添付資料1

DENR-EMB Environmental Research & Lab Services Division

Environmental Management Bureau
Environmental Research and Laboratory Services Division

Standard Operating Procedures and Other Activities on the Dioxins Analysis Component (JICA TC Project)

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DENR-EMB Environmental Research & Lab Services Division

OUTLINE

- Contents of the SOPs of EMB CO for DF analysis
- Overview of the SOPs and the discussions with OP3 Expert Team Members
- Ways forward of ERLSD

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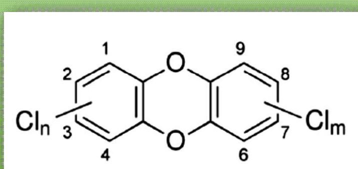
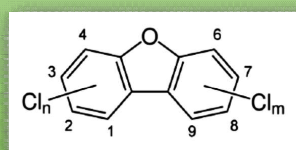


Polychlorinated dibenzo-p-dioxins (PCDDs)



Polychlorinated dibenzofurans (PCDFs)

PCDDs	PCDFs
75 congeners	135 congeners
"Dioxins"	"Furans"
2,3,7,8-TCDD as the most toxic congener	Tend to co-occur with PCDDs

17 priority congeners (7 PCDDs, 10 PCDFs)

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ERLSD SOPs

TEST METHOD

Document No. OLU-Test-009
Revision No. 0 | Page 1 of 37
Effectivity Date:
Subject: Determination of Polychlorinated Dibenzo-*p*-dioxins (PCDDs), Polychlorinated Dibenzofurans (PCDFs) in Ambient Air by High Resolution Gas Chromatography with Magnetic Sector Mass Spectrometer

TEST METHOD

Document No. OLU-Test-013
Revision No. 0 | Page 1 of 37
Effectivity Date:
Subject: Determination of Polychlorinated Dibenzo-*p*-dioxins (PCDDs), Polychlorinated Dibenzofurans (PCDFs) in Stationary Source Emissions by High Resolution Gas Chromatography with Magnetic Sector Mass Spectrometer

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ERLSD SOP Sections:

1. Principle
2. Interferences
3. Sample Storage and Preservation
4. Materials and Apparatuses
5. Equipment
6. Reagents and Standards
7. Procedure
8. Calculations
9. Reporting of Results
10. Quality Control
11. Health and Safety
12. Waste Handling and Disposal
13. Relevant Records
14. References
15. Distribution of Copies
16. Appendices

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Certification Process of Sampling Materials for Dioxins and Furans in Ambient Air and Stationary Source Emissions

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Cleaning and Certification of Cleanliness of Sampling Materials Prior to Dispatch

Cleaning of PUFs, Resins and Filters
- Sequential extraction with solvents (Soxhlet Extraction)
- Furnacing of filters

→ **Removal of trace solvent**
- Vacuum Oven under nitrogen atmosphere

→ **Extraction of a pair of PUF and Filter (or resin and filter)**
- Soxhlet Extraction with Toluene after spiking with labelled-compounds

→ **Concentration and micro-evaporation**
- Rotary Evaporation
- Nitrogen Blowdown

→ **GCHRMS Analysis**
- Quantitation
- Evaluation if permissible levels were met

Furnacing: at 400 degrees Celsius for at least five (5) hours

Extraction conditions: 16-24 hours with toluene @3-4 cycles/hour

Evaluate based on US EPA TO-09A and Method 23 requirements

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1. Cleaning through Soxhlet Extraction

2. Evaporation of residual solvent

Treat representative filter/ PUF or filter/resin from the batch as sample to be analyzed for DFs

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Notes on cleaning time: 22 hours extraction with toluene; 3 hours with acetone (for PUFs)

8 hours with water, 22 hours with methanol, 22 hours with methylene chloride, 22 hours with toluene (for XAD-2 Resin)

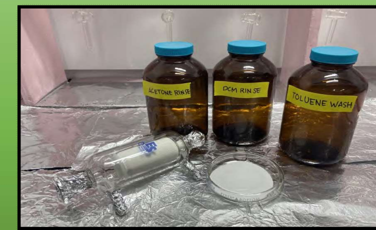
Analysis Process for Ambient Air and Stationary Source Emissions

Ambient Air

PUF and QFF

Reference: US EPA Method TO-09A

Stationary Source Emissions



XAD-2 resin, GFF, Solvent Rinses

Reference: US EPA Method 23

Analysis Phase 1: Extraction of Samples

Manual Soxhlet Extraction – for Ambient Air samples

Extraction conditions: 16-24 hours with toluene @3-4 cycles/hour

(followed by Rotary Evaporation and Solvent Exchange)

Analysis Phase 1: Extraction of Samples

Pressurized Fluid Extraction – for stationary source emissions

Conditions: GFF and XAD-2 resin extracted with PFE using toluene

(followed by Rotary Evaporation and Solvent Exchange)

Note: Solvent rinses are concentrated separately by rotary evaporation and combined with PFE extracts before solvent exchange

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Analysis Phase 2: Cleanup of Sample Extracts

Automated Cleanup (LC Tech)

Columns used:
Positions (1) and (2) are Silica gel columns

Positions (3) and (4) are Carbon Columns

Solvents:
Toluene
Dichloromethane
Hexane

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Analysis Phase 2: Cleanup of Sample Extracts

Manual Cleanup (Silica and Carbon)

Columns used:
Multi-layer acidic silica column: 20% and 40% acidic silica

Carbon Column procured from Kanto Chemical Corp.

ERLSD also has Cape Columns and Cleanup techniques based on previous trainings

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Analysis Phase 3: Concentration and Micro-evaporation

Rotary evaporation of purified extracts

Nitrogen blowdown from conical tube to GC vial: All transfers are facilitated with rinsing to ensure quantitative transfer

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Analysis Phase 4: GC-HRMS Analysis

Columns used: DB-5 and ZB-Dioxins; Instrument Program was developed to meet the criteria for isomer specificity and window-defining tests as required by the reference methods. Additional qualification on peak identification (e.g., signal-to-noise ratios, relative retention time, relative response factors, etc.) are also based on the requirements of US EPA Method 23, Method 1613 and Method TO-09A.

QA/QC REQUIREMENTS

QC TOOLS
Method Blank
Laboratory Surrogate Compound Recoveries
Field Surrogate Recoveries
Mass Resolution, Ion Abundance Ratios
Initial Calibration
Instrument Blanks
CRM analysis
Calibration Verification
Proficiency Testing

Ways Forward:

(1) Monitor contamination levels in the Dioxins laboratory workrooms and enhance practices to prevent possible cross-contamination in the lab.

(2) Procure new LC Tech columns and determine optimum LC Tech conditions to increase recovery rate of ^{13}C-labelled compounds used for isotope dilution.

(3) Verify the viability for use of the cleanup method introduced by JET considering the acquisition of the required glassware and resources.

(4) Analyze the procured fly ash Certified Reference Material for low-level dioxins and furans as representative of stationary source emissions.

(5) Continually conduct Method Verification activities to include spiking of cleaned PUFs and QFF for ambient air DF analysis.

(6) Complete the renovation of the three (3) additional workrooms for organic analyses in the EMB CO laboratory, one of which will be for a second GCHRMS unit.

(7) Acquire a second GC-HRMS equipment to enhance efficiency of DF testing services.

(8) Include Dioxins and Furans analysis in the scope of the parameters to be applied for ISO/IEC 17025 accreditation.

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Thank you for your attention!

JCC Meeting
for

Output 4: Enhancement of The National Government's Capacity to identify issues and provide suggestions/recommendations for other SWM technologies other than WTE

The Technical Cooperation Project (TCP) for Capacity Development on Improving Solid Waste Management (SWM) through Advanced/Innovative Technologies

Activity of Output4

Output 4
National Government's and target LGUs' capacity to **identify issues and provide suggestion/recommendation for other SWM technologies** than WTE is enhanced.

Specific activities

4.1 **Grasp the current situation** by National SWM strategy and 10 year SWM plan in the target LGUs.

4.2 **Identify the current issues** for other SWM technologies in the target LGUs.

4.3 Collect the information of **"Good practice/Good technology" of other SWM technologies in Japan/third world countries**.

4.4 **Summarize and provide suggestion/recommendation** to improve utilization of other SWM technologies to target LGUs.

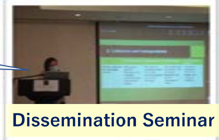
Done on 8th Sep!

4.5 **Seminar** for disseminating suggestion/recommendation is held.

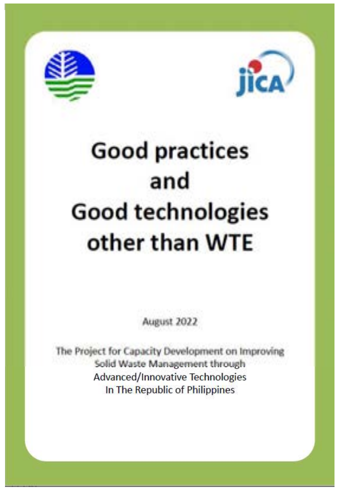

Quezon City


Davao City

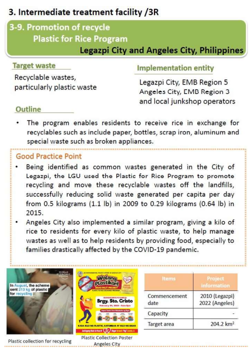

Cebu City


Dissemination Seminar

Booklet of Good Practice and Good Technology



Purpose: To expand and continuously implementation of Output4 activities.
Contents: Good example of SWM other than WTE form the Philippines and other countries.



Recommendations on the Sustainability Plan

Objectives of the Plan

1) To maintain the outcomes of the project

2) To supplement insufficient achievements in the project period

3) To continue the further improvements using the project outcomes to achieve the overall goal of the project

4) To expand the impact of the project to all regions of the Philippines

Structure of the Sustainability Plan

1. Actions to achieve overall goal

- To satisfy the OVI of the overall goal, which will be evaluated by JICA ex-post Evaluation after the project

2. Monitoring Plan from the end of the Project

- Monitoring the implementation of the exit strategy and the continuation of the capacity development
- Monitoring frequency, institutions responsible, monitoring method, and targeted completion month/year to be specified

3. Plan of Operation and Implementation Structure

- How to implement, continues the actions to sustain and improve the project outcome
- Required actions, institution responsible, implementation method, target date to be specified.

1. Actions to achieve overall goal

Overall Goal	Objectively Verifiable Indicators
Improvement of Philippine SWM system through the adoption of WTE and other SWM technologies	1) The outputs of the Project are utilized by more than one LGU. 2) Recommendation by the Project is reflected in the National SWM strategy (2023-28). 3) Result of dioxins analysis is reported in the annual report of EMB.

Indicator 1. Utilization of the technical deliverables for the WTE in LGUs

1) Formalize the technical deliverables such as “BAT/BEP guidelines”, “WTE technical standard (as JAO), PFEC manual

2) Maintain ITWG to discuss/share the WTE projects in LGUs

3) Supports to LGUs to formulate and monitor their WTE project, to get feedback to improve the technical deliverables above mentioned

1. Actions to achieve overall goal

Indicator 2. Reflect recommendations of the project in the National Waste Management Strategy (2023-28)

DENR to suggest NSWMC to reflect the following into the National SWM strategy

a. Reflection in the national strategy of the following and other benefits of waste treatment by WTE
- Sanitary waste treatment
- Waste volume reduction in particular in metropolitan areas to extend the life of final disposal facilities and reduce final disposal capacity requirements
- Applicability of PPP scheme
- Effectiveness in combating plastic waste runoff

b. Reflection of conditions of WTE applicability
- Conditions under which WTE can be applied, such as waste disposal scale, dominant technology, etc. (formulate BAT/BEP guidelines by utilizing information from case studies)
- Appropriate amount of waste tipping fees
- Waste management options in the cities where the above benefits (a) outweigh the cost burden

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1. Actions to achieve overall goal

Indicator 3. Publish the result of dioxins analysis in the annual report of EMB

a. Continuation and accomplishment of incomplete project activities

b. Establishment and publication of annual plan for dioxin analysis project

c. Monitoring and publication of the monitoring results based on the above annual plan (Annual report)

2. Monitoring Plan from the end of the Project

Result of Monitoring shall be quarterly reported to the all member institutions of ITWG as well as JICA Philippines by the secretariat of the ITWG.

Item	Frequency	In charge	Reporting	Target date
Output1				
Formalization of the BAT/BEP case study by DENR, PFEC manual	Monthly	EMB/ SWMD	ITWG meeting	March 2023
Formalization of the technical standards as JAO	Monthly	EMB/ SWMD	ITWG meeting	June 2023
Update DAO2013-22 for hazardous waste management	Quarterly	EMB/ HWMS	EMB-EPTWG	June 2023
Update the regulation of sanitary landfill for MSW	Quarterly	EMB/ SWMD, HWMS	EMB-EPTWG	June 2023
Amend the annotated outline for 10-year SWM plan	Quarterly	EMB/ SWMD	NSWMC Exe-com	June 2023

2. Monitoring Plan from the end of the Project

Item	Frequency	In charge	Method/ Reporting	Target date
Activation of NEC to technically support LGUs	Quarterly	SWMD	ITWG meeting	September 2023
Update DAO2013-22 for hazardous waste management	Quarterly	HWMS	EMB-EPTWG	December 2023
Update the regulation of sanitary landfill for MSW	Quarterly	SWMD/HWMS	EMB-EPTWG	December 2023
Output2				
Update 10-yr plan to include WTE project	N/A	Cebu City	NSWMC meeting	March 2023
Issue of PPP-SWMD guide	Quarterly	PPPC	ITWG meeting	June 2023

2. Monitoring Plan from the end of the Project

Item	Frequency	In charge	Method/ Reporting	Target date
Confirm/discuss the WTE projects in LGUs	Quarterly	ITWG (lead by DOE, PPPC)	ITWG meeting	December 2025 (3yrs after the project)
Output4				
Formalize and publish and upload the booklet of good practices of SWM technologies	Quarterly	EMB-EEIE	Upload and publish	Mar. 2023

2. Monitoring Plan from the end of the Project

Item	Frequency	In charge	Method	Completion target date
Output3				
Follow up of Activity3-4 - Satisfying all the requirements for the initial performance test prescribed in the EPA method	Quarterly	ERLSD	Report from ERLSD	Mar. 2023
Follow up of Activity3-6 - Ambient air: Regular monitoring of dioxins and furans for 10 samples/month	Quarterly	AQMS and ERLSD	Analysis results	Sept. 2023 (can be started only after activity 3-4)
Follow up of Activity3-6 - Stack emission: Regular monitoring of dioxins and furans analysis at ERLSD at least 8 samples/year (factories with measurement obligation)	Quarterly	ERLSD	Analysis results	Sept. 2023 (can be started only after activity 3-4)

3. Plan of Operation and Implementation Structure

Item	In charge	Method	Target date
Before operation			
Preparation and finalization of the sustainability plan	EMB/ SWMD	Draft and confirm the plan by ITWG	Feb. 2023
WTE/SMW			
1) Decision of the leading institution responsible for promotion of the WTE-ACC	ITWG	Discussion, vote?	Mar. 2023
2) Policy on the cost sharing, subsidy to WTE/WTF of LGUs	Institution decided in 1)	TBD	Dec. 2023
3) Technical support to evaluate the WTE-ACC projects of LGUs (Solicited approach)	PPPC, DOE	Technical support	Mar. 2023 – Dec .2025

3. Plan of Operation and Implementation Structure

Item	In charge	Method	Target date
4) Organize/activate the NEC (National Ecology Center) or alternate organization to technically support LGUs	NSWMC or ITWG	DENR SO?	Dec. 2023
5) Technical support to evaluate the WTE-ACC projects of LGUs (Solicited approach)	Organization decided in 4)	Technical support	Dec. 2025
6) Compile lessons from technical supports to LGUs conducted by 3) and 5)	EMB/SWMD, DOE, PPPC, DOST	Monitor and evaluate result of Item3) and 5)	June 2025
7) Update the technical deliverables of the TCPs based on the experiences of WTE in the target LGUs	EMB/SWMD		Dec. 2025

3. Plan of Operation and Implementation Structure

Item	In charge	Method	Target date
Dioxin analysis			
1) Formulate the annual plan of dioxins and furans monitoring for ambient air	AQMS, ERLSD	Planning and authorizing in EMB	Jan. 2025
2) Prepare and publish the annual report of dioxins and furans monitoring for ambient air	AQMS, ERLSD	Publish	2026 (as part of EMB annual report)
3) Receiving the self monitoring reports including dioxins and furans analyzed at ERSLD from the factories	AQMS	Receiving the self monitoring reports	Mar. 2024 (as a part of self monitoring report)

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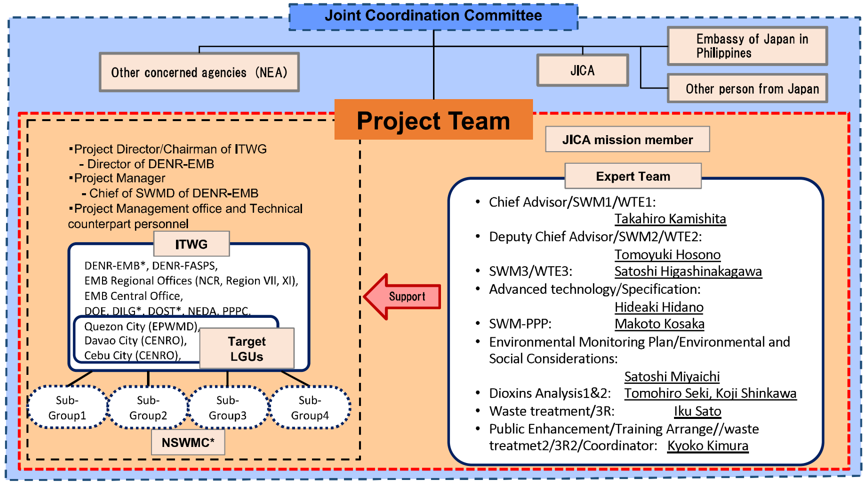
3. Implementation Structure

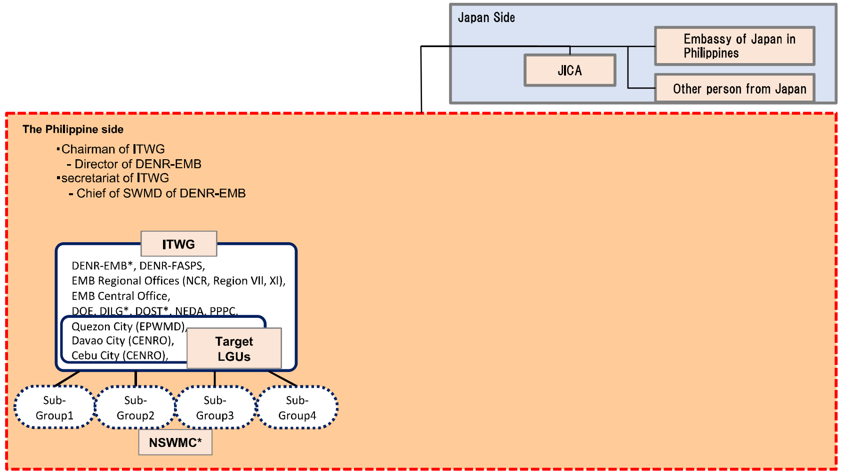
Implementation structure of the TCP



*NSWMC: DENR, DOH, DA, MMDA, DOST, DILG, DPWH, DTI, TESDA, PIA, LCP, LMP, LPP, LnB, NGO, Recycling Industry, Manufacturing and Packaging Industry

3. Implementation Structure

Implementation structure after the TCP (Recommendation)



*NSWMC: DENR, DOH, DA, MMDA, DOST, DILG, DPWH, DTI, TESDA, PIA, LCP, LMP, LPP, LnB, NGO, Recycling Industry, Manufacturing and Packaging Industry

TCP Accomplishments

JICA Expert Team

Contents

Deliverables and Technical Inputs [Output1]

Category	Title	Approval
Document	Case Study Analysis for Guideline of Best Available Technique/ Best Environmental Practice	ITWG: Nov. 2022 2nd JCC: Dec.2021
	The Technical Standards of Waste-to-Energy Facility on Appropriately Controlled Combustion	ITWG: Nov. 2022 1st JCC: Feb.2021
	Manual for Planning, Formulation, Evaluation, and Contract Management (PFEC) of WTE project	ITWG: Nov. 2022 3rd JCC: today
Input	Recommendations on the NSWMC Annotated Outline for the preparation of the 10-year SWM plans	ITWG: April 2022 presented to NSWMC, May 2022
	Recommendations on the regulations of Sanitary Landfills which my accept WTE ash	ITWG: Nov. 2022
Event	Technical Dissemination Seminar 1, 2,	June and Sep. 2022

Deliverables and Technical Inputs [Output2]

Category	Title	Presentation/Approval
Input	Review and comments on Target LGU's 10 year SWM Plans	Progress Report1: May 2020
	Review and comments on Target LGU's Land Use Plan	Progress Report2: May 2021
	Review and comments on Target LGU's WTE Project Proposals	Progress Report1&2
	Review and comments on LGU projects in PPPC pipeline	July 2021
	Review and comments of the SWM PPP Guide	Oct. 2021
	Review and comments on PPPC Conceptual Framework on SWM PPPs	Finalized 2022
Event	Participation in the PPPC Knowledge Sharing Session	Held in Nov. 2022

Deliverables and Technical Inputs [Output3]

Category	Title	Presentation/Approval
Input	Gap analysis of present EMB capacity and required capacity for environmental monitoring for formulation of TCP training plans	Progress Report1: May 2020
Document	Standard Operation Procedures on Dioxins Analysis	ITWG: Nov. 2022 3rd JCC: today
Event	Conduct of trainings on sampling, analysis, and QA/QC of Dioxins and Furans	After the COVID-19 pandemic, 2022

Deliverables and Technical Inputs [Output4]

Category	Title	Presentation/Approval
Input	Report of identified issues and recommendation/suggestion	Progress Report1: May 2020
Document	Booklet of Good Practices and Good Technologies other than WTE	ITWG: June. 2022 3rd JCC: today
Event	Technical Dissemination Seminar 1, 2,	June and Sep. 2022

Achievements of the Project Purpose

Prospect on the completion of Objectively Verifiable Indicators

Project purpose	Objectively Verifiable Indicators	Current status and prospect on the completion
Project Purpose National government and target LGUs' capacity for improving solid waste management utilizing WTE and other SWM technologies is enhanced.	1. Recommendations are made for the National SWM strategy (2023-28) based on the Project's output. 2. Formulation of WTE project is promoted in target LGUs. 3. The dioxins analysis is periodically implemented.	1. [Completed] Recommendations to NSWMC/DENR were given in the Project Completion Report (PCR). 2. [Partially Completed] Technical assistance for WTE project promotion was provided to the target 3 LGUs. For Davao City LGU, a consultant was employed under the Japan Grant Aid for the WTE project. So, JET provided supports for the construction of a new sanitary landfill for ash disposal to be generated from WTE. For Cebu City LGU, JET reviewed the proposal of a private proponent and pointed out unclear points to be confirmed with the proponent, and also provided guidance on how to set the waste amount to be fed to WTE, which is essential to set the capacity of the facility. For Quezon City LGUs, JET discussed with the previous administration and was requested to provide knowledge on the performance monitoring of WTE. However, it was not done because of the administration change. 3. [Partially Completed] The dioxin analysis is periodically conducted during the project activities. In the sense of a regular environmental monitoring of dioxin, it was not be completed by December 2022.

Output	Objectively Verifiable Indicators	Current status and prospect on the completion
Outputs 1. National government's capacity for supporting and coordinating of LGUs' WTE project is enhanced.	1-1.BAT/BEP guideline and Technical Standard for WTE facility (including Standard for O&M of WTE facility) is endorsed by the Project to DENR-EMB for adoption. 1-2.Manual for planning, evaluation, formulation and Supervision of WTE project is endorsed by the Project to DENR-EMB for adoption.	1-1. [Completed] A case study for BAT/BEP guidelines and a Technical Standard for WTE facility (including Standard for O&M of WTE facility) were completed within the project, endorsed by ITWG/JCC and submitted to DENR-EMB. 1-2. [Completed (most probably)] It is a final stage of Manual endorsement. Upon the endorsement by the ITWG meeting, the endorsement to the DENR was discussed at the final JCC.
2. Target LGUs' capacity for Planning, Evaluation, Formulation and Supervision of WTE project is enhanced.	2-1.Updated 10 year SWM plan which reflected the waste volume reduction target and plan is approved by NSWMC in each Target LGU. 2-2.Compiled experiences of target LGUs' WTE project in PPP scheme are reported to NSMWC.	2-1. [Partly completed] Quezon City have not decided to adopt WTE projects, so their WTE projects are not reflected in the SWM 10-year plan. Cebu City is going to update their 10-year plan upon JVA with the private proponent. Davao City has formulated a 10-year plan that considers the reduction of waste volume by WTE. (Year of approval of SWM plan: QC(2018), CC(2018), DC(2019)). 2-2. [Partly completed] None of the WTE projects in the target 3 LGUs made good progress so far. The issues in WTE project formation and promotion in the Philippines were summarized in the PCR.

