画・調査等	
10月21日	金	09:30	～	12:00	講・視	新羽末広幹線における浸水対策について	城間菊次	管路整備課 北部下水道建設事務所	北部建設事務所・新羽末広幹線	横浜市の浸水被害対策(全体講義) 新羽末広幹線視察	
		13:30	～	16:00	講・視	今井川調整池における洪水対策、河川管理、河川監視について	岩山剛	道路局　河川計画課	今井川調整池	治水・洪水環境保全対策	
10月22日	土					休日					
10月23日	日					休日					
10月24日	月	09:30	～	12:00		研修評価会準備		JICA	JICA横浜		
		13:30	～	16:00	討議	下水処理施設の運転・維持管理について意見交換	政策課　　大狭間誠 下水道設備課　吉見補佐 下水道設備課　土屋職員	政策課 下水道施設管理課 下水道設備課	関内中央ビル 3B協議室		
10月25日	火					離日					

ハノイ市エンサ下水処理場整備事業準備調査（PPPインフラ事業）にかかる研修テキストリスト
実務者研修コース

資料番号	資料名
1	横浜市の下水道
2	下水汚泥は資源の宝庫
3	下水道事業中期経営計画2011概要版
4	管路の維持管理
5	全国の処理方式
6	日本の下水道及び横浜市の下水道概要
7	下水道事業の経営
8	神奈川水再生センターの概要
9	横浜市の高度処理
10	新羽末広幹線について
11	横浜市の河川事業
12	横浜市河川事業の概要
13	横浜市の治水事業

集計年月日 2011／10／22

クエスチョネア集計／Questionnaire

研修コース名	ハノイ市エンサ下水処理場にかかる実務者研修
受入期間	2011／10／12　～　2011／10／24
対象人	7名

Ⅰ．研修コース評価 Evaluation of the training course

1．設定された到達目標とニーズの適合について

Did you find the course objectives appropriate according to the needs of your country or organizatio

⇦ appropriate				inappropriate ⇨	X
5	4	3	2	1	
4	3	0	0	0	0

回答が1、2の場合、改善を要す点 If your answer is 1 or 2, what kind of improvement should be r

2．カリキュラム評価 Evaluation of the curriculum

(1) 研修プログラムで最も有益であった研修項目

Please name the most beneficial subject in the training program.

・高度処理技術講義／下水処理所・汚泥集中処理場での視察。(Ms.トゥイ) (Mr.ヒュー) (Ms.フォン)
・汚泥処理技術／資源再利用技術。(Mr.チュン)
・日本の各下水処理場の運転技術。(Ms.アン)
・高度処理技術。(Ms.タイ)
・鳥羽水環境保全センターでの視察。(Ms.タム)

(2) 今後追加すべき研修項目

Please write the subject that should be added to the training program.

・設備機器の維持管理工程。(Mr.チュン)
・下水処理に関連する環境教育。(Ms.アン)
・日本よりインフラ整備が遅れている国に対して、下水処理技術の選択肢を提案する。(Ms.タイ)

(3) 今後削除すべき研修項目

Please write the subject that should be eliminated from the training program.

3．研修期間について　Did you find the duration of the program appropriate?

⇐ appropriate				inappropriate ⇒	X
5	4	3	2	1	
6	1	0	0	0	0

回答が1、2の場合、その理由　If your answer is 1 or 2, please describe the reasons.

4．講師の講義プレゼンテーションについて

What is your evaluation of the presentation by the lecturers in the program?

⇐ good				poor ⇒	X
5	4	3	2	1	
5	2	0	0	0	0

回答が1、2の場合、その理由　If your answer is 1 or 2, please describe the reasons.

5．テキスト、研修機材、講義施設について

What is your evaluation of the textbooks, training equipment, and lecture facilities of the program?

	⇐ good				poor ⇒	X
	5	4	3	2	1	
テキスト／ **textbooks**	5	2	0	0	0	0
研修機材／ training equipment	6	1	0	0	0	0
講義施設／ **lecture facilities**	6	1	0	0	0	0

回答が1、2 の場合、その理由　If your answer is 1 or 2, please describe the reasons.