Output	Objectively Verifiable Indicators	Current status and prospect on the completion
3. National government's capacity of environmental monitoring for WTE project is enhanced.	3-1.Standard Operation Procedure (SOP) for monitoring, analyzing and QA/QC of Dioxins and Furans in ambient air and source emission gas is endorsed by the Project to DENR-EMB for adoption.	3-1. [Completed (most probably)] The draft SOP by EMB-ERLSD was reviewed by JET and discussed with EMB-ERLSD. Upon the endorsement by the ITWG meeting, the endorsement to the DENR was discussed at the final JCC.
4. National Government's and target LGUs' capacity to identify issues and provide suggestion/recommendation for other SWM technologies than WTE is enhanced	4-1. Report of identified issues and recommendation/suggestion is prepared.	4-1. [Completed] Issues and recommendations regarding waste management technologies other than WTE were described in the progress report.

Project Evaluation by DAC 6 Criteria

DAC 6 Criteria

items	Definition
Relevance	◆ Validity with project implementation (development needs) ◆ Focus on "Beneficiary." Consideration for inclusiveness and equity ◆ Appropriateness of the project plan and logic of approach
Coherence	◆ Consistency with development assistance policies of the Japanese Government and JICA ◆ Synergistic effect/mutual relations with JICA's other projects (technical cooperation, loans, grant aid, etc.) ◆ Complementarity, harmonization, and coordination with other assistance/projects in Japan, other development organizations, etc. ◆ Consistency with global framework (international targets, initiatives, standards, etc.)
Effectiveness	◆ The degree of achievement of target level in target year of expected project outcome (differential results across the groups)
Impact	◆ Positive and negative indirect and long-term effects (systems and norms, people's well-being, human rights, gender equality, and the environment)
Efficiency	◆ Comparisons of planned and actual projects inputs, project period, and project cost
Sustainability	◆ Outlook on sustainability of effects that are realized by the project for aspects of policy/political, institutional/organizational, technical, financial, social & environment, risk, and operation & maintenance

Score of evaluation

1. Low
2. Mostly achieved as planned
3. High
4. Very high

Project Evaluation by DAC 6 Criteria

Relevance: High (Score3)

- <u>The Philippines' development policy, development needs, and the Japanese government's assistance policy toward the Philippines have not changed</u> since before the start of the project.
- However, it was difficult for some institutions of the target groups to participate in the project activities.

Project Evaluation by DAC 6 Criteria

Coherence: Very High (Score 4)

- Strong linkage with the ongoing projects of JICA and the Japanese government.
  - JICA Grassroots Project to Davao City
  - Environmental policy dialogue between the Ministry of the Environment of Japan and DENR
  - Japan Grant Aid for WTE project for Davao City

Project Evaluation by DAC 6 Criteria

Effectiveness: Mostly achieved as planned (Score2)

- Factors affecting the activity schedule
  - i. More than 8 months to establish the JCC and appoint CP members
  - ii. The global spread of COVID-19 caused site work to be halted for 2 years
  - iii. Suspension of dioxins analysis activity due to malfunction of the equipment of dioxins/furans analysis (GC/HRMS)
- LGU's WTE projects status was not appropriate to implement some activities
- Difficulties in coordination with LGUs under confidentiality obligation with the private companies

Difficulties in coordinating with LGUs

LGU	Status of WTE project
Quezon	2018: The Original Proponent(OP) for WTE project was decided. Swiss-challenge process commenced in October. 2019: No comparative proposal was submitted by February. The detailed information of WTE could not be shared with JET because of the confidentiality agreement and lack of MOU(DENR-LGU). Due to change of SWM policy after administration change in June, the procurement process was suspended. 2022: Adoption of WTE project is still pending.
Davao	2019: Japan Grant Aid Project for WTE facility was being progressed. The detailed information of WTE could not be shared with JET because of the confidentiality agreement. 2020: A consultant was hired to conduct F/S under the Grant Aid. The feasibility was not verified. Davao City requested financial support to DENR. 2021: A portion of subsidy was approved by DOF. 2022: The project is still being discussed by NEDA-ICC.
Cebu	2019: OP was decided for MBT project in May. Due to administration change in June, OP was cancelled. A proposal was submitted by a private proponent. JET reviewed and gave comments on unclear points of the proposal. 2020: Communication was not possible due to COVID-19 pandemic. 2022: LGU made JV agreement with the private proponent

Project Evaluation by DAC 6 Criteria

Efficiency: High (Score4)

- Inputs to the project were properly utilized and project purpose are mostly achieved. Therefor, the efficiency is "high" even there were the following circumstances;
  - Pandemic of COVID-19 forced remote work and communication. A decision was made to extend the project period by 9 months in February 2021. Then, the resumption of JET experts' work in the Philippines was delayed until March 2022, which affected the project operation.
  - National government officials, such as the EMB, were very busy and sometimes took a long time to respond to JET, or JETs took the initiative in making technical documents. Joint work with ownership of the Philippines CP personnel was difficult.
  - The knowledge and experience to be obtained from the LGUs' WTE projects as case studies could not be reflected in the National Government's regulations, etc. It was not possible for the target LGUs to actively participate in the project and to respond to the project timely due to unclear decisions on the WTE application to the cities.

Project Evaluation by DAC 6 Criteria

Impact: Mostly achieved as planned (Score2)

- Prospect to achieve Overall Goal is highly depends on the continuation and strengthening of project activities after the project period;
  - To achieve the overall goals, it is required to utilize of the project deliverables in LGUs, to share the knowledge and to update project deliverables
  - To maintain and strengthen the functions of the ITWG
  - For dioxin analysis, the execution of uncompleted activities is a condition for achieving the overall goal.
  - The development of dioxin inventories and environmental standards are expected to be impact of the project.

Project Evaluation by DAC 6 Criteria

Sustainability: Mostly achieved as planned (Score2)

- More improvements were expected based on the anticipated capacity level;
  - Supports to the WTE project of 3LGUs in the Output2 activities were not possible
  - Role of the EMB in WTE projects, which provides administrative guidance for waste management, needs to be clarified
  - Due to delays in the work caused by COVID-19 and other factors, some of Output3 activities were not completed, which will be base of the sustainability.

Aspects to confirm the sustainability (WTE/SWM)

Aspect	Factors of Sustainability	Score
Policy/Political	• Improvement of SWM is critical issue, WTE is an option to be introduced. • Renewable energy is promoted • WTE bills are being discussed	3
Organization of the implementing agency	• Institution leading WTE should be clarified • Organization which can support technical aspects of SWM/WTE such as NEC is needed.	2
Technical capacity of the implementing agency	• Technical capacity to support LGUs are insufficient because such activities were limited in the TCP • Experiences and lessons from LGU WTE projects shall be needed to improve the capacity	2
Financial capacity of the implementing agency	• LGUs' financial capacity are weak so that the cost sharing/support by the NG is required as seen in the preceding countries	2
Environmental and social consideration	• WTE-ACC facility has not been developed in the Philippines. • The project shall be carefully evaluated and managed to avoid social conflicts.	2

Aspects to confirm the sustainability (Dioxin Analysis)

Aspect	Factors of Sustainability	Score
Policy/Political	• Monitoring of dioxin/furans is required and promoted	3
Organization of the implementing agency	• ERLSD and AQMS are in charge. • Necessary human resources can be allocated.	3
Technical capacity of the implementing agency	• Capacity of analysis methodology can be maintained. • Further improvements is required for the regular analysis and monitoring	3
Financial capacity of the implementing agency	• Procurement of new equipment is being prepared. • Fund for consumables for analysis should be maintained.	2
Risk	• Capacity of local service provider would be the key for sustainability	2

Summary of Score of DAC 6 Criteria

Criteria	Score
Relevance	High (3)
Coherence	Very high (4)
Effectiveness	Mostly achieved as planned (2)
Efficiency	High (3)
Impact	Mostly achieved as planned (2)
Sustainability	Mostly achieved as planned (2)

Key Factors Affecting Implementation and Outcomes

1. Promote inter-agency collaboration and coordination
2. Inputs from member institutions of ITWG
3. Utilize long-term experience of WTE operation in Japan
4. Active participation of ERLSD personnel and increase in human resource

Technical Cooperation Project for Capacity Development on Improving Solid Waste Management through Advanced /Innovative Technologies

LESSONS LEARNED and WAYS FORWARD

DAVAO CITY, PHILIPPINES

Technical Cooperation Project for capacity development on improving Solid Waste Management through Advanced/Innovative Technologies :

Participation of Davao City:

OUTPUT 2: Enhancement of Target LGUs' capacity for Planning, Evaluation, Formulation and Supervision of WTE project.

OUTPUT 4: Enhancement of National Government's and target LGUs' capacity to identify issues and provide suggestions/ recommendations for other SWM technologies other than WTE.

DAVAO CITY, PHILIPPINES

Technical Cooperation Project for capacity development on improving Solid Waste Management through Advanced/Innovative Technologies :

Activities undertaken with Davao City:

1. Consultation meetings and data gathering (10-year SWM Plan, SW volumes and etc.)
2. Site Visits to Davao City Sanitary Landfill including proposed SLF expansion Site and Proposed Waste-to-Energy Site
3. Attendance to seminars and Online Trainings conducted by JET.

Technical Cooperation Project for capacity development on improving Solid Waste Management through Advanced/Innovative Technologies :

General Outcomes/Realizations:

OUTPUT 2

- Better understanding of Waste-to-Energy Technology addresses the wrong notions and eliminate failures and incorrect decisions through careful planning and evaluation of solid waste situations and the technology.
- Segregation and recycling should complement the WTE process to divert more waste from the landfill thereby ensuring the efficient operation of both facilities (SLF and WTE).

添付資料1

DAVAO CITY, PHILIPPINES

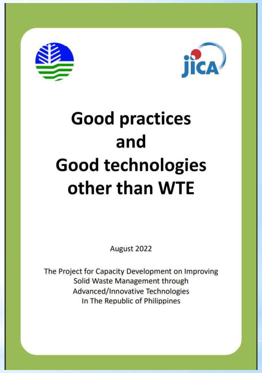
Technical Cooperation Project for capacity development on improving Solid Waste Management through Advanced/Innovative Technologies :

General Outcomes/Realizations:

OUTPUT 4

- Best practices in SWM are already being done in many parts of the country and other countries which can be replicated. Hence, the need to learn from their experiences and adopt the best doable practices to help improve solid waste management in the city.

- Private sector's participation in providing solutions to SWM is indispensable.

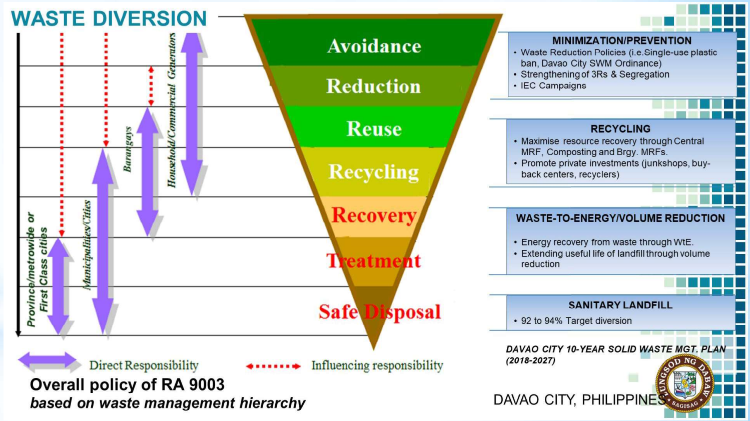


DAVAO CITY, PHILIPPINES

Technical Cooperation Project for capacity development on improving Solid Waste Management through Advanced/Innovative Technologies :

Ways Forward:

- Pursue with the plans, programs and activities outlined in the City's 10-year SWM Plan taking into consideration the learnings/ outcomes of the TCP project especially on increasing SW avoidance and 3Rs.

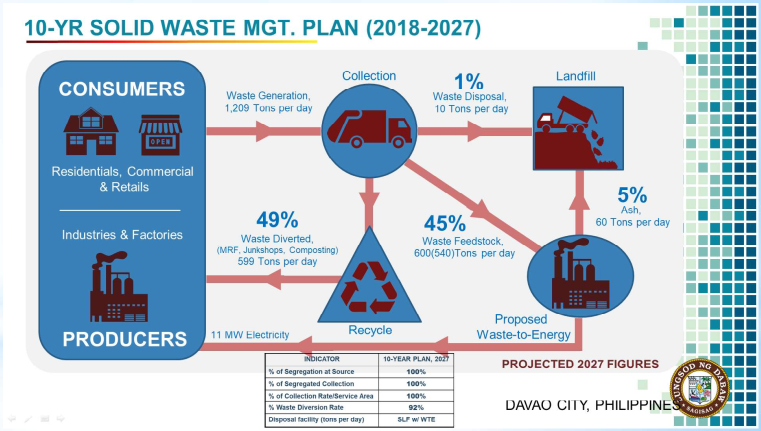


DAVAO CITY, PHILIPPINES

Technical Cooperation Project for capacity development on improving Solid Waste Management through Advanced/Innovative Technologies :

Ways Forward:

- Seek guidance from Outputs produced in the TCP in furthering the WtE project of the City.



DAVAO CITY, PHILIPPINES

THANK YOU!

添付資料1

添付資料1

SWM INITIATIVES & FUTURE PLANS

Mr. Arlie C. Gesta
Officer-In-Charge
Cebu City ENRO

PRESENT INITIATIVES

OPLAN DISIPLINA

Mayor Rama signed the Executive Order (EO) 9 or the "Oplan Disiplina" on October 1, 2022

an Order prescribing the observance of a strong sense of self-control, order, and discipline, and directing the strict enforcement of all existing laws, ordinances, rules, and regulations within the territory of the city of Cebu.

Rama’s new EO reminds Cebu City residents to comply with and support the enforcement of all existing laws, ordinances, rules, and regulations that promote general welfare.

“The City of Cebu, hereby, intensifies and strengthens the enforcement of all existing laws, ordinances, and regulations within the territorial jurisdiction of the city of Cebu. All law enforcement personnel, force multipliers are directed to strictly implement and enforce all laws directly involving the environment, health, safety, sanitation, traffic law, education, among others”.

THE PROBLEM OF SOLID WASTE IS A MATTER OF NATIONAL DISCIPLINE

ENFORCEMENT OF ENVIRONMENTAL ORDINANCES

Technical Cooperation Project (TCP) for Capacity Development on Improving Solid Waste Management (SWM) through Advanced/ Innovative Technologies

JOINT COORDINATION COMMITTEE (JCC) MEETING

13 December 2022, Tuesday | 10:30am – 12:30nn | zoom

WAY FORWARD FOR ACTIVITIES THAT WILL NOT BE COMPLETED UNTIL DECEMBER 2022

Project Output	Pending Deliverables	Way Forward	Timeline
Output 1	Officialize the Technical standards for WTE, endorsed by the JCC to DENR-EMB.	• Revision/Finalization of the draft JAO for the Guidance Document for the Operation of Waste To Energy-Appropriately Controlled Combustion Facilities guided by the comments of the EMB Policy Technical Working Group (EPTWG). • Re-endorsement to the EPTWG for their approval/subsequent endorsement to the DENR.	3rd Quarter CY 2023
	Officialize the Case Study Analysis for BAT/BEP Guidelines for WTE, endorsed by JCC to DENR-EMB.	• Finalization of the draft policy on the BAT/BEP Guidelines for WTE. • Endorsement to the EPTWG for their approval/subsequent endorsement to the DENR.	3rd Quarter CY 2023
	Facilitate the endorsement by JCC to DENR-EMB of the Manual for planning, evaluation, formulation, and supervision for WTE projects	• Preparation of CSW as official endorsement of the JCC-approved PFEC Manual to the DENR-EMB.	2nd Quarter CY 2023

WAY FORWARD FOR ACTIVITIES THAT WILL NOT BE COMPLETED UNTIL DECEMBER 2022

Project Output	Pending Deliverables	Way Forward	Timeline
Output 2	Continue to acquire knowledge of WTE facility and implementation strategies because LGUs might request support from the national government such as DENR-EMB to prepare/evaluate the technical specifications of the WTE project that cannot be completed in this project activity, including other LGUs after the project.	• It was noted in our letter that it is DENR-EMB's mandate to support and encourage programs toward the protection and conservation of the environment, which includes acquisition of knowledge on WTE technology/facilities.	continuous
Output 3	Facilitate the endorsement by JCC to DENR for the SOP.	• Preparation of CSW as official endorsement of the JCC-approved SOP to the DENR-EMB.	2nd Quarter CY 2023
Output 4	Facilitate the endorsement by JCC to DENR and officialise the booklet.	• Preparation of CSW as official endorsement of the JCC-approved Booklet to the DENR-EMB.	2nd Quarter CY 2023

Technical Cooperation Project (TCP) for Capacity Development on Improving Solid Waste Management (SWM) through Advanced/ Innovative Technologies

THANK YOU

添付資料 2 - 技術基準

Republic of the Philippines
Department of Environment and Natural Resources
ENVIRONMENTAL MANAGEMENT BUREAU
DENR Compound, Visayas Avenue, Diliman, Quezon City 1116

EMB MEMORANDUM CIRCULAR
No. 2020 - ____

SUBJECT : GUIDELINES FOR THE TECHNICAL STANDARDS OF WASTE-TO-ENERGY FACILITY ON APPROPRIATELY CONTROLED COMBUSTION

In line with the mandate of the Department of Environment and Natural Resources (DENR) through the Environmental Management Bureau (EMB) to recommend policies to eliminate barriers to waste reduction programs and to effectively implement the Republic Act (RA) No. 9003 otherwise known as the "Ecological Solid Waste Management Act of 2000" and its Implementing Rules and Regulations, as well as, to complement the DENR Administrative Order 2019-21 otherwise known as the "Guidelines Governing Waste-to-Energy (WtE) Facilities for the Integrated Management of Municipal Solid Wastes", the Guidelines for the Technical Standards of "Waste-to-Energy Facilities on Appropriately Controlled Combustion (WtE-ACC Facilities)" is hereby provided as follows:

Section 1. Objective

This Circular is issued to provide a set of technical standards for the evaluation, establishment, and control of Waste-to-Energy on Appropriate Controlled Combustion (WtE-ACC) Facilities for the proper management of municipal solid wastes in the country.

Section 2. Scope

This Circular shall apply to all WtE-ACC Facilities to be operated nationwide. It shall provide comprehensive set of standards in the form of technical checklist for the structure, operation and maintenance of WtE-ACC Facilities and the guidelines for the management of bottom ash and fly ash from them.

Section 3. Definition of Terms

For the purpose of this Memorandum Circular, the following words and phrases shall have the following meanings:

a. Appropriately Controlled Combustion (ACC) shall refer to a Waste-to-Energy technology converting WtE feedstock to energy by combustion technology which follows the following order of objectives:

1. Waste treatment and sanitation
2. Waste reduction
3. Energy recovery

b. **Auxiliary Combustion Device** shall refer to a fuel firing equipment such as oil, gas burners, etc. to control the temperature of combustion chamber at startup or shutdown.
c. **Bureau** shall refer to the Environmental Management Bureau.
d. **Continuous Emission Monitoring System (CEMS)** shall refer to the total equipment used to sample, analyze and provide a permanent record of emissions or process parameters.
e. **Department** shall refer to the Department of Environment and Natural Resources.
f. **Residual Waste** shall refer to remaining waste after the implementation of 3Rs (Reduce, Reuse, Recycle) by LGUs at maximum extent, in economical and institutional terms, regardless of its disposal mode such as being utilized in a WtE facility or disposed in Sanitary Landfill.
g. **Residuals Containment Area (RCA)** shall refer to the temporary storage for WtE Feedstock.
h. **WtE Feedstock** shall refer to any residual waste after the implementation of 3Rs (Reduce, Reuse, Recycle) by LGUs at maximum extent, in economical and institutional terms, to be supplied to a WtE facility for the purpose of waste sanitation, waste reduction, and energy recovery.
i. **WtE-ACC Operator** shall refer to the entity in charge of the day-to-day operations of the WtE-ACC facility, and may be independent to the WtE owner.
j. **WtE-ACC facility** shall refer to the structure/appurtenant facility where the Waste-to-Energy facilities on appropriately controlled combustion operations are housed.

Section 4. Permitting Requirements

All WtE Projects, regardless of the power generating capacity, are covered by the EIS System, and are required to secure ECC as provided for under the issued Memorandum Circular 2020-23 otherwise known as “Clarification on the Requirements of WtE Projects relative to ECC Application pursuant to DAO 2019-21, and other permits cited particularly in Section 5.a of the said MC.

Section 5. Technical Standards and Guidelines

All persons, natural or juridical, who are engaged in structural, operational and maintenance standards for WtE-ACC Facilities must adhere to the minimum standards and guidelines set out in this Section. These standards and guidelines shall be used as the baseline in determining the minimum performance standards and specifications in WtE-ACC projects covered by this Memorandum Circular.

All persons and entities engaged in the subject of WTE facility covered by this guideline shall coordinate with the DENR EMB Central and Regional Office who has jurisdiction over their area of operation and/or principal office of their business, and to ensure compliance to the following standards and guidelines, to wit:

5.1. General

5.1.1. Compliance with other applicable laws and regulations

All WtE-ACC facilities shall comply with existing structural requirements set forth in National Building Code (PD 1096), Occupational Safety and Health Standards (RA 11058) and other applicable regulations to be safe in terms of structural strength against self-weight, loading capacity and other loads, seismic force and temperature stress.

5.1.2. Prevention of Corrosion

All WtE-ACC facilities shall take necessary measures to prevent corrosion caused by exhaust gas, wastewater, etc. generated from waste and a result of waste treatment.

5.1.3. Fire prevention and control

All WtE-ACC facilities shall meet the design conditions and requirements in accordance with RA 9514, or the Fire Code of the Philippines and Rules 9, 10 and 11 of its Revised Implementing Rules and Regulations in particular and take necessary measures to prevent fires and provide fire extinguishers and other fire extinguishing equipment.

5.1.4. Operation stability

All WTE-ACC facilities, whether intended to be run continuously or intermittently, shall be designed for continuous and stable operation for at least 90 days or more per line.

5.1.5. Effective use of residual thermal power

All WtE-ACC facilities shall be capable to effectively use residual heat for several purposes such as power generation, external heat supply, etc.

5.2. Complete Combustion Control

5.2.1. Processing Capacity

All WtE-ACC facilities shall sustain the processing capacity (in tons per day) indicated in the EIS application document. All WtE-ACC operators shall not accept waste more than the indicated capacity in the approved ECC.

The WtE-ACC facility shall secure a new ECC prior to expansion should it be necessary to increase the processing capacity of the WtE-ACC Facility.

5.2.2. Waste Feeding

All WtE-ACC facilities shall have a device capable of quantitatively and continuously introducing waste into the combustion chamber while being insulated from outside air. All WtE operators shall input waste into the combustion chamber continuously in a quantitative manner in a state of isolation from the outside air. When inputting waste into the combustion chamber by the pit crane method, ensure that waste is mixed uniformly at all times.

5.2.3. Structural Requirement for Combustion Chamber

All WtE-ACC facilities shall have a combustion chamber meeting the following requirements:

i. The system shall be designed such that it is possible to incinerate waste in a state where the temperature of the combustion gas is 850 degrees Celsius or more.
ii. The system should be capable of retaining the combustion gas for 2 seconds or more while maintaining the temperature of 850 degrees Celsius or more.
iii. The system shall be isolated from outside air.
iv. The system should keep the temperature of the combustion gas promptly raised to or above the temperature said in (i), and to be equipped with an auxiliary combustion device necessary to maintain the temperature.
v. The equipment should be installed to supply the necessary amount of the air for combustion (Limited to those having the function of adjusting the amount of supplied air.).

5.2.4. Operational Requirements for Combustion Chamber

WtE Operators shall:

i. Maintain the temperature of the combustion gas in the combustion chamber at 850 degrees Celsius or more.
ii. Incinerate so that loss of ignition of the incinerated bottom ash is 5% or less. However, this shall not apply to the case where the

incinerated bottom ash is used so as not to cause hindrance to the preservation of the living environment.

iii. Quickly raise the furnace temperature to or above said in (i) by operation an auxiliary combustion device, etc. when starting operation.

iv. Keep the temperature of the said furnace to or above said in (i) by operating an auxiliary combustion device, etc., and burn all waste when the operation of the said facilities is to be stopped.

5.2.5. Continuous Measurement and Record of Temperature of Combustion Gas

All WtE-ACC facilities shall have equipment continuously measuring and recording the temperature of the combustion gas near the wall of the combustion chamber. All WtE Operators shall continuously measure, record and maintain a record of the temperature of the combustion gas in the combustion chamber.

5.3. Exhaust Gas Control

5.3.1. Cooling System of Combusted Gas

All WtE-ACC facilities shall have a cooling facility capable of lowering the temperature of the combustion gas flowing into the dust collector to approximately 200 degrees Celsius or less. However, this shall not apply to the case where the temperature of the combustion gas can be quickly cooled to approximately 200 degrees Celsius or less in the dust collector.

All WtE Operators shall ensure the cooling of the temperature of the combustion gas flowing into the dust collector to approximately 200 degrees Celsius or less. However, this shall not apply to the case where the temperature of the combustion gas can be cooled to approximately 200 degrees Celsius or less in the dust collector.

5.3.2. Continuous Measurement and Record of Temperature of Combusted Gas flowing into the dust collector

All WtE-ACC facilities shall have a device continuously measuring and recording the temperature of the combustion gas flowing into the dust collector. All WtE Operators shall continuously measure, record and maintain a record of the temperature of the combustion gas flowing into the dust collector.

5.3.3. Exhaust gas treatment system

All WtE-ACC facilities shall have exhaust gas treatment systems (Limited to those with an advanced function to remove dust) capable of preventing the hindrance in the preservation of the living environment caused by the exhaust gas discharged from the chimneys of the facility shall be provided. WtE operators shall, in its operation, comply with exhaust gas emission standard specified in Section 19 of RA8749 to prevent the hindrance in the preservation of the living environment caused by exhaust gas, and remove soot and dust accumulated in cooling equipment and exhaust gas treatment equipment.

5.3.4. Continuous Measurement of CO in exhaust gas

All WtE-ACC facilities shall have equipment for continuously measuring and recording the concentration of carbon monoxide (CO) in the exhaust gas discharged from the chimney of the facility.

i. All WtE operators shall incinerate waste so that the concentration of carbon monoxide (CO) in exhaust gas discharged from chimneys is 100 ppm or less (as 1 hour average at 12% O_2 basis).
ii. Provided, however, that this shall not apply to an WtE-ACC facilities which it is inappropriate to use the concentration of carbon monoxide (CO) as an index for the maintenance of combustion in order to suppress the generation of dioxins in exhaust gas discharged from chimneys, and which measures and records the concentration of dioxins in said exhaust gas at least once every three months.
iii. All WtE operators shall continuously measure and record the concentration of carbon monoxide (CO) in the exhaust gas discharged from a chimney. This continuous measurement shall be kept from the time which WtE facility starts its operation until CO concentration could be enough low after stop operation.

5.3.5. Emission limit value of Dioxins and Furans

All WtE-ACC facilities shall incinerate waste so that the concentration of dioxins in exhaust gas discharged from chimneys is less than the concentration specified in 6.3 c) of DENR Administrative Order No. 2019-21.

5.3.6. Monitoring frequency of exhaust gas

Aside of requirement of CEMS installation for the monitoring of operation performance of WtE-ACC facilities, all WtE-ACC facilities shall measure and record the concentration of dioxins in the exhaust gas emitted from chimneys at least once a year, and the concentration of exhaust gas (Limited to the substances related to sulfur oxides (SOx), dust, hydrogen chloride (HCl) and nitrogen oxides (NOx)) at least once in 6 months for the purpose to determination of compliance of NESSAP of DAO2000-81.

5.4. Wastewater Control

5.4.1. Wastewater sealing

All WtE-ACC facilities shall have a structure that holds wastewater generated in the facility to ensure that leakage and permeation to underground water is avoided.

5.4.2. Wastewater from WtEs

In the case where exhaust gas discharged from chimneys is washed or cooled with water, WtE-ACC facilities should ensure that the scattering and outflow of the said water shall not hinder the preservation of the living environment.

In the case that wastewater is discharged from facilities, the facilities shall have the wastewater treatment facilities necessary to comply with the effluent standards set in DAO2016-08 to ensure that the water quality does not hinder the preservation of the living environment.

5.5. Management of Ash

5.5.1. Responsibility of Ash Management

WtE-ACC residues such as fly and bottom ash shall be managed appropriately through the use of appropriate technologies to ensure that handling, transport and disposal is executed without exposing harm to the people and the environment surrounding the facility.

Ash management generated from WtE-ACC shall be primarily under the responsibility of the LGU, aligned to their responsibility of managing MSWM in accordance with RA9003. LGUs can, however, in its waste processing contract, delegate the responsibility to the WtE Operator.

5.5.2. Ash discharge

All WtE-ACC facilities shall have an ash discharging facility and its storage facility capable of discharging and storing fly ash separately from bottom ash. The structure of ash discharging facility shall ensure that fly ash and bottom ash do not scatter or fly out.

All WtE operators shall discharge and store fly ash from bottom ash separately.

5.5.3. TCLP Test / Determination of Toxicity Characteristics

The management of the generated fly and bottom ash will depend on its classification. The ash shall be subjected to a laboratory analysis specifically Toxicity Characteristics Leaching Procedure (TCLP) and pH test to determine if it is hazardous or not.

a. Ash Classified as Hazardous Waste

The generated fly and bottom ash classified as hazardous wastes shall be managed in accordance with the provisions of DAO 2013-22: Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36).

b. Ash Classified as Non-Hazardous Waste

The generated fly and bottom classified as non-hazardous wastes shall be managed in accordance with the provisions of DAO 2001-34: Implementing Rules and Regulations of the Philippine Ecological Solid Waste Management Act of 2000.

5.5.4. Cement solidification or chemical treatment of ash

In the case of stabilization of fly ash or bottom ash by cement solidification or chemical treatment, a kneading device capable of uniformly mixing fly ash or bottom ash, cement or chemicals and water shall be provided.

In such case, fly ash or bottom ash, cement or chemicals and water shall be uniformly mixed.

5.6. Other Environmental Pollution Control

5.6.1. Prevention of Noise and Vibration

All WtE-ACC facilities shall have a structure not generate extreme noise and vibration, nor damage the surrounding living environment. All WtE-ACC Operators shall, in its operation, comply with Noise Control Standard specified in NPCC MC 1980-002 and take necessary measures so that surrounding living environment will not be damaged by significant noise and vibration.

Approaches in structural and site layout must be complied particularly on the waste handling operations that must be totally enclosed to contain noise.

5.6.2. Prevention of Scattering and Offensive Odor

All WtE-ACC facilities shall have a structure or equipment necessary for odor management. WtE-ACC Operators shall take necessary measures to ensure the prevention of waste scattering and emission of offensive odor. Provision of appropriate technologies and practices to minimize odor and litter concerns should be implemented and strictly observed.

5.6.3. Housekeeping inside of the facility

All WtE-ACC facilities shall endeavor to prevent the occurrence of mosquitoes, flies, etc. and maintain the cleanliness of the premises and surrounding area. Provision of pest control programs to control specific vector populations and practices that reduce the likeliness of attracting vectors should be implemented and strictly observed.

5.7. Other Requirements

5.7.1. Periodical inspection

In addition to the preceding items, all WtE-ACC facilities shall be taking the necessary measures to maintain the functions of the facility, and periodically conducting functional inspections and inspections of exhaust gas and water quality.

5.7.2. Record management

Records of check, inspections and other measures concerning the maintenance of facilities (including emergency measures) shall be prepared and retained for five (5) years in soft and hard copies.

Section 6. Separability Clause

If any provision of this Memorandum Circular, or the application of any such provision to any person or circumstance, shall be held to be unconstitutional, invalid, illegal or unenforceable, the remainder of the provisions hereof that are not affected, or the application of such provision to persons or circumstances other than those as to whom or which it is invalid, illegal or unenforceable, shall not in any way be affected or impaired thereby.

Section 7. Repealing Clause

All other Circulars inconsistent with any provisions hereof are hereby repealed and amended accordingly.

Section 8. Effectivity

This Circular shall take effect fifteen (15) days after the publication in a newspaper of general circulation and upon acknowledgment of receipt of a copy thereof by the Office of the National Administrative Register (ONAR).

Issued this __th day of _____ 2021, Quezon City, Philippines.

ENGR. WILLIAM P. CUÑADO
OIC - Director

添付資料 3 - BAT/BEPガイドラインのためのケーススタディ

3-1 ：ケーススタディ分析

添付資料 3-1: ケーススタディ分析

Japan International Cooperation Agency

Department of Environment and Natural Resources

Case Study Analysis for Guideline of Best Available Technique / Best Environmental Practice

Under the Project for Capacity Development on Improving Solid Waste Management through Advanced/Innovative Technologies in the Republic of the Philippines

December 2021

Inter-Agencies Technical Working Group

Subgroup Output 1

Table of Content

Appendixes

Appendix 1: Comparison of Case Study Data in the Target Countries

Appendix 2: Case Study Sheets

Appendix 3: EMB Director's letter requesting WtE Operator/Manager to Cooperate the Case Study

Chapter 1. Introduction

1.1 Background and Objectives

In the Philippines, as envisaged by RA 9003, solid waste must be segregated, utilized as effectively as possible, and treated and disposed of in a sanitary manner after reduction of waste for final disposal. This is also in line with the globally accepted concept of Waste Hierarchy. However, many LGUs in the Philippines have not established a complete sanitary waste flow.

In view of this situation, it is necessary to find a realistic way to solve the critical problem of unsanitary solid waste management, along with the realization of the 3Rs in line with the ideals of RA9003, which has been pursued over the past 20 years.

The problem is particularly acute in the big LGUs, which have large populations and generate large amounts of municipal solid waste on a daily basis. For this reason, such major LGUs are considering adopting Waste-to-Energy (WtE) technologies as one of the solutions.

In this context, the Philippine government worked on a legislation to direct the development of WtE projects, thus, the National Solid Waste Commission (NSWMC) issued Resolution 669 in 2016. The Department of Environmental and Natural Resources (DENR) also conducts activities to align with this Resolution.

The DENR Administrative Order (DAO) 2019-21 otherwise known as the **Guidelines Governing WtE Facilities for the Integrated Management of Municipal Solid Waste** has been issued to provide a guideline on evaluation, establishment, operation, and decommission of WtE facilities for integrated management of municipal solid waste. The guidelines cover the minimum requirements for the development of WtE facilities and is useful for development and operation of WtE facilities utilizing municipal solid waste. In addition to the guideline, it is necessary to have the more detailed information of the technical, institutional, and financial alternatives of WtE projects to develop WtE facilities in the Philippines.

The WtE Guidelines from DAO 2019-21does not provide the operational standards for WtE technologies. While the minimum requirements must be met, the objective is to provide information from existing case studies that can be used as reference for WtE facilities necessary for LGUs. It was intended to have a flexibility for the facilities to adopt- allowing them to observe the standards through the recommended technologies gathered from other WtE facilities across the globe.

According to the requirement described in Section 12 of the National Solid Waste Management

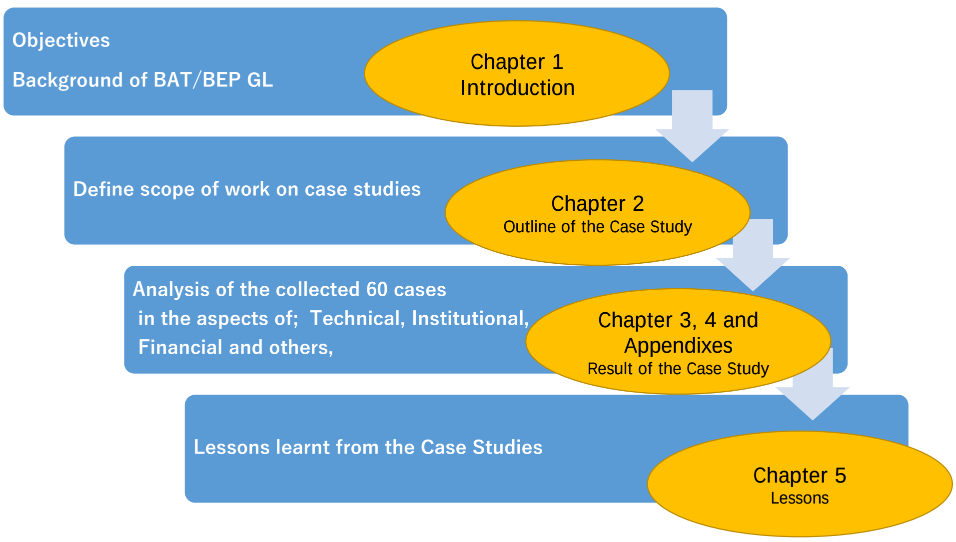
Commission (NSWMC) Resolution 669 issued in June 2016, the National Ecology Center (NEC) shall prepare the Best Available Technologies (BAT) /Best Environmental Practices (BEP) guidelines for Waste to Energy (WtE) technologies. However, NEC has not yet been established at this moment. In line with this, an activity under the Technical Cooperation Project (TCP) entitled **Project for Capacity Development on Improving Solid Waste Management through Advanced/Innovative Technologies in the Republic of the Philippines** under Output 1 was tasked to prepare the draft BAT/BEP guideline. The JICA Experts Team (JET) was tapped to implement the said TCP and coordinate with Philippine counterparts to carry out the activities of the project.

In this context, this BAT/BEP guideline is prepared to provide some of the best available technologies and best environmental practices through a survey of cases studies of the existing WtE facilities in Asian, European, and American countries with more detailed technical, institutional and financial information.

JET tried to obtain credible information from WtE implementing agencies (local/national government), project operators, and secondary information sources and validate by 2 or more sources. However, it was not possible for implementing agencies, operators to validate all gathered information. It is a constrain of the case studies that there are missing information including the latest updates.

1.2 Structure of the Guideline

The structure of the guideline is as follows:



The outline of the case study such as scope, methodology, schedule, and survey contents are explained in Chapter 2. The collected case studies and the information gathered from each case are discussed in Chapter 3 and 4. The BAT/BEP as the example of suitable technology of combustion type, energy recovery procedure, pollution control technique and ash treatment and of institutional aspects such as project scheme, financial scheme, citizen participation are summarized in Chapter 5.

The results of the analysis from the data gathering are summarized in Chapter 5.

Chapter 2. Outlines of the Case Study

2.1 Methodology

The survey was conducted mainly by utilizing secondary information. The information sources for the case studies are the internet, professional journals, official websites of the facilities, and magazines.

In the secondary information, many facilities did not disclose detailed information on project costs, operating costs, and detailed technologies, and such information were not obtained.

To supplement such information, we attempted to obtain additional information by sending official letters through DENR-EMB to the operators and managers of WtE facilities in the case study. The survey yielded responses on two WtE facilities[1], which were reflected in the case study.

2.2 Schedule

The case study was conducted during the period indicated below.

Literature and other information survey: March 2020 - March 2021

Questionnaire survey (via EMB letter): December 2020 - March 2021

2.3 Scope of Case Studies

There are various types and capacities of WtE facilities currently operating across the world. It is necessary to determine the scope of the case study of WtE facilities to be considered in this report,

[1] Klemetsrud Combined Heat and Power (CHP) plant(ID302, Norway), Palm Beach Renewable Energy Facility 2 (ID318, USA) responded to the EMB letter.

that can be used as references for the WtE facilities to be put up in the Philippines.

(1) WtE Technology

WtE Technology generally refers to the technology which uses thermal energy to generate energy in the form of electricity or heat, from waste. In DAO 2019-21, WtE is defined as “the process of converting wastes with various technologies, usually the conversion of non-recyclable waste materials into useable heat, electricity, or fuel through a variety of processes”.

Though there are various types of WtE technologies such as Gasification/Pyrolysis, Refused Derived Fuel (RDF), and Biomethanation (aerobic digestion, biogas) Facilities, combustion technology is one of the most popular[2] and reliable WtE technologies at this moment with a long history of application. In this BAT/BEP guideline, the case studies would be primarily targeted for the WtE facilities utilizing combustion technology, so called the Appropriately Controlled Combustion (WtE-ACC).

(2) Countries and Region

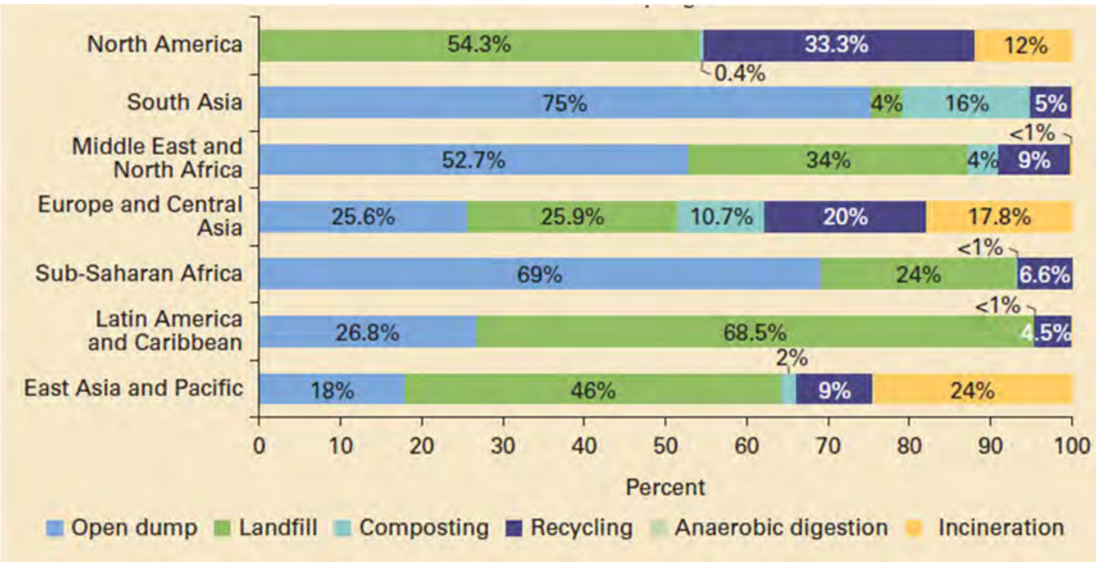
The WtE track record of waste combustion and the characteristics of the Philippines are considered to decide the countries and region for the case study. As shown in **Figure 2.1**, the track record is dominated by North America, the EU, and Asia; therefore, WtE cases in the following three regions were included in the study.

Table 2.1 Region and Country of the Cases of WtE

Region/Country	Characteristic
East Asia (Japan, China, Taiwan, and Korea)	・ a high percentage of cases processed by WtE-ACC and a large number of cases. (ex. 376 waste incinerators in Japan (not including 71 private facilities)) (Source: Ministry of Environment, Japan, 2017) ・ This region belongs to Asia same as the Philippines and share similarities in terms of climate, such as humid climate and typhoons. ・ Many technology providers.
Southeast Asia/ South Asia	・ The region to which the Philippines belongs. While there are not many WtE-ACC facilities in operation, efforts, and introduction of facilities in neighboring developing countries are useful for reference.
EU, North America (Other Developed Region)	・ In, EU, the introduction of WtE-ACC has been promoted by the policy to reduce the final disposal volume. (ex. 492 WtE-ACC cases in Europe (not including hazardous waste treatment facilities)) (Source: CEWEP, 2018) ・ Many technology providers.

Source: Prepared by ITWG-Subgroup Output1

[2] https://www.uncclearn.org/wp-content/uploads/library/unep23092015.pdf



Source: What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050, World Bank, 2018)

Figure 2.1 Treatment and Disposal Method by Region

(3) Treatment Capacity

a Range of the Capacity of WtE-ACC in the Case Study

The minimum treatment capacity to be collected and analyzed in this guideline is set as 100 tons/day based on the two reference documents of waste combustion facility.

・ Pre check list for Feasibility Study of Waste Power Generation Plant (2019, JICA)

One of the most important items to be checked for the target municipality is that “the target city population is 100,000 or more. (Or plant capacity is 70 tons/day or more).”

The reason to decide these values are described in the explanatory note of JICA pre checklist as follows.

(Source: the explanatory note of Pre checklist for Feasibility Study of Waste Power Generation Plant,2019)

The larger the target city population, the better. The larger the scale of the waste incineration power generation facility, the more appropriate environmental measures can be taken, the lower the construction and operation costs per ton of waste, and the higher the power generation efficiency. As a guide for target cities considering the introduction of MSW incineration power generation, a population of at least 100,000 is required.

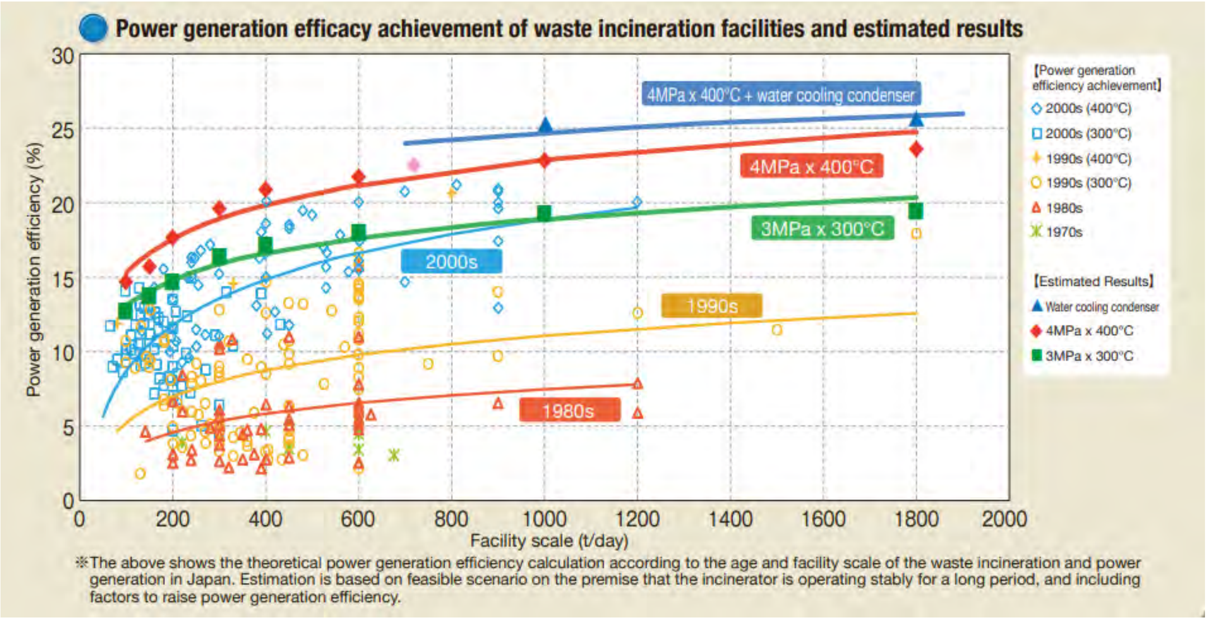
In May 1997, the Ministry of Environment, Japan issued a notice entitled "Plan for Wide-Area Waste Incineration," stating that, as a general rule, waste incineration plants to be built in the future should be fully continuous furnaces that produce little dioxin, and that incineration should be carried out under stable combustion conditions, and that the necessary scale of incineration plant should be secured. In order to achieve this, it is necessary to secure the required scale of incineration facilities. The required scale of the incineration plant should be 300 tons/day or more (at least 100 tons/day), taking into account geographical and social conditions as much as possible.

Taking into consideration the recent improvement in power generation efficiency, the introduction of waste incineration power generation facilities in local cities in Japan, and the fact that "power generation may be difficult for small-scale facilities of less than about 70 tons/day ", the target city population should be 100,000 or more (or the facility scale should be 70 tons/day or more). In order to increase the population of the target city, it is effective to establish a wide-area treatment system in cooperation with multiple cities, and wide-area treatment is being promoted in Japan.

Table 2.2 Capacity of the Waste Combustion Facility in Japan

Treatment Capacity (ton/day)	Number of Case			Electricity Generation capacity (Average)		
		With electricity generation	Ratio (%)	Capacity (kW/case)	Efficiency (average %)	Total Generation (MWh/Case)
Less than 50	372	2	0.5	86	1.8	347
50~100	204	14	6.9	1,240	11.3	5,330
100~300	394	144	36.5	2,624	12.4	11,759
300~600	133	118	88.7	5,642	13.2	25,454
600<	59	59	100.9	14,408	12.2	53,495
Total	1,162	337	29.0	-	-	-

Source: Ministry of Environment, Japan



Source: Ministry of Environment, Japan

Figure 2.2 Efficiency Improvement of Electricity Generation of WtE-ACC Facilities in Japan (1970s – 2000s)

- Municipal Solid Waste Incineration -A Decision Maker's Guide- (2000, World Bank)

One of the keys for incineration economy is given that "To be economically feasible, the individual incineration units should have capacities of at least 240 tons/day (10 tons/hr), and there should be at least two separate unit"

Although 100 tons/day is larger than the 70 tons/day indicated in the JICA Pre checklist, the target capacity of the case study is set at a slightly larger scale, referring to the World Bank (WB) document.

On the other hand, the maximum capacity was not set for data collection because giga size facility is not so common and such information is limited.

b Waste Amount Estimate for LGUs in the Philippines

In order to get approximate treatment capacity of WtE for LGUs in the Philippines, waste amount is estimated based on the LGU's population (**Table 2.3**) and waste generation unit by the NSWMC[3] as shown in **Table 2.4**.

The capacity of the waste treatment either WtE-ACC or other treatment methods should be able to accommodate the waste generation volume of LGUs. The waste volume depends on the size of local government. Each LGU bears the responsibility of municipal solid waste management in the Philippines.