6. 研修運営管理について

What is your evaluation of the general administration and management of the training program?

	⇐ good				poor ⇒	X
	5	4	3	2	1	
JICA	6	1	0	0	0	0
受入機関／ training institution	6	1	0	0	0	0
コーディネーター／ coordinator	7	0	0	0	0	0

7. 期待充足度 Did the training meet your expectations?

⇐ satisfied				unsatisfied ⇒	X
5	4	3	2	1	
7	0	0	0	0	0

回答が1、2の場合、その理由 If your answer is 1 or 2, please describe the reasons.

8. 到達目標達成度 Evaluation of level of objective accomplishment

(1) 到達目標1 Objective 1

ハノイ市の適正な下水処理の促進

到達目標1の達成度 Did you achieve objective 1?

	← 十分達成できている fully achieved			達成していない → unachieved		X
	5	4	3	2	1	
研修実施前／ before the traininbg	1	3	0	3	0	0
研修実施後／ after the training	5	2	0	0	0	0

回答が3、4、5の場合、今回の研修で得た情報・知識は、業務に活用可能か。

If your answer is 3,4,or, 5, do you find the information and knowledge obtained through the training program useful to your job in your country?

← 十分活用できる very useful				活用できない → not useful	X
5	4	3	2	1	
5	2	0	0	0	0

回答が4、5の場合、業務おける具体的な活用内容及び方法

If your answer is 4 or 5, please describe how it applies to your job.

・ハノイ市の下水処理業務に活用する。(Ms.トゥイ)
・ハノイ市の下水処理場の処理技術を向上する。(Mr.チュン)
・下水処理場の新人教育に模型を使った教育手法。高度処理の導入研究。(Ms.アン)
・ハノイ市の下水処理場計画や建設業務に活用する。(Mr.ヒュー)(Ms.フォン)
・下水処理の専門を深める。(Ms.フォン)
・ハノイ市の下水処理事業における諮問業務に適切な判断ができる。(Ms.タイ)
・下水処理場の管理業務の専門性・効率性を高める。／3W技術や有機炭素増加技術の研究。(Ms.タム)

回答が1、2の場合、その理由 If your answer is 1 or 2, Please describe the reasons.

Ⅱ.その他 Others

1. JICAのブリーフィングについて　What is your evaluation of JICA's briefing?

⇐ good				poor ⇒	X
5	4	3	2	1	
4	3	0	0	0	0

回答が1、2 の場合、その理由　If your answer is 1 or 2, please describe the reasons.

2. ジェネラルオリエンテーションについて　What is your evaluation of the general orientation?

⇐ good				poor ⇒	X
5	4	3	2	1	
4	3	0	0	0	0

回答が1、2 の場合、その理由　If your answer is 1 or 2, please describe the reasons.

3. 日本の印象　What kind of impression of Japan did you get through your stay here?

⇐ good				poor ⇒	X
5	4	3	2	1	
6	1	0	0	0	0

(1)回答が1、2 の場合、その理由　If your answer is 1 or 2, please describe the reasons.

(2) 回答が4、5 の場合、その理由　If your answer is 4 or 5, please describe the reasons.

・日本は平和的で親近感が溢れて、近代的である。(Ms.トゥイ)
・日本の環境は非常に清潔である。国や国民の環境対策はとても優れて、資源の再利用は効率的である。(Mr.チュン)
・清潔な環境。便利な交通システム。日本人はマナーが良い。(Ms.アン)
・日本の下水処理システムはとても近代的で清潔な環境を確保している。(Mr.ヒュー)
・すばらしい国である。(人々、インフラ整備、交通網、下水処理排水システム等) (Ms.フォン)
・日本は環境に対して非常に配慮している。日本人はとても丁寧で外国人、とりわけベトナム

4. その他コメント　Any other comments

・日本の下水処理・排水分野における技術を是非学習したい。(Ms.フォン)