Table 2.3 Population in Primary LGUs[4] (2015)

Category	Less than 500,000	0.5 to 1 million	1 to 2 million	2 to 3 million	More than 3 million	Total
Number of LGUs	49	40	20	8	3	120

Source: Categorized based on population census (2015)

Table 2.4 Numbers of LGUs Categorized according to the Amount of Waste Generation

Category (tons/day)	Less than 100	100-200	200-300	More than 300	Total
Number of LGU	34	43	20	23	120
%	28.3	35.8	17.7	19.2	100.0

Source: Calculated based on per capita waste generation rate described in National Solid Waste Management Status Report [2008-2018]

It is analyzed that about 80% of Primary LGUs including provinces do not generate more than 300 tons/day but twenty-three (23) LGUs do. This opens the possibility in 23 municipalities to consider WtE facilities with more than a 300 tons/day capacity which satisfies at least 240 tons/day, the benchmark given by the WB document. At the same time, equivalent to the required capacity of feasible WtE-ACC.

c Clustering of LGUs

A clustering of LGUs can be a way to set the bigger capacity of WtE-ACC facility which may give not only more electricity generation but more efficiency in electricity generation. This can also be a

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3 The municipal solid waste generation rate per capita in each LGU are assumed as 0.69 [kg/day/person] for High Urban Cities including Metropolitan Manila and the other is 0.34 [kg/day/person]. In addition, it is assumed that 60% of municipal solid waste will be treated as WtE after separation of recyclable or incombustible waste.

4 Primary LGUs includes 81 provinces, 33 highly urbanized cities (HUC), 5 independent component cities (ICC), and an independent municipality (Pateros of NCR)

solution to support small LGUs, which does not have capacity in terms of financial, technical and human resources aspect, by bigger LGUs as recommended in RA9003 for even conventional management of municipal solid waste such as MRFs. This is because it has been promoted in the experienced countries such as one in EU and Japan. However, the following issues shall be considered and discussed to make consensus among LGUs for adopting the LGUs clustering.

- Possible change in administration of LGUs,
- Site selection concerns (Not in my backyard or NIMBY),
- Waste collection and transportation efficiency, as transportation distances could be longer for member LGUs
- Environmental impact by WtE-ACC, waste transportation etc.

In the case of Japan, more than 300 ton/day of WtE-ACC facility is recommended for the purpose to efficient energy recovery in WtE-ACC facility according to the Ministry of Environment, Japan circular in 1997. The clustering of LGUs is possible in case that certain conditions for LGUs listed above are satisfied.

d　Application of WtE-ACC to LGUs in the Philippines

It is commonly understood that the WtE-ACC require more waste treatment cost than conventional municipal solid waste management consists of only waste collection, transportation, and final disposal at landfill site. Nevertheless, it is considered as a practical method for the megacity suffering from huge waste amount and limitation of land for final disposal site.

Considering the fact that any WtE-ACC facility has not been developed in this country, it is assumed that mega cities such as Quezon City, Davao City and Cebu City, where LGUs struggles with huge amount of waste generation, would be candidates to install such facility at initial stage of WtE-ACC development in the Philippines as the TCP collaborates.

Table 2.5 Waste Generation in Quezon City, Davao City and Cebu City

LGUs	Quezon City	Davao City	Cebu City
Waste Amount (tons/day)	3,320	991	862
Year of data	2019	2017	2015

Source: 10-year SWM Plan of LGUs

2.4 Survey Contents

The survey contents which illustrate the characteristic of WtE-ACC facility are adopted as shown in

Table 2.6. In addition to the WtE-ACC cases, governmental policy to control and support the WtE-ACC facility development in neighboring countries were surveyed.

Table 2.6 Survey Contents of the Case Studies

Survey Item	Survey Contents
Profile	
Implementing Body	- Name of local government (LGU) - Name of association by multiple LGUs in case of cluster waste management - Name of public service corporation or special purpose company in case of PPP project
Site	- Name of country and location - Area /footprint is described Footprint (ha) - Land Use
Planned and actual schedule	- Schedule of planning, design, construction, and operation - Their planned and actual schedule
Coverage (Scope)	- Scope of implementation body (only WtE-ACC, or including waste collection, transportation, energy recovery and distribution, ash disposal, etc.)
Technical Aspect	
Target Waste	- Type of target waste is described such as municipal solid waste or industrial - If target waste includes hazardous waste or not - If target waste includes sewerage sludge or not
Capacity/Quantity	- Plant capacity of daily or annual quantity of “Target Waste”
Processing Type	- Type of incineration facility like stoker type or fluidized bed combustion, Refused Derived Fuel (RDF), etc.
Lower calorific value of the target waste	- Lower calorific value of “Target waste” - Information on range of lower calorific value (LCV)
Heat Utilization	- Power generation for electricity utilization - Heating value by utilizing heating for community or other hot water utilization
Pollution Control	- Management of exhaust gas, wastewater, etc. - If national standards on emissions are observed or are imposing stricter standards
Ash Management	- Treatment and disposal procedure of bottom ash including separation process of recyclable material in the bottom ash - Treatment and disposal procedure of fly ash
Technical Provider	- EPC contractor or manufacturer of WtE-ACC facility
Institutional Aspect	
Business Scheme (Implementation Framework)	- Public Own & Operate, Public Own & Private Operate (separate), - BOO, BOT, BTO, etc. under PFI (Financed by Private)
Development Approach	- Solicited approach which is proposed by local government, or unsolicited approach which is proposed by private service providers.
Citizen Involvement	- Public consultation process including explanatory meeting - Information dissemination to public
Project income and / cost	- Government tax, power sales, gate fee (tipping fee), other government subsidies for initial/annual, etc. - Capital expenditure (CAPEX), operation expenditure (OPEX)

Source: ITWG Subgroup Output1

2.5 The Collected WtE-ACC Cases

The 60 cases have been collected and the number of cases by each country is summarized as shown in **Table 2.7**. The case of WtE-ACC facilities includes East Asian countries (China, Taiwan, and Japan), Southeast/South Asian countries (India, Singapore, Thailand, and Vietnam), European countries (EU) (Austria, Belgium, Demark, Finland, France, Germany, Italy, Spain, Sweden, and United Kingdom) and North American countries (USA).

The percent of municipal waste treated by WtE-ACC plants in some European countries and in Japan is relatively high as illustrate in **Figure 2.3**, It was analyzed on the website showing the data that it could be because those countries have little open space for landfills. Furthermore, JET is familiar to the case in Japan which has many experiences of waste combustion since 1960s' and can access to the detailed information, half of the gathered cases- 30 among 60- are from this country. Singapore is the only country in Southeast Asia at this moment where the waste combustion is the mainstream of waste management before the final disposal by landfilling. The cases were collected to cover the countries as many as possible for EU members and USA.

Table 2.7 Number of WtE-ACC Cases by Regions and Countries

Region/Country	Number of Cases
East Asia	**32**
China	1
Japan	30
Taiwan	1
Southeast/South Asia	**8**
India	1
Singapore	4
Thailand	2
Vietnam	1
North America	**3**
USA	3

Region/Country	Number of Cases
EU	**17**
Austria	2
Belgium	1
Denmark	2
Finland	2
France	1
Germany	1
Italy	1
Netherlands	1
Norway	1
Spain	1
Sweden	3
United Kingdom	1
Total	**60**

Source: ITWG Subgroup Output1

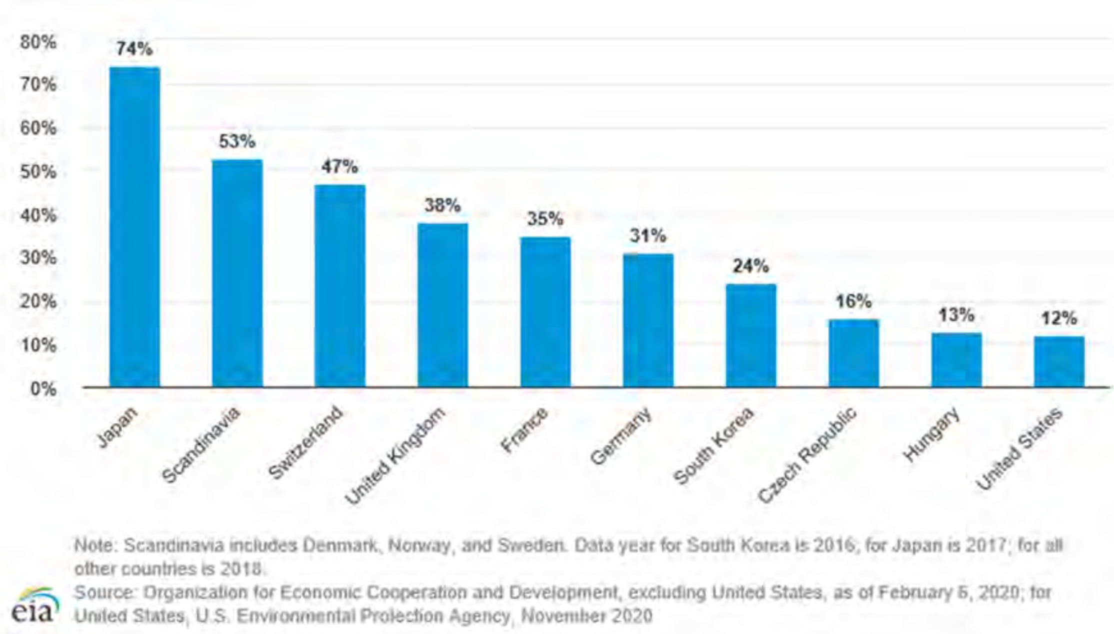


Figure 2.3 Percent of Total Municipal Solid Waste That is Burned with Energy Recovery in the Selected Countries

Chapter 3. Example of the Collected Information for the Cases

3.1 The Collected Cases of WtE-ACC Facility

The profiles of all cases are shown in **Table 3.1**.

Table 3.1 List of WtE-ACC Case Study

ID	Name of Facility	Country	Treatment capacity (tons/day)	Electricity generation (MW)	Design LCV (kJ/kg)	Start. Const. (Year)	Start Operation (Year)	Business Scheme	Development Approach	Furnace
101	Ota Incineration Plant	Japan	600	22.8	14,800	2010	2014	Public Build and Operate	Solicited	Grate
102	Shinkoto Incineration Plant	Japan	1,800	50.0	10,501	1994	1998	Public Build and Operate	Solicited	Grate
103	Suginami Incineration Plant	Japan	600	24.2	8,854	2012	2017	Public Build and Operate	Solicited	Grate
104	Maishima Incineration Plant	Japan	900	32.0	8,768	-	2001	Public Build and Operate	Solicited	Grate
105	Higashisaitama Incineration Plant	Japan	800	24.0	7,572	1991	1995	Public Build and Operate	Solicited	Grate
106	Tobuki Incineration Plant	Japan	300	2.1	8,255	1994	1998	Public Build and Operate	Solicited	Grate
107	Ukisima	Japan	900	12.5	9,600 - 11,300	1991	1995	Public Build and Operate	Solicited	Grate
108	Sunrise Clean Center	Japan	160	3.9	8,963	2015	2019	DBO	Solicited	Grate
109	Kushiro Wide-area Federation WtE facility	Japan	240	4.4	8,600	2003.1	2006.3	DB+O (15yrs)	Solicited	Fluidized bed, gasification, and melting
110	Funabashi city south incineration plant	Japan	339	8.4	9,900	2016.3	2020.3	DBO (15yrs)	Solicited	Grate
111	Mito city incineration plant	Japan	330	9.6	9,300	2016.3	2020.3	DBO (20yrs)	Solicited	Grate
112	Yatsushiro environmental center	Japan	134	2.9	9,200	2015.3	2018.9	DBO (20yrs)	Solicited	Grate
113	Miyanojin Clean Center	Japan	163	3.6	9,700	2013.3	2016.3	DBO (20yrs)	Solicited	Grate
114	Yokkaichi Clean Center	Japan	336	9.0	10,100	2012.1	2016.3	DBO (20yrs)	Solicited	Grate

ID	Name of Facility	Country	Treatment capacity (tons/day)	Electricity generation (MW)	Design LCV (kJ/kg)	Start. Const. (Year)	Start Operation (Year)	Business Scheme	Development Approach	Furnace
115	Asakawa Seiryu Environmental Association Combustible Waste Treatment Facility	Japan	228	5.2	9,200	2016.11	2020.3	DBO (20yrs)	Solicited	Grate
116	Tachibana Shori Center	Japan	600	9.0	9,500	2017.1	2023.7 (planned)	-	Solicited	Grate
117	Thermal Energy Center	Japan	420	10.6	9,600	2020.3	2025.3 (planned)	DBO (15yrs)	Solicited	Grate
118	Ozenji Treatment Center	Japan	450	7.5	-	2007	2012	Public Build and Operate	Solicited	Grate
119	Clean Center Rinkai Plant	Japan	450	13.5	10,170	2009.11	2013.4	BTO (20yrs)	Solicited	Gasification and Melting
120	Hamamatsu City New Incineration Plant (tentative)	Japan	399	15.1	9,200	2018.2	2024.4 (planned)	BTO (20yrs)	Solicited	Gasification and Melting
121	Nerima Incineration plant	Japan	500	18.7	8,489	2010, 12	2015, 11	Public Build and Operate	Solicited	Grate
122	Kuwana Wide Area Cleaning Business Association Waste Treatment Facility	Japan	174	3.1	4160-10,370	2017	2020	DBO (20yrs)	Solicited	Grate
123	Toshima Incineration plant	Japan	400	7.8	9,709	-	1999	Public Build and Operate	Solicited	Fluidized bed
124	Shibuya Incineration plant	Japan	200	4.2	9,787	1998	2001	Public Build and Operate	Solicited	Fluidized bed
125	Saitama city Sakura Environmental Center	Japan	380	8.5	9,536	2010	2015	DBO	Solicited	Gasification and Melting
126	Musashino Clean Center	Japan	120	2.7	8,413	2014	2017	DBO (20yrs)	Solicited	Grate
127	Funabashi city north incineration plant	Japan	381	8.8	6,400	-	2017	DBO (15yrs)	Solicited	Grate
128	Hatsukaichi Energy Clean Center	Japan	150	3.1	-	2016.7	2019.4	DBO	Solicited	Fluidized bed
129	Yokohama city, Kanazawa Incineration Plant	Japan	1,200	35.0	9,825	1995	2001	Public Build and Operate	Solicited	Grate
130	Yokohama city, Tsurumi Incineration Plant	Japan	1,200	22.0	11,646	-	1995	Public Build and Operate	Solicited	Grate

ID	Name of Facility	Country	Treatment capacity (tons/day)	Electricity generation (MW)	Design LCV (kJ/kg)	Start. Const. (Year)	Start Operation (Year)	Business Scheme	Development Approach	Furnace
201	Tuas Incineration Plant	Singapore	1,700	20.0	-	-	-	Public Build and Operate	Solicited	Grate
202	Tuas South WtE Plant	Singapore	3,000	36.0	-	-	2000	Public Build and Operate	Solicited	Grate
203	Senoko WtE Plant	Singapore	2,205	36.0	-	-	1993	Public Build and Operate	Solicited	Grate
204	Keppel Seghers Tuas WtE Plant	Singapore	800	22.0	-	-	2009	BOT	Solicited	Grate
205	Nong Khaem WtE plant	Thailand	500	9.8	-	-	2014	BOT	Solicited	Grate
206	Maoli WtE Plant	Taiwan	500	11.8	9,660	-	2008	BOT	Solicited	Grate
207	Can Tho solid waste treatment plant	Vietnam	400	75.0	6,280	2017	2019	BOO (22yrs)	-	Grate
208	Laogang solid waste treatment plant (phase I)	China	3,000	60.0	7,100	-	2014	-	Solicited	Grate
209	Jabalpur WtE facility	India	600	11.5	3780-4620	-	2016	BOT	-	Grate
210	Phuket WtE facility	Thailand	500	5.0	> 7,200	-	1999	-	-	Grate
301	Afval Energie Bedrijf Amsterdam (AEB)	Netherlands	4,400	125.0	10,000	2004	2008	DBO	Solicited (1993), Unsolicited (2007)	Grate
302	Klemetsrud Combined Heat and Power (CHP) plant	Norway	1,080	130.0	10,000-11,000	Line 1&2: 1983	Line 1&2: 1985 Line3 :2011	-	-	Grate
303	Issy-les-Moulineaux WtE plant (Isseane)	France	1,700	52.0	8,000 - 11,700	(2001-Civil Works) 2003	2007	DB+O	Solicited	Grate
304	ASM Brescia ‘Termoutilizzatore’	Italy	2,670		6300 - 13800	-	1998 (MSW), 2004 (Biomass)/	DBO	-	Grate
305	Zabalgarbi / Bizkaia WtE Plant	Spain	830	95.0	8,000	1999	2005	-	-	Grate
306	Wien-Spittelau	Austria	720	6.0	9,500	2012	2015	PPP	Solicited	Grate

ID	Name of Facility	Country	Treatment capacity (tons/day)	Electricity generation (MW)	Design LCV (kJ/kg)	Start. Const. (Year)	Start Operation (Year)	Business Scheme	Development Approach	Furnace
307	Amager Bakke	Denmark	1,870	66.0	11,500	-	2017	-	Solicited	Grate
308	Incineration Line 6 / The Energy Tower	Denmark	720	19.0	-	2011	2014	Public Build and Operate	Solicited	Grate
309	Lahti Gasification Facility (Kymijärvi II)	Finland	830	50.0	16,100	2009	2012	DBO	Solicited	Fluidized bed
310	Allington Energy from Waste (EfW) Incinerator	United Kingdom	1,500	43.0	6,500 - 12,500	2004	2008	-	Solicited	Fluidized bed
311	Brussels Waste-to-Energy plant*	Belgium	1,368	20.0	9,000	1984	-	-	Solicited	Grate
312	Sysav South Scania Waste-to-energy plant	Sweden	2,100	833.3	-	-	1973 (1st/2nd), 2003 (3rd), 2008 (4th)	-	Solicited	Grate
313	Lejonpannan (CHP Plant)	Sweden	770	83.5	10,500	2013	2016	-	Solicited	Grate
314	Dåva kraftvärmeverk (Deaf 1)	Sweden	750	310.0	-	2000	-	-	Solicited	Grate
315	Mainz Waste-to-Energy Plant	Germany	1,130		9,815	-	2003, 2008	-	Solicited	Grate
316	Pfaffenau Waste Incineration Plant	Austria	830	14.0	-	2006	2008	-	-	
317	Riikinvoima Ekovoimalaitos WtE Plant	Finland	480	54.0	-	2014	2017	-	-	Fluidized bed
318	Palm Beach Renewable Energy Facility 2	USA	3,000	95.0	-	2012	2015	DBO (20yrs)	Solicited	Grate
319	SEMASS Resource Recovery Facility	USA	3,000	78.0	11,630	-	1989	-	Solicited	
320	Montgomery County Resource Recovery Facility	USA	1,830	55.0	-	-	-	-	Solicited	Grate

Note: “-“ means the data was not able to obtain,

Note: ID100-199: Cases of Japan, ID201-299: Cases of other Asian countries, ID301-399: Cases of EU and North American countries

Sources: ITWG Subgroup Output 1

3.2 Examples of the collected information for the Cases

The pertinent information gathered from each WtE-ACC facility in the 60 collected cases is compiled into 2 slides consist of “profile of the facility” and “salient features” (See Appendix 2). The compiled information of the two cases is shown below as examples. The most survey contents were filled for these two cases but for some cases where information was not available, certain cells were left blank.

(1) Ota Incineration Plant, Tokyo, Japan

Ota incineration plant is located in the land area of 9.2 ha in Ota ward in Tokyo Metropolis, which is operated by the implementation body, the Clean Authority of Tokyo (CAT23). The plant has been planned in 2006, which is 4 years before the bidding by CAT23. It is the union responsible for WtE-ACC facilities in 23 wards (LGUs) of Tokyo Metropolis and owns and operates 21 WtE-ACC facilities. Because approximately every 3-5 years, they have to develop new construction plan of WtE-ACC, it has much capabilities and know-hows of WtE-ACC procurement and operation.

The bid for Ota incineration plant whose treatment capacity is 600t/day was announced and was awarded for design-build EPC contractor. Design and construction period are for 4 years from 2010 to 2014 and operation was started from 2014 as planned in 2006.

The plant has two lines and the capacity of each line is 300 tons/day. The main heat usage in the plant is electricity generation and they generate 22.8 MW of electricity. The LCV of municipal waste in the design is around 14,800 kJ/kg. The target waste is combustible waste which is transported to the plant by separate collection from the waste collection points. The CAPEX is around JPY19 billion (around US$200 million) and OPEX is JPY1.5 billion (around US$16 million). The revenue sources of CAPEX and OPEX are indicated in the figure below.

The collection and transportation are implemented by the ward, municipal solid waste incineration, power sale and final disposal is implemented by the ward too. The adopted process types, which is the type of furnace such as stoker and fluidized bed combustion, is stoker type. The applied standards of pollution control are set as stricter than the national standards of Japan and they utilize wet scrubber, selective catalytic reactor, and bag filter. Wastewater is discharged into public sewerage after the treatment. Bottom ash is utilized for cement material which is called as eco-cement and fly ash is disposed of at the landfill site after stabilization.

Ota Incineration Plant / Researcher: JET

Name	Ota Incineration Plant	Location	Ota ward, Tokyo, Japan
Impl. Body	Clean Authority of TOKYO	Footprint	9.2ha
Capacity	600t/d (300 x 2lines)	Heat Usage	Power 22.8MW
Target Waste	Source segregated "Combustible Waste"	Waste Quality	14,800 KJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	2006	-	2010	2010	2014	2014	2039	2039
Actual	2006	2008.4	2010	2010.6	2014.9	2014.9		

Capex	18.797 B-JPY	Source ('12-14)	NG Subsidy (30%), Bond (50%), LG (20%)
Opex	1.486 B-JPY/yr (2019)	Source ('18-19)	LGs' share (57%), TF (26%), Energy (17%)
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG (ward)	LG (ward)	LG	LG	LG	LG

Process Type	Incineration (Stoker),	EPC / Tech	Takuma (JPN)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Scrubber + SCR + Bag Filter)	Discharge to Sewage	Eco-cement	Provincial SLF after chemical treatment	

NIPPON KOEI EJEC 1

The features of this case are summarized in the slide of "Description of salient features" as shown in **Table 3.2**. Three features are highlighted: 1) the smooth implementation of the project, as actual schedule is as same as planned in 8 years before commercial operation, which means no delay, 2) the regular monitoring reports were published for public and the visit tours at the plant for residents to build the trust and the relationship were conducted as well, 3) LGU prepare the plan and adopt solicited approach for tender process. During the planning stage, they prepare the budget for investment and operation and maintenance for this project.

Table 3.2 Salient Features of Ota Incineration Plant

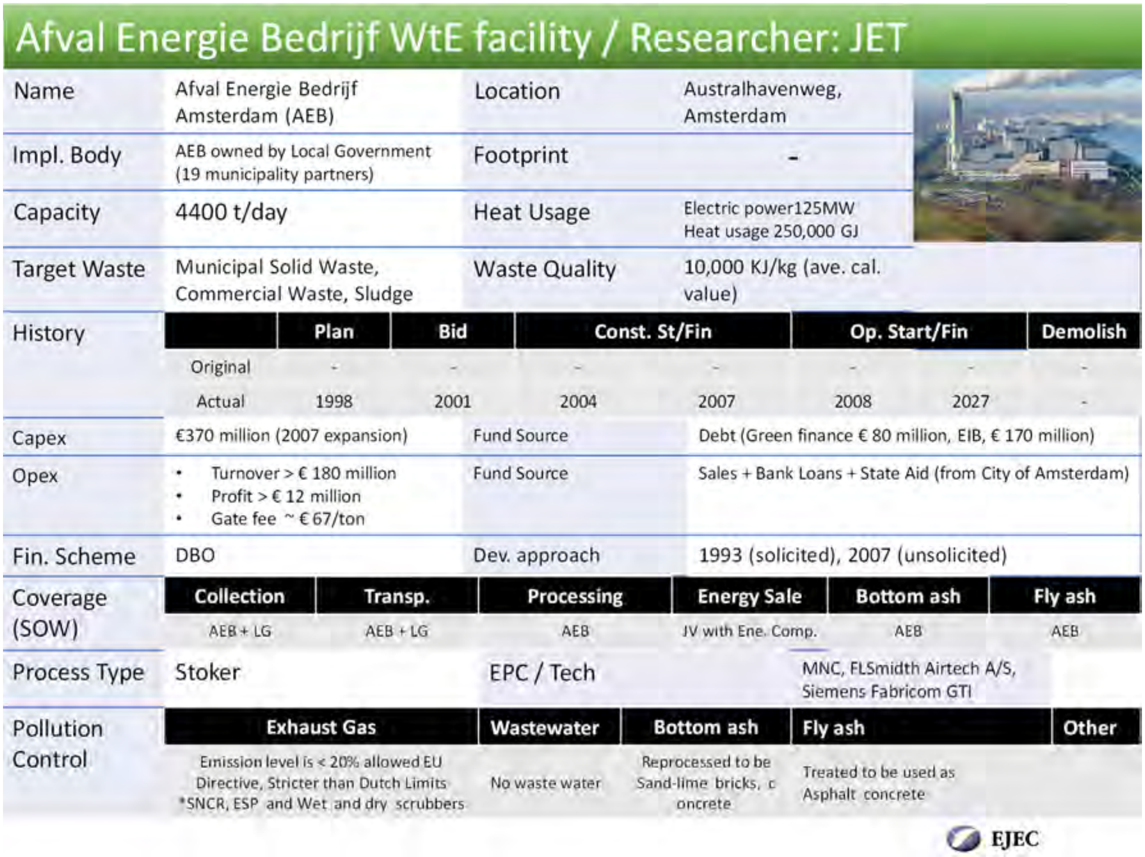
Salient Features	Explanation
Smooth Implementation	According to the planned schedule of planning, design, bidding, construction and operation, the actual activities have been implemented without significant delay.
Build trust in the relationship with residents	From planning stage, environmental consideration has been implemented and monitoring report is periodically published to the public.
Strong ownership of LG (Solicited x Budget)	LG adopt the solicited approach for tender process as well as their planning and budget preparation with support of central government.

Source: Analyzed by ITWG Subgroup Output1

(2) AEB plant, Amsterdam, Netherland

Afval Energie Bedrijf (AEB) plant is located in Amsterdam and the implementation body is AEB, a service branch of the city of Amsterdam that the City of Amsterdam is the sole shareholder. The capacity of the facility is totally 4,400 tons/day, which includes 6 lines. Though there is no information of planned schedule, it takes around 6 years from 1998 to 2004 for planning and bidding and the construction period is around 3 years from 2004 to 2027. After the period, the operation is planned as 20 years.

The main heat usage in the plant is electrical power generation and community heating. The electricity generation capacity is 125 MW. The planned LCV of waste quality is around 10,000 kJ/kg. The target waste is municipal solid waste, commercial waste, and sludge. CAPEX is around € 370 billion (around US$440 billion). The OPEX is not clear but the turnover is €180 million (around US$210 million) by tipping fee € 67/ton (US$80/ton). The coverage indicates that collection and transportation is implemented by AEB and surrounding local governments. Except energy distribution, AEB implements the WtE-ACC operation and final disposal of bottom ash and fly ash. The type of process of the facility is the stoker. The applied pollution control standards are stricter than EU Directive as well as Netherland national standards. Scrubbers and Selective Catalytic Reactor are installed and operated. The plant applies the closed system to prevent wastewater discharge. Bottom ash is utilized for cement material or sand-lime brick.



Afval Energie Bedrijf WtE facility / Researcher: JET

Name	Afval Energie Bedrijf Amsterdam (AEB)	Location	Australhavenweg, Amsterdam
Impl. Body	AEB owned by Local Government (19 municipality partners)	Footprint	-
Capacity	4400 t/day	Heat Usage	Electric power125MW Heat usage 250,000 GJ
Target Waste	Municipal Solid Waste, Commercial Waste, Sludge	Waste Quality	10,000 KJ/kg (ave. cal. value)

History	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	1998	2001	2004	2007	2008	2027	-

Capex	€370 million (2007 expansion)	Fund Source	Debt (Green finance € 80 million, EIB, € 170 million)
Opex	• Turnover > € 180 million • Profit > € 12 million • Gate fee ~ € 67/ton	Fund Source	Sales + Bank Loans + State Aid (from City of Amsterdam)
Fin. Scheme	DBO	Dev. approach	1993 (solicited), 2007 (unsolicited)

Coverage (SOW)	Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
	AEB + LG	AEB + LG	AEB	JV with Ene. Comp.	AEB	AEB

Process Type	Stoker	EPC / Tech	MNC, FLSmidth Airtech A/S, Siemens Fabricom GTI

Pollution Control	Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
	Emission level is < 20% allowed EU Directive, Stricter than Dutch Limits *SNCR, ESP and Wet and dry scrubbers	No waste water	Reprocessed to be Sand-lime bricks, c oncrete	Treated to be used as Asphalt concrete	

EJEC

The features of this case are summarized in the slide of "Description of salient features" as shown in **Table 3.3**. Three features of the case are 1) the large treatment capacity by transporting wastes including 19 surrounding municipalities, 2) the high thermal efficiency as net efficiency of electricity generation is approximately more than 30%, 3) efficient transport of waste by utilizing train or barge.

Table 3.3 Salient Features of AEB plant

Salient Features	Explanation
1. High Capacity	The plant can process 4400 t/d, an average 1,400,000 tons of waste + 100,000 tons of sludge per year.
2. High Thermal Efficiency	The newest two lines of the Amsterdam moving grate combustion plant utilizes reheat Rankine steam cycle which produces electricity with a net efficiency of >30%. The annual availability is reported to be >90%.
3. Efficient Transport of Waste due to Plant Accessibility	Waste are shipped partly through barges and through railway. The presence of link roads and a railway makes the site easily accessible.

Source: Analyzed by ITWG Subgroup Output1

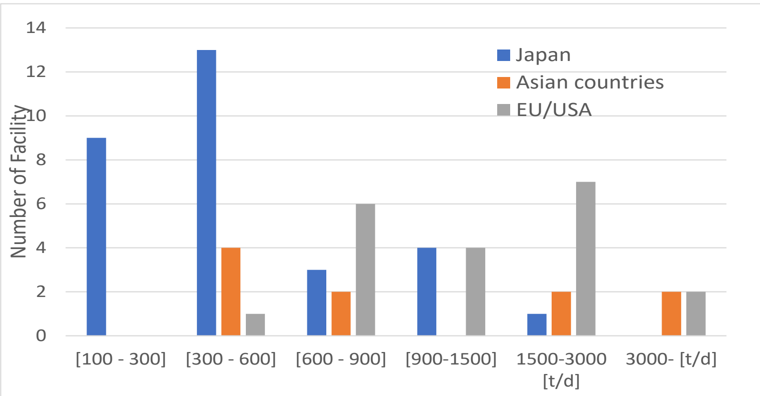
Chapter 4. Results of the Case Studies

4.1 Technical Aspects

4.1.1 Capacity of WtE-ACC Facility

(1) Total Capacity of the WtE-ACC Facility

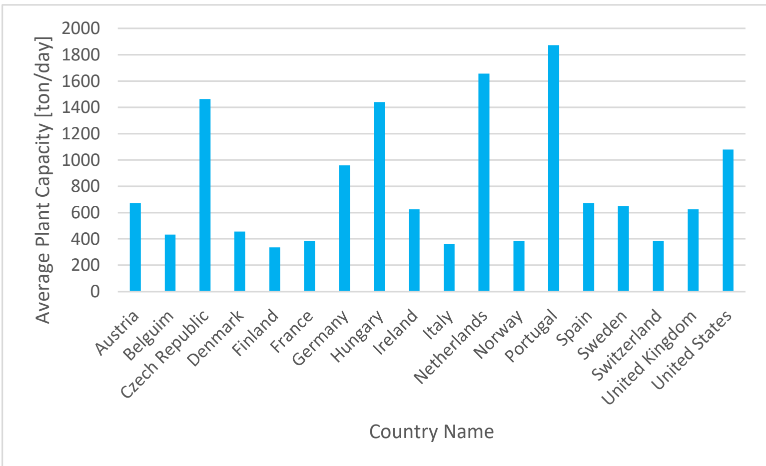
The distribution of the WtE-ACC facilities in the case study is shown in **Figure 4.1**, which is categorized by the treatment capacity ranges. The minimum treatment capacity is 120tons/day for Musashino Clean Center (ID[5]126, Japan) while the maximum, capacity was 4,400tons/day of Afval Energie Bedrijf Amsterdam (ID301, Netherland).



Source: ITWG Subgroup Output1

Figure 4.1 Capacity of WtE Facilities of the Case Study

In EU, the capacity of 6 country WtE-ACC cases is more than 1,500 tons/day out of the 17 cases, which count for 35%. According to the ISWA data (see Figure 4.2), the average capacity of WtE-ACC facilities in 5 countries of EU exceed 600ton/day out of 17 countries. It is analyzed that the bigger capacity, more than 1,000 ton/day, of WtE-ACC facilities are commonly developed in EU and USA. This is because they promote bigger capacity and high efficiency WtE-ACC facility in the energy policy and also promote clustering of local government units to gather more waste.



Source: Waste-to-Energy State-of-the-Art-Report 6th Edition ISWA

Figure 4.2 Average Capacity of WtE facilities in EU and USA

On the other hand, Japan has less capacity where most of the cases are

[5] ID corresponds to ID number in **Table 3.1**.

between 100 ton/day to 600 ton/day, according to the statistic of Ministry of Environment, Japan, as shown in **Table 2.2**. Three (3) cases out of 30 WtE-ACC facilities in the case study have the capacity more than 1,000 ton/day.

In Japan, in principle, all LGUs shall treat their municipal waste in their jurisdiction to avoid waste transportation beyond the boundary. Because of this principle and the national governmental policies including subsidy, during and after high-economic development in 1960s onward, individual small-scale LGUs developed and own their combustion facilities and management of waste by combustion became common since the 1970s. Then, due to the following situations, many relatively small-scale WtE-ACC facilities are still existing.

・ Old facilities like 6 cases in the case study which started operation in 1990s, are still being operated after drastic rehabilitation

・ The default management system is maintained even when the facility is renewed.

・ National Government (Ministry of Environment Japan) subsidise 1/2 to 1/3 of CAPEX for all WtEs-ACC regardless the capacity of facility planned by LGUs as long as the project plan meets the regulation.

・ Small-scale facility is accepted for remote islands and areas where the collection and transportation distance is long.

(2) Capacity of a Single Furnace

The maximum capacity of a single furnace is around 1,000 ton/day for a 24-hour operation for the case of stoker type incinerators. One thousand (1,000) tons of treatment capacity was confirmed in the Palm Beach Renewable Energy (ID 318, USA) and the Semass Resource Recovery (ID319, USA). The maximum capacity of the fluidized bed type is 200tons/day confirmed in Toshima Incineration plant (ID123, Japan) while this information is available only 2cases.

In the planning and design stage of WtE-ACC facilities, maintenance period of the combustion furnace should be considered. For a facility that consists of multiple furnaces give a benefit that the facility is not required to suspend operations during the maintenance period. The cases adopting multiple furnaces reported by the case study is shown in **Table 4.1**.

Table 4.1 Number of Furnace Lines and Treatment Capacity of Single Furnace

Lines of Furnace	Cases	Minimum	Maximum	Note
1	1	720	720	ID308, Incineration Line 6, Denmark
2	13	60	450	
3	11	100	1,000	
4	2	200	750	
5	1	340	340	ID201, Tuas Incineration Plant, Singapore
No information	32	-	-	
Total	60	60	1,000	

Source: Analyzed by ITWG Subgroup Output1

4.1.2 Combustion Technology

The stoker type of furnace is adopted in 83% of cases (48 out of 58 cases). This trend is confirmed in all regions in the study. It is analyzed that the stoker type (moving grate)[6] is the most common because this technology has a long historical experience and a stability in operation.

Table 4.2 Type of Combustion Furnace in the Case Study

	Fluidized bed (FB)	Stoker	Gasification and Melting (GM)	FB, GM	Cases
1. East Asia	3	25	3	1	32
2. Southeast/South Asia	0	8	0	0	8
3. EU	3	13	0	0	17
4. North America	0	2	0	0	3
Total	6	48	3	1	58
Ratio (%)	10	83	5	2	100

Note: No information in two cases (one in EU and one in North America) out of 60 cases.

Source: ITWG Subgroup Output1

The characteristic of the two dominant furnace types, stoker type (Moving Grate) and fluidized bed combustion type, is shown in **Table 4.3**. Although the Fluidized Bed has an advantage given that a smaller space required for installation, the capacity of single furnace is much lower than a stoker type. In terms of environmental and social aspects, both types of furnace can meet requirements specified

6 https://www.researchgate.net/publication/304401875_Energy_Recovery_from_Municipal_Waste_based_on_Moving_Grate_Technology/fulltext/578e5b4708aecbca4caacd6a/Energy-Recovery-from-Municipal-Waste-based-on-Moving-Grate-Technology.pdf?origin=publication_detail

in the conditions of the contract. No significant difference in the initial cost per unit tons of waste is found between both types in the experiences of Japan.

Table 4.3 Comparison of Two Combustion Technologies Dominant in the Case Study

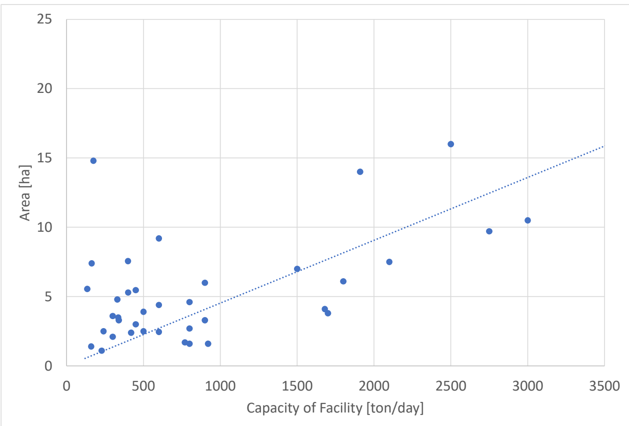
Items	Stoker Type	Fluidized Bed Combustion Type
Type of acceptable waste	- Various types of municipal solid waste - Waste with very high calorific value - Liquid waste	- Various types of municipal solid waste - Bulky waste needs to be shredded to input
Capacity of single furnace	- Less than 1,000 tons/day (24 hours)	- Less than 200 tons/day (24 hours)
Advantage	- High reliability - Less electricity utilization - Higher capacity of treatment - No need for shredding of bulky waste before combustion	- High combustion speed - Less oxidation of metal - Requires a smaller space of combustion furnace than stoker type incinerators
Disadvantage	- Much auxiliary fuel is necessary for starting the process of combustion - Bigger area required than Fluidized Bed Type	- Waste shredding required for bulky waste before feeding to combustion furnace - Lower capacity than stoker type - High ratio of fly ash - Relatively difficulty of Combustion control

Source: ITWG Subgroup Output1 based on Guideline for Planning and Designing of Waste Treatment Facility Development in Japan (2017)

4.1.3 Required Area of WtE-ACC Facility

A WtE-ACC facility needs a sufficient area for a facility building that includes a waste receiving pit, combustion furnace, energy recovery facility, air pollution control facility, stack, inside roads and buffer zone.

The area of WtE-ACC facilities in the collected cases is shown in **Figure 4.3**. It is analyzed that approximately 2 to 4 ha/1,000tons/day is necessary.

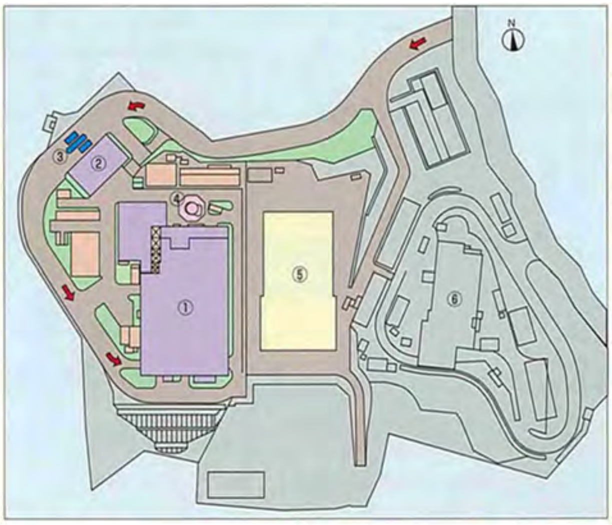


Source: ITWG Subgroup Output1

Figure 4.3 Area of each WtE facility

The total area and footprint basically depend on the capacity of the WtE-ACC facility. The area also depends on the supplemental facilities to be added, such as material recovery facilities (like a crushing facility, separation conveyor, plastic baler), ash storage area, pretreatment facility, and heat utilization facility, to name a few. (ex. Tobuki Incineration

Plant (ID106, Japan) as shown in **Figure 4.4**. Additionally, there are other considerations that affect the area requirement per supplemental facility. The buffer zone for example, depends on the surrounding condition and environmental regulation in each country. For example, in Japan, the Factory Location Law (1959) stipulates necessary green area and environmental facility like park or sports area while the distance as buffer zone for the surrounding communities is not required. As shown in the following pictures, some WtE-ACC facility are constructed in the center of city, where the wide land for the construction of WtE-ACC facility is not available. If the prevention measure of air pollution by stack, air pollutants control system, mitigation measure of noise and vibration is adopted, the WtE-ACC facility can be constructed in the urban area.



Note: (1) Incineration plant, (2) Office, (3)Truck weighing station (4)Stack, (5)Incombustibles Treatment Center, (6)Plastic Recycling Center (7)Tobuki Yuttari Hall
Source: Tobuki Incineration Plant

Figure 4.4 An Example of WtE-ACC Facilities Layout

	
Wien-Spittelau, Vienna, Austria (ID306) Source: Leaflet of Wien Energie GmbH	Shibuya Incineration Plant, Tokyo, Japan (ID124) Source: Clean Authority of Tokyo

Figure 4.5 Examples of WtE-ACC Facility located in the Center of the Urban Area

4.1.4 Category of Target Waste for Combustion

As confirmed in the case study, in Japan, the target waste of incinerators is mainly “combustible waste” defined and announced by the local government as a rule and an obligation in the waste collection target area, which shall be consistent with their municipal solid waste management plan. Waste generators such as citizens and business owners separate deposit and discharge their waste for collection process following the rule. Normally, industrial waste is to be managed under the responsibility of waste generators and treated in an industrial waste incinerator. WtE-ACC facilities such as Higashisaitama (ID105) and Hamamatsu (ID120) also treat sewerage sludge with combustible municipal waste. Some facilities also receive disaster waste in emergency cases in the case of earthquakes and flood disaster that is frequently experienced in Japan.

In EU and USA, the target waste of WtE-ACC facility is mostly reported as municipal solid waste and non-hazardous industrial waste. Normally, definition of combustible waste is not used, unlike Japan. According to the reference document of some case studies, the separate collection is implemented, and the target wastes for WtE-ACC facility are the waste residue after separation of recyclable waste and compostable waste. It is assumed that the target waste may include the residues from the Mechanical Biological Treatment (MBT) facility after the separation of recyclable plastic, metal, paper, and/or compostable waste as well as municipal solid waste which is directly collected from households and business establishments.

In addition to municipal solid waste, Sysav South Scania (Sweden, ID312) and Lahti Gasification (ID309, Finland) accept industrial waste, and Klemetsrud Combined Heat and Power (ID302, Norway) treats hospital waste. There is no information available, but it seems that different tariffs may be applied to the waste received other than municipal waste. Palm Beach (ID 318, USA) targets “unprocessed waste”. It cannot be determined whether it means "garbage that is not subject to processing by another method" or "accepted without processing at all".

In the case of Southeast and South Asian countries, the target waste is defined as municipal waste (5cases) or combustible waste (2cases). It is supposed that mainly mixed collected municipal solid wastes are treated by the WtE-ACC facilities because many localities have not practiced the separate collection, and the completeness of waste separation is poor even when the separate collection is introduced in the LGUs in these regions.

The combustion furnace, either stoker or fluidized bed type, can accept most of type of waste. Even incombustible waste such as metal, concrete brick or liquid waste can be treated while it is not desirable. However, nowadays, each local government defines the type of waste for WtE-ACC to sustain their waste management. This must be the same in the Philippines.

4.1.5 Physical Composition of the Target Waste

The physical composition of target waste data which are only available in the case studies of Japan are shown in **Figure 4.6**. The maximum, minimum and average rates are shown in **Table 4.4**. The range of physical composition of paper/cloth, which is highest ratio is 42.6 to 63.5 % and its average is 51.8%. The range of food waste is 5.3% to 19.6 % and its average is only 9.4%.

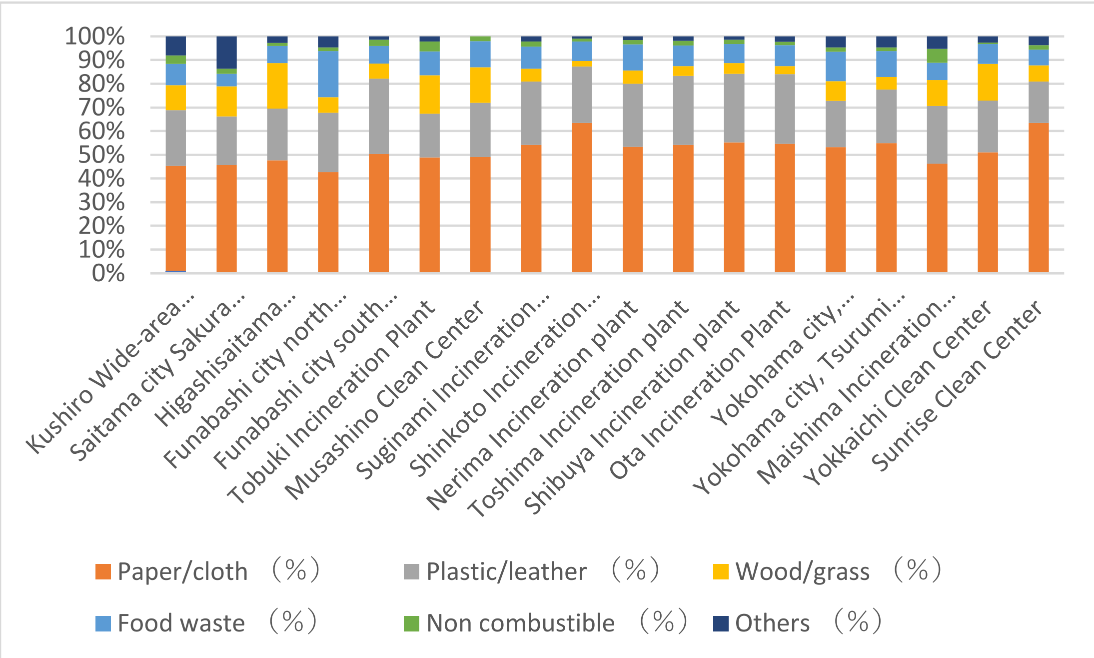
The comparison of physical composition of the target waste of WtE-ACC facility in Japan and Vietnam is shown in **Figure 4.7**. In the case of Vietnam (Can Tho, ID207), the ratio of food waste is 40.3% and pater/cloth is 16.8%. The ratio of plastic and leather is 24.2% in facilities of Japan and 17.5% in Vietnam. The date implies the higher LCV of facilities in Japan, because food waste, which contains more moisture usually, has lower calorie and plastic has higher calorie as shown in **Table 4.5**.

Table 4.4 Physical Composition of the Target Waste in WtE-ACC Facilities in Japan

	Paper/cloth	Plastic/ leather	Wood/grass	Food waste	Non-combustible	Others
Maximum	63.5	32.0	19.3	19.6	5.9	13.6
Average	51.8	24.2	8.8	9.4	2.2	3.6
Minimum	42.6	17.4	2.4	5.3	0.7	0.0

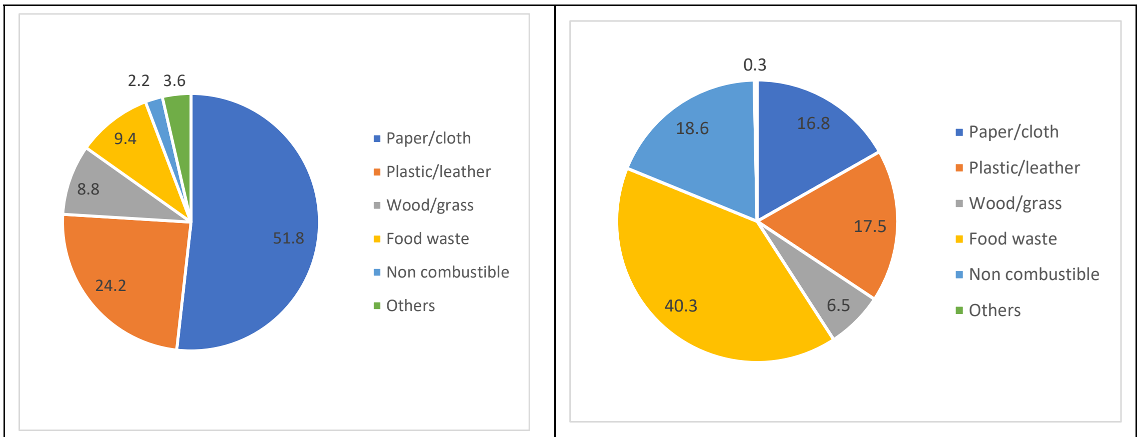
Unit: %

Source: ITWG Subgroup Output1based on the data of Ministry of Environment Japan (2020)



Source: Ministry of Environment Japan (2020)

Figure 4.6 Physical Composition of Waste in the WtE-ACC facilities in Japan



Japan (Average of the Case Study)	Can Tho solid waste treatment plant (ID207)

Source: ITWG Subgroup Output1 based on the Ministry of Environment, Japan

Source: Environmental and Social Impact Assessment Report of Can Tho Waste to Energy Project

Figure 4.7 Waste Physical Composition (the Cases in Japan, Can Tho in Vietnam)

Table 4.5 Lower Calorific Value of Municipal Solid Waste by Material

Material	Lower Calorific Value [kJ/kg] (Dry base)	Lower Calorific Value [kJ/kg] (Wet base)
Paper	14,700	9,400
Kitchen waste	14,300	500
Textile	19,100	14,900
Wood, grass	8,700	5,400
Plastic	34,900	28,900
Leather/Rubber	26,800	25,300

Note: The data is average LCV measured after the separation for each physical composition at WtE-ACC facilities of Metropolis Tokyo

Source: Formula, Model and Numerical Data of Environmental Technology and Science (2004)

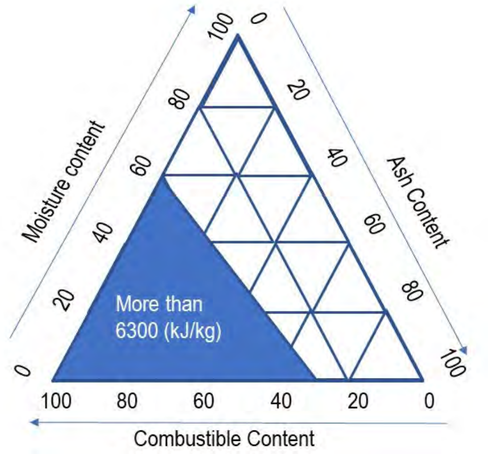
4.1.6 Moisture and Combustible and Ash Contents of the Target Waste (Three Components), Bulk Density

The data of moisture, combustible, and ash ratio of waste, so called “Three Components”, and bulk density are frequently referred to in the planning of WtE-ACC facilities. This information which were only obtained in the case studies of Japan, are shown in **Table 4.6**.

The values of 3 components are used for the design of furnace, heat mass balance and ash discharge systems while bulk density of target waste is to calculate the capacity of pre-treatment facility, waste pit (bunker), and hopper.

According to the research of National Institute for Environmental Study of Japan, moisture content, combustible and ash content should be within the blue triangle zone shown in **Figure 4.8** and LCV should be more than 6,300kJ/kg (1,500 kcal/kg) for suitable combustion. The values of three components in **Table 4.6** fall in the zone.

The range of three components such as moisture content, combustible, ash content in the target waste is shown in **Table 4.6**. The range of moisture contents is from 33.3 to 52.6 % and the range of combustible is 41.1 to 60.2 % and the range of ash is 4.7 to 10.7 %, and each average of moisture, combustible and ash components is 40.9 %, 52.0 % and 7.1 % of Max contents. The value of bulk density of the target waste ranges from 104. 3 to 235.0 ton/m3 and the average is 145.8 ton/m3 according to information of the Ministry of Environment, Japan (2020).



Source: National Institute for Environmental Study of Japan

Figure 4.8 Values of Moisture, Combustible and Ash Content for Suitable Combustion

Table 4.6 Three Components of the Target Waste (Cases in Japan)

	Moisture (%)	Combustible (%)	Ash (%)	Total (%)
Average	40.9	52.0	7.1	100.0
Maximum	52.6	60.2	10.7	100.0
Minimum	33.3	41.1	4.7	100.0

Source: ITWG Subgroup Output1 based on the data of Ministry of Environment Japan (2020)

4.1.7 Lower Calorific Value of the Target Waste

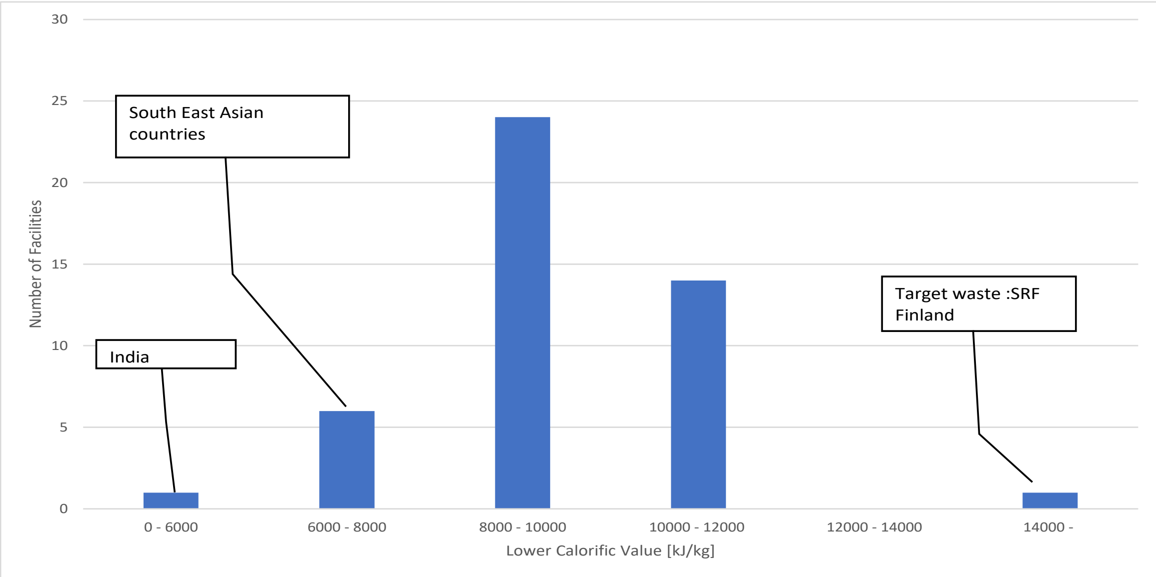
It is confirmed that most of the average LCV of WtE-ACC facilities design are around 8,000 kJ/kg to 10,000 kJ/kg. In the reference documents of the cases, actually, the maximum and minimum thresholds of acceptable LCV of the facilities are commonly not disclosed though the average value is given.

The LCVs of the cases are shown in **Figure 4.9**. In the developed countries such as EU, USA and Japan, it is normal that the LCV is more than 8,000 kJ/kg. The highest value found in the case study is 16,100kJ/kg of the Kymijarvi II (ID309, Finland) which is receiving Solid Recovered Fuel (SRF, higher LCV category of Refused Derived Fuel in EU).

On the other hand, in the cases of countries in Southeast and South Asia, the LCV is less than 8,000 kJ/kg. As a typical case, the reported LCV is only at 4,200 kJ/kg in India (ID209, Jabalpur WtE facility). As seen in **Figure 4.7**, the low-calorie material such as food waste may occupy bigger portion in waste composition in Southeast/South Asia, which could be the reason of lower value of the LCV.

It is described in “The Design and Planning Procedure of Waste Treatment Facility” in Japan published in 2017 that the LCV normally requires 4,200 to 5,000 kJ/kg at least to maintain suitable combustion conditions, while NIES stated that stable operation requires more than 6,300kJ/kg as shown in **Figure 4.8**. In this sense, the value of the facility in India meets the minimum value in the document. In fact, the LCV of waste in the developed countries could sometimes be less than 4,200 kJ/kg depending on waste materials and its nature such as moisture contents.

The LCV of waste to be treated in the WtE-ACC facilities may meet the facility requirement by incorporating a process to homogenize waste characteristics and to reduce moisture by drying before inputting to the combustion furnace. Even if the waste cannot be well incinerated, supporting combustion functions through an external energy burner by utilizing auxiliary fuel like diesel oil could be adopted. However, frequent use of auxiliary fuel requires more cost. That is why the appropriate waste quality specification are vital for WtE-ACC.



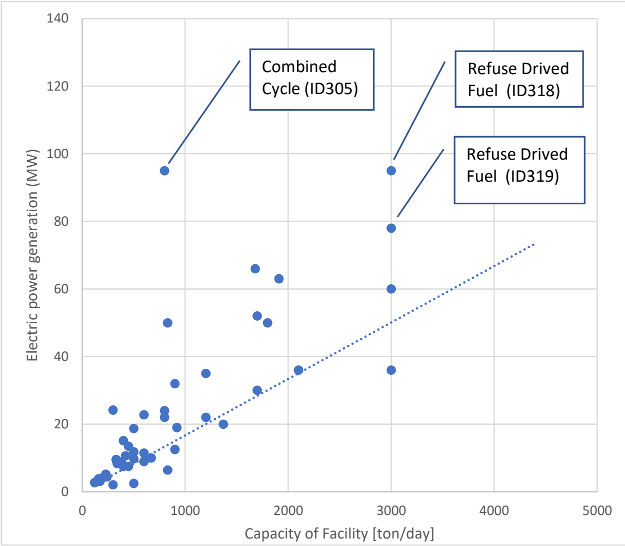
Source: ITWG Subgroup Output1

Figure 4.9 Lower Calorific Value of the Target Waste in WtE-ACC facility

4.1.8 Thermal Energy Recovery Process

(1) Relationship between the Capacity of WtE-ACC and Electric Power Generation

Electric power generation accords on the capacity of the WtE-ACC facility in general as shown in **Figure 4.10**. The bigger treatment capacity is preferable in terms of electricity generation and its efficiency. According to the experiences of WtE-ACC facilities in Japan, the electric power generation efficiency of WtE-ACC facilities of less than 50 tons/day is much lower than the WtE-ACC facility which has the capacity of a few hundred tons per day (See **Table 2.2**).



Source: ITWG Subgroup Output1

Figure 4.10 Electric Power Generation by Capacity of WtE facility

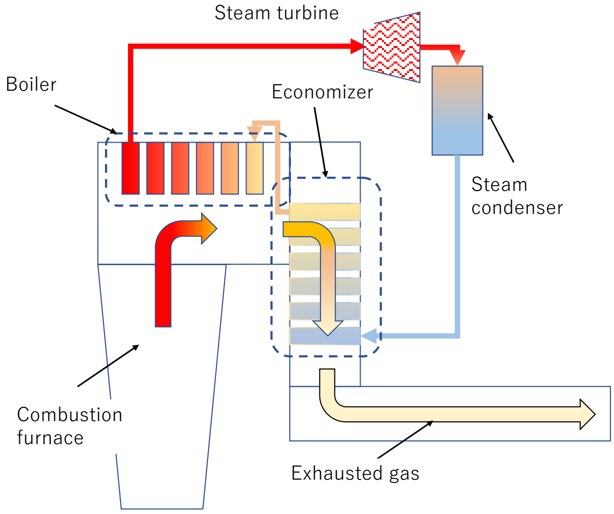
In addition to lower efficiency, in the case of cities which do not generate more than 100 tons/day of municipal waste, the treatment capacity of WtE-ACC facility may be as small as 100tons/day but it will not be able to yield excess electricity to be sold to outside such as power companies. The advantage of having a large-scale combustion facility is that surplus electricity can be sold to an electric power company.

(2) Efficiency of Electricity Generation

Heat exchange rate, effective utilization of exhausted gas and the efficiency of steam turbine system could also affect the recovery rate or efficiency.

In the case of combined cycle, thermal energy of exhausted gas of turbine generator by fossil fuel is utilized in combined system, so that the electric power generation is much higher than normal cases. For RDFs, where the target wastes are higher calorific materials like paper and plastic, the electric power generation is higher than normal cases.

The typical energy recovery process is shown as **Figure 4.11**. In the process of energy recovery, the thermal energy in combustion gas is changed into a superheated steam in the boiler. The superheated steam is transferred to a steam turbine generator, where the steam turns the turbine generator thereby causing electricity generation. The steam from turbine generator is cooled into hot water by the steam condenser. On the other hand, the exhausted gas which exchanged the heat in the boiler, goes to an economizer to preheat the hot water. The heated hot water is transferred to the boiler to exchange the heat to become steam.



Source: ITWG Subgroup Output1

Figure 4.11 Electric Power Generation Process

Steam can also be extracted from the turbine at an intermediate lower pressure stage, which is used in this plant or to export surplus thermal energy to supply a district heating network or to supply other necessary facilities of thermal energy.

Electricity generation efficiency highly depends on stream temperature and pressure. As, in cases in EU and USA, steam temperature and pressure are higher than the cases of Japan, and the electricity generation efficiency in EU and USA is higher than cases in Japan as well. For example, in the case of Afval Energie Bedrijf Amsterdam (ID301, Netherlands), the steam temperature is around 420°C and pressure is around 13MPa, electricity generation efficiency is around 30%. In case of ASM Brescia (ID304, Italy), the efficiency is around 30% with steam temperature is 450– 480°C and pressure is 6 to 7 MPa.

However, it is also noted that high steam temperature and pressure may cause corrosion of the boiler steam tube, which result in corrosion in a shorter period of operation.

From this information, we infer that the replacement period for the boiler steam tube in Japan is longer compared to EU or USA because boiler temperature and pressure are lower in facilities in Japan. In the case of Tsurumi Incineration Plant (ID130, Japan), boiler temperature is around 400 °C and pressure is around 3.9MPa.

The technology options for promoting effective power generation are summarized as **Table 4.7**.

Table 4.7 Technology Options for Efficient Power Generation

Item	Technology	Explanation
- Increase of heat exchange capacity	- Reduction of exit temperature of economizer	- Utilization of lower temperature economizer to reduce the thermal energy of the exhaust gas
	- Lower air ratio combustion or combustion gas recirculation by advanced combustion control	- Use of enhanced process control will maximize the combustion efficiency to ensure maximum burn-out of the organic waste content and reduce excess air levels - Optimum oxygen levels can be achieved using combustion gas recirculation;
- Effective utilization of steam	- No utilization of steam for reheating of exhausted gas after cooling	- Introduction of low temperature catalyst de-nitrogen or high efficiency dry exhausted gas treatment system - In case of wet exhausted gas treatment system, exhausted gas is necessary for reheating which consumes heating energy, and causes the reduction of power generation efficiency
	- No introduction of reheating system of exhausted gas after the treatment to prevent white fume	- In case of the introduction of reheating system of exhausted gas to prevent white fume, thermal energy will be utilized for reheating, which causes the reduction of energy efficiency
	- No utilization of wastewater closed system	- In case of utilization of closed system of water usage, the temperature at boiler exit has to be set at a higher temperature, which will cause the reduction of boiler efficiency.
- Increase of the efficiency of steam turbine system	- Introduction of high temperature and pressure boiler (high steam pressure and superheat temperature）	- Increasing steam pressure and temperature will increase the enthalpy of the steam and allow greater energy to be recovered in the steam turbine. - To increase high temperature and pressure, it is necessary to use corrosion prevention metal and frequent maintenance, or overhaul will be needed for decreasing the lifetime.
	- Introduction of steam condensing turbine	- Steam condensing turbine contribute to the reduction of air pressure in the outlet of turbine which increases energy efficiency
	- Water cooled steam condenser	- Heat energy difference between inlet and outlet by utilizing water cooling method increase will increase energy exchange efficiency. The water in cooling tower waste, river water or sea water can be utilized for that.
	- Combined cycle with fossil fueled-fired power plant (external superheating)	- Exhaust gas from gas turbine generator will add to the energy by combustion gas from WtE-ACC, which cause the increase of energy efficiency
- Increase of thermal energy	- Increase of waste quantity to be incinerated (capacity of WtE-ACC facility)	- Increase of incinerated waste quantity affects the enhancement of energy efficiency. However, it is arguable whether a few of large WtE-ACC facilities or a large number of relatively small WtE-ACC facilities should be constructed. - In case of large capacity of WtE-ACC, there is large impacts of the suspension due to the large maintenance or overhaul activity.

Source: ITWG Subgroup Output1 based on Guideline for Planning and Designing of Waste Treatment Facility Development in Japan (2017)

(3) Thermal Utilization other than Electricity Generation

The surplus heat recovery from electric energy generation process can contribute to the greater efficiency of thermal energy utilization. Steam extracted from the turbine can be used directly for process heating within the facility, used for other industries, or used to produce hot water for a district heating network.

In EU and USA, incineration power generation is carried out and surplus energy is used as heat at the same time. There are cases where the rate of local heating is bigger than power generation, as in the case of Amager Bakke (ID306, Denmark) and Wien-Spittelau (ID307, Austria).

In Japan, there are many cases of power generation for electricity distribution and the surplus energy is utilized for other uses such as hot water pools (ex. Ozenji Treatment Center, ID118, Japan), spas (ex. Tobuki Incineration Plant, ID106, Japan) and a heating of botanical garden (Shinkoto Incineration Plant, ID 102, Japan).

Source: Hachioji City
SPA in Tobuki Incineration Plant, ID106)

Source: Clean Authority of Tokyo
Heating of botanical garden in Shinkoto Incineration Plant, ID102)

Figure 4.12 Examples of Thermal Utilization other than Electricity Generation

The utilization methods of heat energy other than electricity generation are summarized in **Table 4.8**, which are useful even though the temperature or pressure of steam is not so high as used for electricity generation. They function as demonstrations to illustrate the multiple purpose that WtE-ACC facilities can provide for the community or citizens near the facility.

Table 4.8 Utilization of Thermal Energy other than Electricity Generation

Item		Explanation
Utilization outside of WtE-ACC facility	Heating system for community, botanical garden	Steam or hot water for community Distance from WtE-ACC facility to beneficiary shall be considered for heating system.
	Hot water swimming pool, hot spa	Hot water swimming pool for recreational purposes

Item		Explanation
Utilization inside WtE-ACC facility	Pre-heating of primary air	To promote effective combustion
	Prevention of fume	Re-heat exhausted gas before its release in the stack to prevents white fume of moisture vapor due to increase in the temperature
	Steam or hot water utilization in the building of facility	Thermal energy utilization as steam and hot water in the WtE-ACC facility

Source: ITWG Subgroup Output1 based on Guideline for Planning and Designing of Waste Treatment Facility Development in Japan (2017)

4.1.9 Environmental Pollution Control

(1) Exhaust Gas Treatment

1) Emission Standard

The compliance to the national emission standards is the requirement to permit the facilities to operate. In fact, all facilities in the case study which provide the data of treated exhaust gas meet the set standards. It is also important to note that in the cases of EU, USA and Japan, facilities set more stringent standards than the national standard. To illustrate, two examples of emission standards are shown in **Table 4.9** and **Table 4.10**. The actual value is even much lower than facility standard in the case of Shinkoto (ID102, Japan) where operational conditions of all WtE-ACC facilities in Japan are open to public. While the mandatory monitoring frequency of Japan and EU are set as in **Table 4.11**, actual monitoring is more frequently conducted also to obtain trust from local community.

Table 4.9 Emission Standard of Exhaust Gas in Japan

Parameter	Japanese Law	Facility standard (Shinkoto, ID102)	Actual
NOx [ppm]	250	60	36 - 41
HCl [ppm]	430	15	<2
SO_2 [ppm]	Area basis	20	<1
Particulates [mg/Nm^3]	80	0.02	<0.001
Mercury [μg/Nm^3]	50	-	<5
DXNs [ng/Nm^3]	0.1	-	<0.00005

Source: Consolidated by ITWG Subgroup Output1

Table 4.10 Emission Standard of Exhaust Gas in EU

Parameter	EU Directive	Facility standard (Isseane, ID303, France)
NOx [ppm]	87.7	28.5
HCl [ppm]	5.5	2.2
SO_2 [ppm]	15.7	7.5
Particulates [mg/Nm3]	9	1.3
Mercury [ppm]	45	13.1
DXNs [ppm]	0.09	0.03

Source: Consolidated by ITWG Subgroup Output1

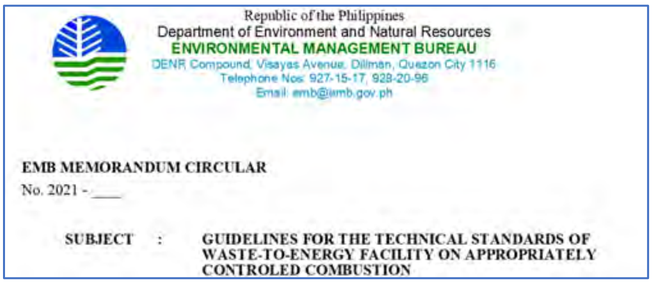
Table 4.11 Monitoring Frequency of Emission Parameter in Japan and EU

Item	O&M/S in Japan (Section 17 above)	Circular (Kansei 95) MOE Japan	EU Directive 2010-75
	Mandatory	Recommendatory	Mandatory
Capacity of WtE →	All	For >200t/d	
DXNs	1/year	-	2/year
SOx	2/year	6/year	Continuous
Dust	2/year	6/year	Continuous
HCl	2/year	6/year	Continuous
NOx	2/year	6/year	Continuous

Source: Consolidated by ITWG Subgroup Output1

Report Draft EMB MC on "Guideline for the Technical Standards of Waste-to-Energy Facility on Appropriately Controlled Combustion"

Draft EMB Memorandum Circular on "Guidelines for the Technical Standards of Waste-to-Energy Facility on Appropriately Controlled Combustion" was crafted by Intergovernmental Technical Working Group for Output 1 of JICA Technical Cooperation Project for Capacity Development on Improving Solid Waste Management (SWM) through Advanced/Innovative Technologies.


Republic of the Philippines
Department of Environment and Natural Resources
ENVIRONMENTAL MANAGEMENT BUREAU
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EMB MEMORANDUM CIRCULAR
No. 2021 - ____

SUBJECT : GUIDELINES FOR THE TECHNICAL STANDARDS OF WASTE-TO-ENERGY FACILITY ON APPROPRIATELY CONTROLED COMBUSTION

This draft Circular is aiming to provide a set of technical standards for the evaluation, establishment, and control of Waste-to-Energy on Appropriate Controlled Combustion (WtE-ACC) Facilities for the proper management of municipal solid wastes in the country to supplement the DENR Administrative Order 2019-21 otherwise known as the "Guidelines Governing Waste-to-Energy (WtE) Facilities for the Integrated Management of Municipal Solid Wastes."

In the draft Circular, exhaust gas standards and its monitoring frequency are stipulated as below;

5.3.6. Monitoring frequency of exhaust gas

Aside of requirement of CEMS installation for the monitoring of operation performance of WtE-ACC facilities, all WtE-ACC facilities shall measure and record the concentration of dioxins in the exhaust gas emitted from chimneys at least once a year, and the concentration of exhaust gas (Limited to the substances related to sulfur oxides (SOx), dust, hydrogen chloride (HCl) and nitrogen oxides (NOx)) at least once in 6 months for the purpose to determination of compliance of NESSAP of DAO2000-81.

In the draft, mandatory monitoring frequency is set as 2 times in a year which is same with Japan while Japanese recommendatory requirement is 6 times in a year as shown in Table 4.11

Report Disclosure of Environmental Monitoring Result to the Public Domain

In Japan, all MSW treatment facilities shall be obliged to disclose its operational plan and operation conditions. This is applied for the facilities not only operated by LGUs but also operated by private (through contract from LGUs).

In the website of DBO contractor named Asakawa Environment Technology Corp. (ID 115, Japan), hourly record data of HCl, NOx, SOx, PM and Mercury are disclosed. By this, on January 31st 2021, 170 μ g/m3N of Mercury was confirmed and disclosed to the public which exceed 3 times or more of regulatory emission limit of 50 μ g/m3N. The implementation government agency, Asakawa Seiryu Env. Union associated by 3 cities in Tokyo, immediately disclosed this fact with following response actions. This sincere behavior establishes the trust among LGUs, union, local residents and community.

Table 4.12 Environmental Monitoring Daily Report on 31 Jan 2021

Furnace #	No. 1				
Pollutants	HCL	NOx	SOx	PM	Hg
Unit	ppm	ppm	ppm	g/m3N	μg/m3N
Self-Imposed St.	10	20	10	0.005	50
Mandatory St.	430	250	2700*	0.040	50
2021/1/31 1:00	6	10	0	0	1
2021/1/31 2:00	6	10	1	0	1
2021/1/31 3:00	6	13	1	0	1
2021/1/31 4:00	6	14	0	0	1
2021/1/31 5:00	6	10	0	0	1
2021/1/31 6:00	6	11	0	0	1
2021/1/31 7:00	6	11	0	0	1
2021/1/31 8:00	6	9	0	0	1
2021/1/31 9:00	6	9	2	0	0
2021/1/31 10:00	6	11	3	0	0
2021/1/31 11:00	6	12	3	0	1
2021/1/31 12:00	6	11	1	0	1
2021/1/31 13:00	6	7	1	0	1
2021/1/31 14:00	6	9	2	0	1
2021/1/31 15:00	6	14	3	0	1
2021/1/31 16:00	6	10	2	0	1
2021/1/31 17:00	6	10	0	0	1
2021/1/31 18:00	5	10	0	0	1
2021/1/31 19:00	5	10	0	0	1
2021/1/31 20:00	6	9	0	0	1
2021/1/31 21:00	6	10	1	0	1
2021/1/31 22:00	6	11	2	0	1
2021/1/31 23:00	5	10	1	0	1
2021/2/1 0:00	6	10	0	0	1

Furnace #	No.2				
Pollutants	HCL	NOx	SOx	PM	Hg
Unit	ppm	ppm	ppm	g/m3N	μg/m3N
Self-Imposed St.	10	20	10	0.005	50
Mandatory St.	430	250	2700*	0.040	50
2021/1/31 1:00	4	11	0	0	3
2021/1/31 2:00	4	12	0	0	3
2021/1/31 3:00	4	13	0	0	3
2021/1/31 4:00	4	11	0	0	3
2021/1/31 5:00	4	11	0	0	3
2021/1/31 6:00	3	13	0	0	3
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2021/1/31 8:00	4	11	0	0	3
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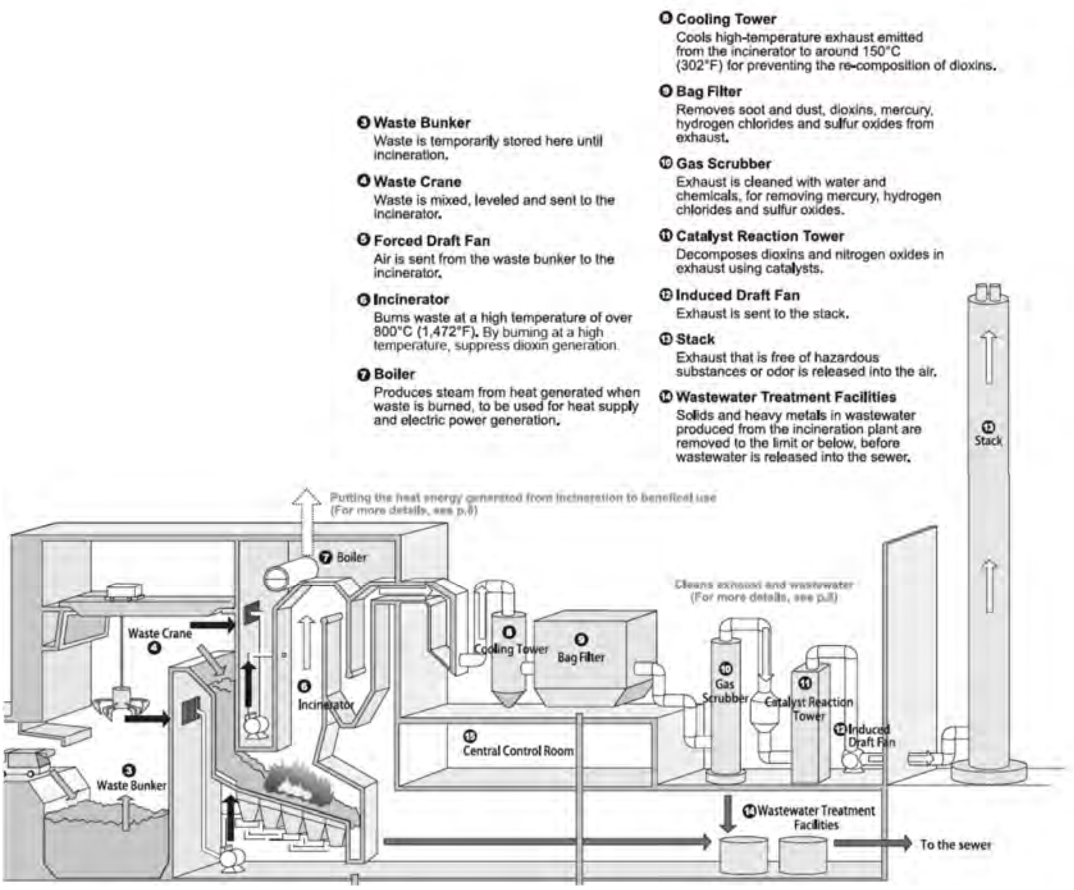
2021/1/31 10:00	3	12	0	0	3
2021/1/31 11:00	3	12	0	0	6
2021/1/31 12:00	4	14	0	0	170
2021/1/31 13:00	4	12	0	0	43
2021/1/31 14:00	4	10	0	0	29
2021/1/31 15:00	5	10	0	0	22
2021/1/31 16:00	5	11	0	0	17
2021/1/31 17:00	5	11	0	0	16
2021/1/31 18:00	5	12	0	0	9
2021/1/31 19:00	5	12	0	0	6
2021/1/31 20:00	5	9	0	0	5
2021/1/31 21:00	5	14	0	0	5
2021/1/31 22:00	4	13	0	0	5
2021/1/31 23:00	3	11	0	0	4
2021/2/1 0:00	4	10	0	0	4

Source: Website of Asakawa Environment Technology Corp. (https://asakawa.ekankyo21.com/)

In the case study outside of Japan, there are some projects which disclose concentration of pollutants in exhaust gas, however, most of them are not updated timely and no one disclose continuous hourly data. In the recent developments of WtE Incineration in Asian countries, there are some articles reporting that exhaust gas of WtE incineration facility exceed its emission limit (Bangkok, Delhi, etc.). While these facilities equip CEMS (Continuous Emission Monitoring Systems), acquired data is not disclosed to the public in timely manner. Timely disclosure of emission data and secure residents to access such data are quite important success key for environmental management and trust building with neighboring communities. This level of environmental strictness can be specified in the technical specification of WtE-ACC in each bidding document of LGU, but should be regulated in national level.

2) Treatment Process

To satisfy the emission standards, WtE-ACC plants equip exhaust gas treatment system consisted by cooling tower, scrubber or bag filter, etc. as shown in **Figure 4.13**. After the boiler, exhaust gas is cooled in a cooling tower and enters a bag filter to remove dust. In case of dry scrubber, activated carbon and lime for the absorption of dioxins and acid gas like HCl and SO2 is added before the collection of the dust at the bag filter. For wet scrubbers, wet scrubber can be installed to remove acid gases at the subsequent stage of the bag filter. After which, nitrogen oxides are removed through Selective Catalytic Reduction (SCR).



Source: Prepared by ITWG Subgroup Output1 based on Waste Report (2020) by Clean Authority of Tokyo

Figure 4.13 An Example of Exhaust Gas Treatment of WtE-ACC facility

The exhaust gas treatment system has to be designed for the emissions limits in the jurisdiction where the plant is located (national and/or local standards), available space, height restrictions and economic factors.

Table 4.13 and **Table 4.14** show pollution control devises for each air pollutant comes from solid waste combustion.

In EU and USA, some WtE-ACC cases, such as Wien-Spittelau (ID 306, Austria) and Amager Bakke (ID307, Denmark), adopt electrostatic precipitator instead of bag filters. There are cases of both dry and wet scrubbers for acid gas treatment such as Afval Energie Bedrijf Amsterdam (AEB) Plant (ID301, Netherland) and Wien-Spittelau Plant (ID306, Austria). There are also cases of Selective Catalytic Reactor (SCR) as Sysav South Scania Waste-to-energy plant (ID312, Sweden) and Palm Beach Renewable Energy Facility (ID318, USA) and Selective Non-Catalytic Reactor (SNCR) for NOx treatment such as Afval Energie Bedrijf Amsterdam (AEB) Plant (ID301, Netherland) and Issy-les-Moulineaux WtE plant (ID303, France).

On the other hand, in Japan, bag filter or dry exhaust gas treatment system is mostly utilized. SNCR and SCR are applied for the treatment system for NOx as well. However, WtE-ACC facilities that require stricter standards usually utilize wet scrubber for acid gases such as HCl or SO_2 Ota Incineration Plant (ID 101), Suginami Incineration Plant (ID103) are examples that adopted the technology. The typical pollution control technologies are explained in **Table 4.14**.

Table 4.13 Typical Pollution Control Technology for Air Pollutant

Air Pollutant	Pollution Control Technologies
Dust/Particulates	Bag filter
Nitrogen Oxides (NOx)	Flue gas recirculation, SNCR and SCR
Acid Gases (Sulphur Dioxide, Hydrogen Chloride, Hydrogen Fluoride)	Wet scrubber, semi-dry scrubber or dry scrubber, bag filter
Heavy Metals (Mercury, Cadmium, Lead, Copper, etc.)	Bag filters, Activated carbon injection
Dioxins and Furans	Flue gas recirculation, rapid cooling bag filter, activated carbon injection

Source: ITWG Subgroup Output1

Table 4.14 Pollution Control of Exhaust Gas

Typical Pollution Control Technologies	Explanation of Each Pollution Control Technology
Bag filter	Bag filters are composed of filter bags, which capture particles in exhaust gas. Bag filters can capture particles with high removal efficiency. Pollutant Particles or gaseous pollutant absorbed with particle are removed effectively. In the bag surface, it is possible to react to neutralize acid gases after the addition of chemical agent. Therefore, bag filter is normally set after the scrubber.
Flue gas recirculation	Flue gas recirculation lowers excess air rate, reduces exhaust gas, and increases thermal efficiency. In addition, it lowers formation of thermal NOx due to lower excess air rate.
SNCR and SCR	SNCR does not use catalytic die to high temperature injection of ammonia or ammonia compound into the flue gas, for example at around 850 - 950°C. SCR operates on the same principle as SNCR, but at a much lower temperature range of 200 – 300°C. This is achieved by the use of a catalyst to accelerate the reaction between the NOx and ammonia at low temperatures. Higher NOx removal is possible, but the costs are higher, and the catalyst is sensitive to other pollutants and therefore the system usually needs to be located on the end of pollution control system.

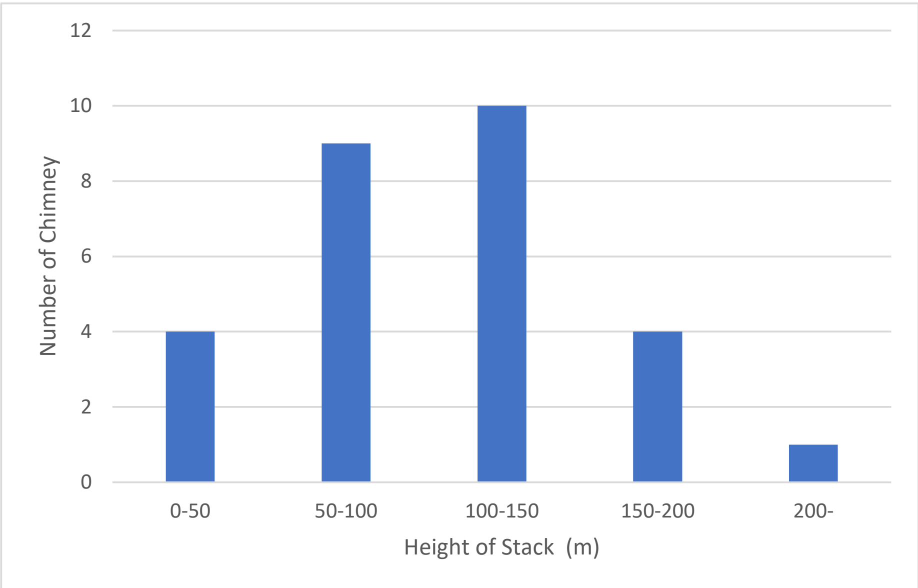
Typical Pollution Control Technologies	Explanation of Each Pollution Control Technology
Scrubber (Wet scrubber, semi-dry scrubber or dry scrubber)	1) Wet Scrubber The exhaust gases are brought into contact with water and liquid reagents, and pollutant gases are absorbed. The wet scrubber is effective at removing acid gases, but is less efficient in thermal energy terms (due to the cooling effect of the water spray) and produces a liquid residue which requires treatment in a water treatment plant 2) Dry and semi dry scrubber Both the dry and semi-dry scrubber type neutralizes acid gases and produce a dry residue. Dry or semi-dry filters are generally preferred as the dry residue is easier to handle but they are less effective than wet scrubber.
Flue gas recirculation	Flue gas recirculation lowers excess air rate, reduces exhaust gas, and increases thermal efficiency. In addition, it lowers formation of thermal NOx due to lower excess air rate.
Rapid cooling	Rapid cooling reduces the risk of dioxin reformation due to the prevention of de novo synthesis by preventing longer retention time of the temperature between 200 and 400°C.

Source: ITWG Subgroup Output1 based on Guideline for Planning and Designing of Waste Treatment Facility Development in Japan (2017)

3) Stack

By discharging the exhaust gas from the stack, it is expected to diffuse pollutant to the atmosphere for the purpose to reduce this concentration on the ground.

The height of stack confirmed in the case study is shown in **Figure 4.14**. Out of twenty-eight (28) cases which have the information of height of the stacks. 10 cases are the range of 100-150m, 9 cases in the 50-100m. So, about 70% is in the range of 50 to 150 m.



Source: ITWG Subgroup Output1

Figure 4.14 Range of Height of Stack in the Cases of WtE-ACC facility

As shown in **Figure 4.14**, the highest stack confirmed in the case study is Toshima Incineration plant (ID 123, Japan), the height is 210 m. Contrastively, the stack height is sometimes restricted by the regulations such as urban planning, aviation requirements and the requirement to maintain the landscape.

Among the cases studies, there are two cases of less than 30 m height of stack. Issy-les-Moulineaux WtE plant (ID 303, France), its stack height is 21m to maintain Seine river landscapes. Sunrise clean center (ID 108, Japan), its stack height is designed as 25m because of aviation law). In these cases, the stack is not visible as seen in **Figure 4.15**.　When the height of stack will be such low, the ground level pollutant concentration may increase due to low diffusion of exhaust gas from the stack. In these plants, stricter emission standards are applied, which of course resulting in a cost increase.

Sunrise Clean Center, ID108, Japan
Source: Sunrise Clean Center

Issy-les-Moulineaux WtE plant, ID303, France
Source: SYCTOM

Figure 4.15 An Example of WtE-ACC with Lower Stack

(2) Wastewater

Wastewater is generated from waste pit, washing process of car and platform. boiler, ash treatment, and from domestic facilities. Because the quality of the wastewater from different facility and equipment is so different, it is important to treat separately. In this case the capacity of waste treatment facility can be minimized. A certain type of wastewater can be discharged with little treatment. In addition, if it is possible to discharge sewerage from the facility, the capacity load of wastewater treatment facility can be reduced. The types of wastewater and main treatment process are shown in **Table 4.15**.

Table 4.15 Main Sources of Wastewater and the Characteristics

Item	Wastewater comes from					
	Waste pit	Ash treatment	Wet scrubber	Domestic wastewater	Washing equipment or facility	Washing car
pH	5-7	7-12	5-8 (after treatment)	5-8	7-11	5-8
SS	○	●	●	○	◎	◎
BOD	●	◎	○	○	○	○
COD	○	◎	◎	○	○	○
Oil	◎	–	–	○	○	◎
Salt	–	◎	●	–	○	–
Fe	○	●	◎	–	○	◎
Zn	○	●	◎	–	○	–
Mn	–	●	◎	–	○	–
Cr	–	◎	◎	–	○	–
Cd	–	○	◎	–	–	–
Cu	–	○	◎	–	–	–
Pb	–	◎	◎	–	–	–
Hg	–	–	○	–	–	–

Note: ●: Especially high concentration, ◎: high concentration, ○: some concentration, –: Little concentration

Source: ITWG Subgroup Output1 based on Guideline for Planning and Designing of Waste Treatment Facility Development in Japan (2017)

Table 4.16 Pollution Control of Wastewater

Wastewater comes from	Characteristics	Treatment
Waste pit and car and platform washing	High organic contents (high BOD) Fluctuation due to change of waste amount and characteristics. Oil in wastewater from car washing	- Organic wastewater can be treated by biological treatment method - Inorganic wastewater can be treated by coagulation/ chelate/ alkali/ sulfide filtration process, etc. - In principle, organic wastewater shall be separated from the inorganic content.
boiler	High temperature, which may affect wastewater treatment process shared with wastewater from other sources	
Wastewater from ash treatment	To be treated as inorganic wastewater in case of low ignition loss	
Wastewater from domestic facility	Wastewater from toilet and kitchen in the administrative office Quality is same as domestic wastewater	

Source: ITWG Subgroup Output1 based on Guideline for Planning and Designing of Waste Treatment Facility Development in Japan (2017)

4.1.10 Ash Treatment and Disposal

The residues from combustion process are classified into bottom ash which is taken from the bottom of combustion furnace, and fly ash which is captured at the cooling process of combustion gases and the air pollution control equipment (i.e. scrubbers, bag filter, etc.), which include a part of boiler ash and air pollution control residues. Fly ash may contain heavy metals with high boiling temperature and is captured in bag filters or other pollution control devices. Boiler ash are collected in the heat recovery and cooling system including boiler, economizer and superheater and air pollution, is handled as fly ash or bottom ash based on the process in each WtE-ACC facility.

(1) Bottom Ash

Bottom ash consists of relatively large fragments and does not contain heavy metal and dioxins in high concentration as exceeding environmental standards, which makes it relatively easier to handle. Normally, recyclable non-ferrous and ferrous metal scrap in bottom ash is separated by magnetic separator and only inorganic fragment is stored in ash storage facility for bottom ash. Bottom ash can be utilized as a cement ingredient or aggregate, or roadbed material after a melting treatment. Iron scrap and non-ferrous metals are recycled. After the separation, the residue of bottom ash will be utilized as cement aggregate, other construction material such as backfilling material, roadbed after its melting, baking and aging, or other necessary processing. The chloride content in bottom ash inhibits its utilization as a construction material.

In the cases of Japan, bottom ash is utilized as cement ingredient of the cement project called as Eco -cement, in which more than a half of products (as dry base) are made by bottom ash of WtE-ACC facilities. This is practiced in most of WtE-ACC facilities in Metropolitan Tokyo such as Ota Incineration Plant (ID 101) and Shinkoto Incineration Plant (ID102). Bottom ash is taken off for producing Eco-cement with around US$470/ash-ton of payment to the company, which mean that the utilization of bottom ash as cement ingredient can be operational under special condition only and not be a revenue source of LGUs. It could be recognized that the government and society are supporting reduction of ash to be disposed of at the landfill to maintain its life span.

As other example of utilization of bottom ash, through ash melting process adopted in WtE-ACC such as Kushiro Federation WtE (ID 109) and Funabashi City South Incineration Plant (ID 110), material for asphalt pavement, filling material, roadbed material and aggregate is generated.

It is supposed that WtE-ACC cases in EU and USA would also use bottom ash as filling material or aggregate, while the treatment method is not clearly described in the collected case studies.

(2) Fly Ash

The common technique for managing fly ash consists of solidification or stabilization of residues through mixing with cement or inorganic binding agents.

In Japan, fly ash is mainly disposed of after cement solidification as confirmed in Hatsukaichi Energy Clean Center (ID128), chemical treatment in Toshima Incineration plant (ID123) and Musashino Clean Center (ID127).

In EU, the treatment and disposal method of fly ash is basically disposed in hazardous waste landfill site. In the case of Allington Energy from Waste (ID310, UK), Lahti Gasification Facility (ID309, Finland) and Isseane (ID303, France), fly ash is handled as a hazardous waste and disposed in hazardous waste landfill sites. Abandoned salt mining site with solid deep bedrock located in Germany is also used as a hazardous waste landfill site as reported in the case of Wien-Spittelau (ID306, Austria). Fly ash from the WtE-ACC in Italy (ASM Brescia, ID304) also is filled in salt mines in Germany. In Afval Energie Bedrijf Amsterdam (ID301, Netherlands), ash is separated into bottom ash, boiler ash, ash from bag filter, and other types. These ashes are treated separately. It was noted that reacted gypsum or salt is utilized for construction material.

4.2 Institutional and Financial Aspects

In this part, the findings of institutional and financial aspect, in particular, project development procedure, financial information such as CAPEX and OPEX, public involvement, and subsidy programs in neighboring counties are discussed.

4.2.1 Project Development and Implementation

(1) Business Scheme / Project Implementation Framework

Table 4.17 and following box shows typical business scheme (PPP Modality, or Implementation Framework) of WtE-ACC project.

The role and responsibilities for each business scheme such as Traditional business contract (public own and operate), DBO, BTO, BOT and BOO are summarized for each scheme as follows.

Table 4.17 Business Schemes and Responsibility of Public and Private Operators

	PFI			DBO	DBM	Public + Long term contract	Public works
	BOO	BOT	BTO				
Degree of public involvement							
Role	weak						strong
Construction							
Design	Private	Private	Private	Public	Public	Public	Public
Construction	Private	Private	Private	Public	Public	Public	Public
Funding	Private	Private	Private	Public	Public	Public	Public
Operation							
Operation	Private	Private	Private	Private	Public	Private	Public
Maintenance	Private	Private	Private	Private	Private	Private	Public
Ownership of facilities							
Construction period	Private	Private	Private	Public	Public	Public	Public
Operation period	Private	Private	Public	Public	Public	Public	Public

:Role of the private sector

Notes: In DBO, Public entity orders private contractor to construct the facility.
Source: ITWG Subgroup Output1

◇Public-works projects / Public Build and Operate Project
The public sector is responsible for everything from securing financial resources to designing, constructing, and operating the facility.

◇Design-Build plus Operate separate order scheme, DB+O (Public + Long term contract)
The public sector designs and constructs the facilities, and the private sector is entrusted with the operation of the facilities for multiple years.

◇Design-Build-Operate, DBO
The public sector raises funds through bonds and grants, etc., and comprehensively outsources the design, construction, operation, etc. of facilities to the private sector.

◇Design-Build-Maintenance, DBM
The public sector raises funds through bonds and grants, etc., and comprehensively outsources the design, construction, maintenance, and management of facilities to the private sector.

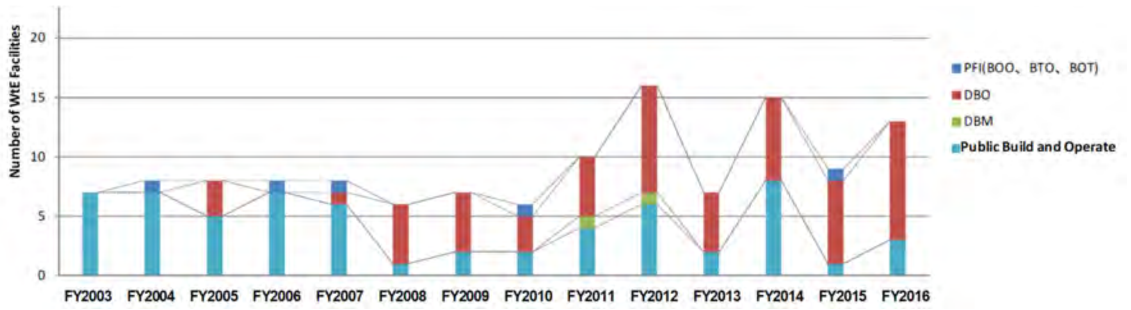
◇PFI

・Build-Transfer-Operate, BTO
The private sector is responsible for financing, design, construction, and operation of the facility. Ownership will be transferred to the public after completion of the facility.

・Build-Operate-Transfer, BOT
The private sector is responsible for financing, design, construction and operation of the facility. Ownership will be transferred to the public at the end of the commissioning period.

・Build-Own-Operate, BOO
The private sector will be responsible for financing, design, construction, and operation of the facility. Ownership will not be transferred to the public even after the end of the commissioning period.

In Japan, WtE-ACC facilities are used to be built under the Public-Build and Operate scheme, however, recent 10 years, Design-Build and Operate (DBO), a shape of PPP schemes is majorly applied for 100 tons/day or more size of WtE-ACC facilities. In these “Public-Build and Operate” and “DBO” schemes, LGUs to budget both construction and operational cost and procure EPC and O&M at once or separately. In Japan, national subsidy for CAPEX (1/3 to 1/2 depends on LGU and facility specification) can be enjoyed for LGUs while operational cost shall be covered by annual budget of LGU.



Note: The facilities which have more than 100ton/day of treatment capacity only
Source: Feasibility Study for PFI project development in Izumo, Japan

Figure 4.16 Historical Transition of WtE-ACC Business Scheme in Japan

Table 4.18 is an analysis of case studies in the aspect of business scheme. Out of 60 cases, 22 cases are public build and operate scheme, in which 13 cases are in Japan and 9 cases are in EU countries. With regard to DBO, 13 cases are found in Japan while only 1case is found in USA. BOT or BOO schemes are applied in Thailand, Taiwan, India, Singapore and Vietnam while no cases in Japan. Cases in Thailand, India and Vietnam are first WtE-ACC installations in each country. In Taiwan[7] and Singapore8, BOT or BOO is not majority of their business scheme in WtE-ACC development.

Table 4.18 Business Schemes applied for the WtE-ACC Case Studies

Business Scheme	Number of cases	In Japan	Outside of Japan	Remark
Public Build (DB) and Operate	21	13	8	Japan, Singapore, Netherland, Italy, Denmark, Finland
DB+O (15yrs)	1	1	0	Japan
DB+O	2	0	2	France, Singapore
DBO (15yrs)	4	4	0	Japan
DBO (20yrs)	10	9	1	Japan, USA
BTO (20yrs)	2	2	0	Japan
BOT (20yrs)	3	0	3	Thailand, Taiwan, India

[7] BOT/BOO are 3 cases (12.5%) out of 24 existing WtEs, and majority is DBO (called as OT), which is 16 cases (67%) in Taiwan as of 2017 (Municipal Solid Waste (MSW) Incineration’s Potential Contribution to Electricity Production and Economic Revenue in Taiwan, Journal of Taiwan Energy, Volume 4, No. 1, March 2017).

[8] In Singapore 2 of 4 existing WtEs are public build and operate scheme, and Tuas Nexus WtE, which is being constructed, is DBO based project.

BOO (25yrs)	1	0	1	Singapore
BOO (22yrs)	1	0	1	Vietnam
-	15			Data can't be obtained in this Case Study
Total	60			

Source: ITWG Subgroup Output 1

(2) Development Approach

There are 2 development approaches, namely "Solicited" and "Unsolicited". According to PPP Center, these are explained as below;

Solicited vs Unsolicited Proposals

Solicited proposal

A solicited proposal refers to projects identified by the implementing agency (IA) from the list of their priority projects.

In a solicited proposal, the IA formally solicits the submission of bids from the public. The solicitation is done through the publication of an invitation for interested bidders to submit bids, and selection of the private proponent is done through a public competitive process.

Unsolicited proposal

In an unsolicited proposal, the private sector project proponent submits a project proposal to an IA without a formal solicitation from the government. An unsolicited proposal may be accepted for consideration and evaluation by the IA, provided it complies with the following conditions:

1. It involves a new concept or technology and/or it is not part of the list of priority projects in the Philippine Investment Program (PIP) [Medium Term Public Investment Program, Comprehensive and Integrated Infrastructure Program (CIIP)] and the Provincial/Local Investment Plans;
2. It does not include a Direct Government Guarantee, Equity or Subsidy;
3. It has to go to ICC for the determination of reasonable Financial Internal Rate of Return (FIRR) and approval to negotiate with the Original Proponent; and
4. After successful negotiation, proceed to publication and request for competitive proposals according to Swiss Challenge Rules.

Source: PPP Center Website (https://ppp.gov.ph/ppp-program/what-is-ppp/)

Solicited approach was taken in 51cases (85%) out of 60 cases as shown in **Table 4.19**. Only one case (Afval Energie Bedrijf Amsterdam, ID301, Netherlands) adopted the unsolicited approach in their recent development while first phase of this facility was developed by solicited approach. In the developed countries such as EU and Japan, LGUs budget the front-end cost (project development cost, e.g. concept building, master plan, feasibility studies, and preparation of bidding document) and call for bid of WtE-ACC partner, phased project development can be implemented.

Table 4.19 Development Approach of WtE-ACCs

Development option	Cases	%
Solicited	51	85
Solicited (1993), Unsolicited (2007)	1	2
No information	8	13
Total	60	100%

Source: ITWG Subgroup Output1

On the other hand, there are numerical numbers of submitted unsolicited proposals in Philippines and other developing countries of South East and South Asia, where LGUs don't have enough budget for such front-end cost. However, there are also a mountain of cases which private proposals without enough deliberation of the concept or master plan of LGUs' MSW management will be cancelled or not materialized because of market changing, loss of private interest, administration changes, etc.

As main concern, unsolicited proposal in the absence of LGU's sufficient WtE-ACC plan is mismatching of interests in both parties. Private company normally proposes the project within their interest in terms of technology, capacity and scope of works. If there is not well-engineered LGU's WtE-ACC project plan (conceptual plan, F/S, etc.), LGU cannot evaluate the proposal appropriately because LGUs don't have the project idea, which part of MSW systems to be contracted out to the private sector.

WtE-ACC is a waste treatment project as well as power generation project. Since implementation of municipal solid waste treatment as planned is the obligation of LGUs, LGU shall have right to handle the WtE-ACC project planning and implementation. By reducing the scope of works for private partner, LGUs decision flexibility can be increased. For the purpose to increase the number of private interest, national government shall specify minimum technical requirements and specifications, and local governments shall detail out the facility requirements based on local municipal solid waste management conditions and expectations.

Therefore, it is suggested that LGUs to prepare its MSW facility plan by themselves (not rely on private proposal at beginning). In which, main objectives and expectation of WtE-ACC facility, waste stream, scope of private company shall be at least presented. By this, evaluation of unsolicited proposals can be drastically reduced.

(3) Scope of Project

As discussed earlier, LGU shall be fully responsible for MSW management generated in their jurisdiction. Therefore, some parts of it LGUs can contract out to private partners in their sole discretion. This case study attempts to figure out the scope of WtE-ACC private partner.

At first, all of LGUs orders construction of WtE-ACC facilities to the plant manufacturer. Since the complexity of the plant facility, not same as drawings-based order system applied in other public infrastructure such as road and bridges, performance-based ordering system is applied in most of WtE-ACCs. This is also called as design-build EPC (Engineering-Procurement-Construction) and in these cases, LGUs mobilize labors to operate and own WtE-ACC facility.

However, such direct operation requires LGU operators enough knowledgeable and experienced and not so practical for small LGUs who owns only one WtE-ACC, so, recently O&M services are also included in the initial procurement which is called as “Design-Build and Operate (DBO)” scheme. Further, while facility’s ownership and financing in DBO is still belonging to the local government, in BOT/BOO schemes financing as well as facility owning are handled by private partner.

Although these differences of business schemes (PPP modalities) are still discussion within WtE-ACC scope, **Table 4.20** shows the task allocation throughout the waste management flow (from collection to disposal of WtE-ACC residues) in each local government. Out of selected 11 WtE-ACC cases, there are no case which LGs contracts to WtE-ACC partner to do municipal solid waste collection and transportation services.

Table 4.20 Case studies on Scope of Works between Public/Private

Scope	Business Scheme	Collection	Transp.	Processing	Energy Sale	Bottom Ash	Fly ash	Remarks
Suginami Incineration Plant (ID103)	Public Build and Operate	LG	LG	CAT23 (Public)	CAT23 (Public)	CAT23 (Public)	Tokyo Metropolitan Government	
Kushiro Wide-Area Federation WtE Facility (ID109)	DB+O (15yrs)	LGs	LGs	Federation (Public)	Federation (Public)	Federation (Public)	Federation (Public)	
Funabashi South Incineration Plant (ID110)	DBO (15yrs)	LG	LG	SPC	LG	LG	LG	
Mito city incineration plant (ID111)	DBO (20yrs)	LG	LG	SPC	LG	SPC	SPC	
Tuas South WtE Plant (ID202)	Public Build (DB) and Operate	NEA	NEA	NEA	NEA	NEA	NEA	
Keppel Seghers Tuas WtE Plant (ID204)	BOT (25yrs)	NEA	NEA	SPC	SPC	NEA	NEA	
Nong Khaem WtE plant (ID205)	BOT (20yrs)	BMA	BMA	SPC	SPC	BMA	BMA	
Afval Energie Bedrijf Amsterdam (AEB) (ID301)	Public Build (DB) and Operate	AEB+LGs	AEB+LGs	AEB	JV with energy grid	AEB	AEB	
Issy-les-Moulineaux WtE plant (Isseane) (ID303)	DB+O	SYCTOM	SYCTOM	Private	SYCTOM	Private	Private	
Amager Bakke (ID307)	Public Build (DB) and Operate	LGs	LGs	ARC	ARC	ARC	ARC	
Palm Beach Renewable Energy Facility 2 (ID318)	DBO (20yrs)	SWA	SWA	PBRRC	PBRRC	SWA	SWA	

Notes) ■: responsibility of public entity, ■: responsibility of private partner,

(4) Implementation Schedule

Table 4.21 shows the required periods for the development of WtE-ACC by case study. Average project implementation timeline is 2.9 years for preparation of bid, 4.0 years for construction (including design) according to the cases in operation.

2.9 years from planning to bid announcement seems a bit longer. However, considering the longest case takes 5.3 years and there are a lot of projects which are not materialized, implementation bodies must know that due deliberation of facility plan as well as bidding document must be taking time.

With regard to the construction period, since most of facilities are ordered based on design-build basis, designing, construction and commissioning requires 4.0 years in average, at maximum 6.6 years. In minimum a case shows 2.0 years but this case only has the information of year, so actual construction period might be longer than 2 years.

In Japan, most of facilities are constructed/operated in line with the time schedule as planned, this eases local government projects future budget requirement and increases readiness of private partners participation.

With regard to the concession period of DBO contract, most of the cases range from 15 to 20 years and 20 to 25 years for BOT/BOO contract.

Table 4.21 Case Studies on the Duration of Original Plan to Bid and Construction

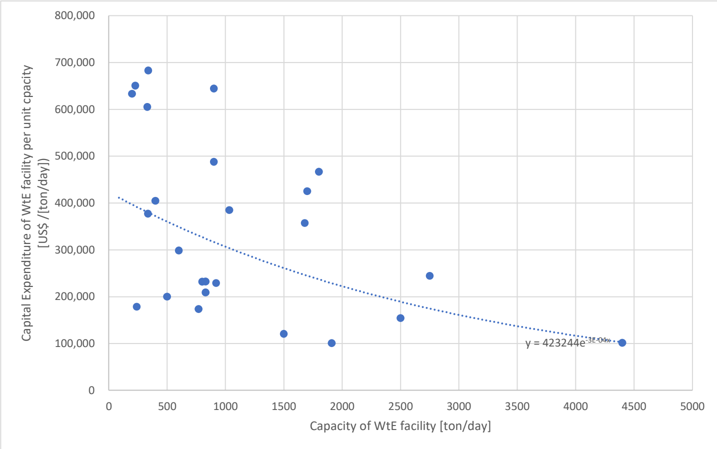
Duration (Years)	Effective number	Average	Maximum	Minimum*
Plan to Bid	15	2.9	5.3	1.0
Construction (incl. design)	37	4.0	6.6	2.0

Note: Some cases don’t have the month of bid or completion of construction so minimum years might be deliberated more.

4.2.2 Finances of WtE-ACC projects

(1) Capital Expenditure (CAPEX)

It is difficult to obtain the capital expenditure of WtE-ACC facilities. The few data that have been gathered are summarized in **Figure 4.17**. In Japan, only the aggregated project cost of DBO projects including O&M cost were obtained. Therefore, such DBO projects are removed from the estimation of CAPEX. The range of capital expenditure is from US$100,000 to US$700,000 per ton/day. As described in **Figure 4.17**, the capital expenditure per capacity tends to decrease as the capacity of WtE-ACC facility increase. Larger capacity WtE-ACC facility is recognized as more cost effective. In this sense, it is better to gather municipal solid wastes from plural LGUs if conditions to cluster can be satisfied such as consensus among LGUs on a reasonable cost of waste transportation.



Source: ITWG Subgroup Output1 based collected case studies

Figure 4.17 CAPEX of each WtE facility

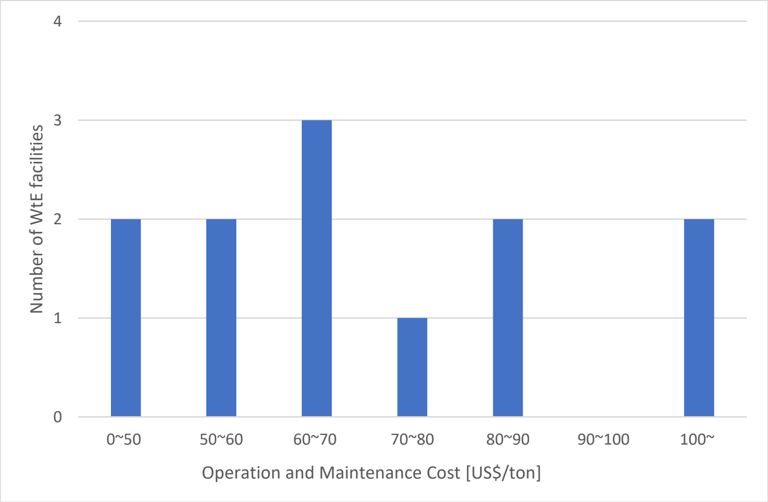
(2) Operation and Maintenance Expenditure (OPEX)

Operation and maintenance expenditure include fuel, electrical and material cost for chemical agent and personnel cost. In the case of WtE-ACC facilities, many parts of the operation are implemented automatically including combustion control, power generation, cooling system, pollution abatement system. The maintenance cost of combustion chamber or electric power generation is expensive.

The operation and maintenance cost of WtE-ACC facilities, especially in EU and Asian countries other than Japan are not published and are difficult to access. However, according to the data collected in Japan, the OPEX of incineration is approximately US$50 - 100/ton. There are two cases of more 100 US$, which will include overhaul maintenance cost. The data includes the DBO projects and Public Build and Own projects. There is no indication of significant differences between the costs of DBO projects and Public Build and Own projects.

The examples of breakdown of the O&M cost of WtE-ACC facility in cases of Japan are shown in **Table 4.22**.

In case of Shinkoto and Toshima, the ratios of maintenance cost are respectively around 37% or 44% of total cost. On the other hand, it is only 13% in case of Ota WtE-ACC facility. In case of Ota WtE-ACC plant, the rate of others is high including outsourcing of operation. The reason of low ratio of personnel cost like only 5% will be also due to the outsourcing of operation of the WtE-ACC.



Source: Consolidated by ITWG subgroup opuput1

Figure 4.18 OPEX of each WtE facility

Table 4.22 Examples of Operation and Maintenance Cost of WtE-ACC Facility (Japan)

Item	Unit	Shinkoto (ID102)		Toshima (ID123)		Ota (ID101)	
Personnel cost	million US$	7.0	22%	1.9	13%	0.7	5%
Utility cost	million US$	2.3	7%	0.8	5%	0.9	6%
Maintenance	million US$	13.8	44%	5.2	37%	2.0	13%
Ash handling	million US$	4.7	15%	1.3	9%	3.2	21%
Others	million US$	3.6	12%	5.0	35%	8.3	55%
Total O&M cost	million US$	**31.4**	**100%**	**14.2**	**100%**	**15.0**	**100%**
O&M cost	US$/ton	76.4	-	154.1	-	86.8	-
Wase amount	1,000 ton/yr	411.6		92.1		173.1	

Source: Clean Authority of Tokyo (2019)

4.2.3 Public Involvement, Information, Education and Communication (IEC)

Consensus with public, and public involvement is an essential part of the smooth implementation of WtE-ACC project. Most of the countries have their own EIA systems, which facilitates the public involvement process of the project. As part of the process of EIA, public hearing and public consultation meetings are held during the planning and design stage. In case of Japan, the procedure of public consultation meeting for WtE-ACC project is stipulated in the act or ordinance of either National or local government. A public consultation meeting is open to anyone including residents near the site, NGO, academic experts. The meeting date or venue and the project profile are disseminated before a certain day and the project so that the participants have time to prepare the questions or explain their opinions.

In the EIA procedure, normally, regular environmental monitoring including the relevant information of WtE-ACC operation, especially quality of exhaust gas, water quality, if it is discharged, is mandatory.

WtE-ACC facilities accept facility tours by the public including residents, NGOs and students so that the WtE-ACC operator can verify their environmental compliance and performance of municipal solid waste treatment. The tour is often utilized as an opportunity of environmental education to visitors as well. The visitors of WtE-ACC are reminded and encouraged to think about solid waste issues, their lifestyle and behavior in daily life. Some pictures from a WtE-ACC facility tour exhibiting the environmental education area, air quality monitor in a WtE-ACC facility is shown in **Figure 4.19**.

WtE-ACC Facility Tour for Residents


Exhibition Zone for Visitors

Explanatory Panel for Visitors

Disclosure of Quality of Emission Gas from WtE-ACC

Source: Clean Authority of Tokyo

Figure 4.19 Examples of Environmental Education and Information Disclosure at WtE-ACC

4.2.4 Cost-Sharing Scheme for WtE in Neighboring Countries

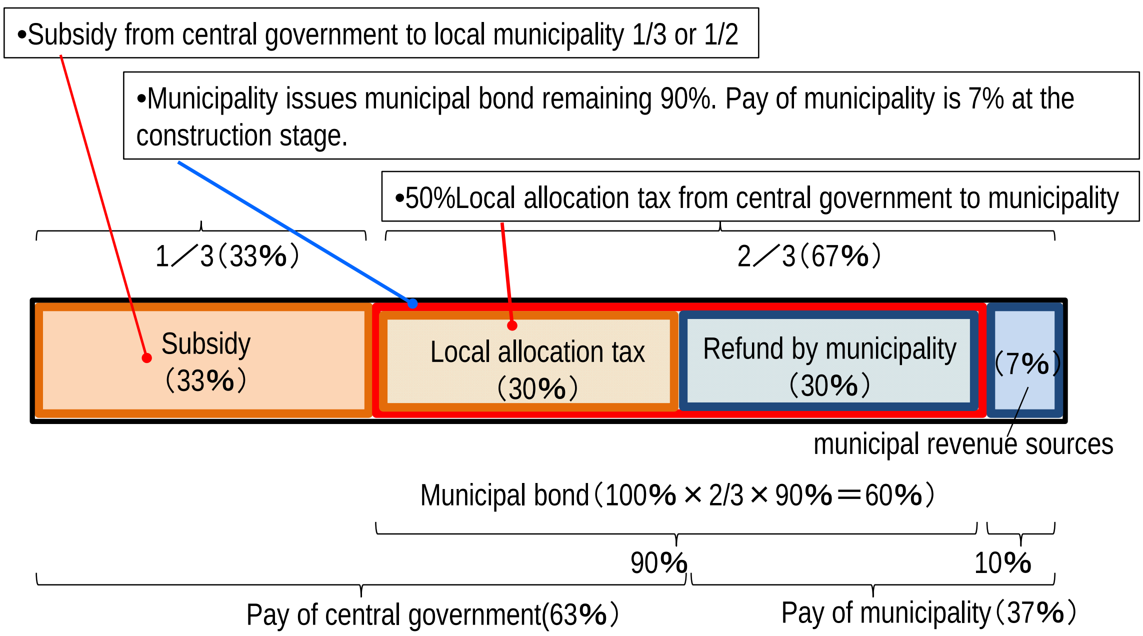
(1) Funding support for SWM facilities by National Government in Japan

In Japan, to promote a sound material cycle society, the National Government grants one thirds of the initial investment if SWM facilities including WtE-ACC facility meets certain conditions. The outline of Japanese funding support scheme for SWM facilities is summarized in **Table 4.23**. Besides, a half of the portion funded by municipal bonds will also be reimbursed by the local allocation tax from the National Government as shown in Source: ITWG Subgroup Output1

Table 4.23 Summary of Japanese Funding Support Scheme for SWM Facilities

Objective	・ Supporting municipalities for establishing a sound material-cycle society
Eligible facilities	・ Material recycling facility ・ Incombustible and plastic recycling facilities, stockyards, etc. ・ Energy recovery type waste treatment facility ・ Waste power generation facilities, heat recovery facilities, biogas facilities, etc. ・ Organic waste recycling facility ・ Facilities for recycling human urine & organic waste ・ Septic tank ・ Final disposal site
Grant rate	・ 33% of facility construction cost (50% in case of advanced facility)

Source: ITWG Subgroup Output1 by referring to the website of Ministry of Environment Japan



Source: ITWG Subgroup Output1

Figure 4.20 Funding Support Scheme for SWM Facilities in Japan

(2) WtE-ACC project promotion by PPP scheme in Indonesia

The Government of Indonesia declared promotion of WtE-ACC projects in the country and designated the 12 priority areas for development of WtE-ACC facilities by the Presidential Decree No. 35 enacted in 2018. Although the WtE-ACC facility is not yet operational in Indonesia, some local governments are currently preparing to develop WtE-ACC projects.

The following policy instruments were installed in Indonesia to promote WtE-ACC projects by PPP scheme:

A) Viability Gap Funding (VGF): Government's subsidy for investment cost of PPP projects
A financial support funded by Ministry of Finance, to support establishment of PPP projects by providing part of construction cost for projects with high social benefits but low profitability.

- Form of payment: cash.
- Eligibility for payment: part of construction cost.
- Timing of payments: stipulated in PPP project agreement.
  (Certain stages during construction period and commercial operation date.)
- PPP projects implemented by LGUs can be funded from LGUs' fund in addition to VGF.

B) Availability Payment (AP): Government's subsidy for operational cost of PPP projects.

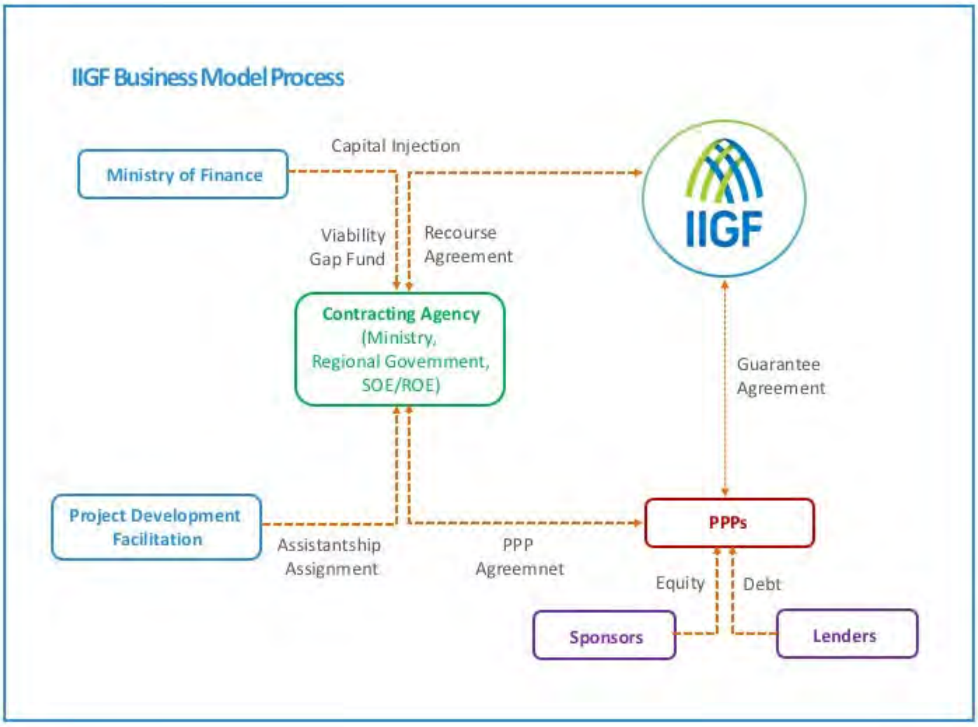
A system whereby Government Contracting Agency (GCA) promises a fixed payment to the private operator in return for the provision of infrastructure services at a specified quality under a PPP contract. Adequate return on investment for PPP projects involving operation & maintenance of infrastructure over a long term can be guaranteed from private operator's perspective.

C) Feed-in-tariff: set at US¢13.35/kWh

D) Indonesian Infrastructure Guarantee Fund (IIGF): Government's guarantee for PPP project

IIGF is a public guarantor established and 100% owned by Ministry of Finance. IIGF guarantees the performance of GCA in PPP projects and promises financial compensation on behalf of GCA in case GCA defaults on its obligations, thus making a significant contribution to reducing risk of private operators. In PPP projects where IIGF guarantee contracts are signed, three types of contracts (i) PPP project contract, (ii) guarantee agreement, and (iii) recourse agreement are basically signed by private sector, GCA, and IIGF. **Figure 4.21** illustrates the business model process of IIGF.

- PPP Project Contract:
  A PPP project contract is concluded between Private Operator and GCA, which stipulates rights and obligations related to a PPP project.
- Guarantee Agreement:
  IIGF and Private Operator will conclude a guarantee agreement for a PPP project. This agreement will guarantee performance of a PPP project contract by GCA.
- Recourse Agreement:
  In addition to the above, IIGF will enter into recourse agreement with GCA. If certain requirements are met, IIGF will make payments to Private Operator on behalf of GCA in response to payment requests by Private Operator. Then, IIGF will collect recourse payments from GCA under this Recourse Agreement.



Source: IIGF, Indonesia

Figure 4.21 IIGF's Business Model Process

(3) Feed-in-tariff (FIT) for WtE

Feed-in Tariff (FIT) is a policy mechanism under the Republic Act No. 9513 or the Renewable Energy Act of 2008 which is designed to accelerate development and investment in renewable energy (RE) technologies by offering long-term contracts to renewable energy producers. It is one of the regulatory tools to promote private sector investments in renewable energy. Under this scheme, RE generators are guaranteed purchase of their power generation at a cost-based price with reasonable rate of return on investments over a long period of time.

The FIT Rules was promulgated by the Energy Regulatory Commission (ERC) on 12 July 2010 per ERC Resolution No. 16, Series of 2010. FIT is a Non-Fiscal incentive scheme that offers guaranteed payments on a fixed rate per kilowatt-hour for electricity sales for qualified renewable energy producers. The ERC further issued Resolution No. 10 Series of 2012 on 27 July 2012, approving the FIT rates and equivalent degression rates corresponding the installation target set per RE technology.

After the 3-year FIT regime which ended on December 2017, Installation target for run-of-river (ROR) hydropower and biomass technology were undersubscribed and reasons for such include issues on permitting and licensing. With this, the FIT System for the two (2) technologies were extended until end of 2019 or until full subscription of the installation targets. As of 31 December 2019, the period for qualification of FIT for biomass has ended and fully-subscribed. Meanwhile, the extension of the FIT System for ROR hydropower shall continue until full subscription of the 250 MW installation target is achieved.

The FIT scheme applied for WtE projects in the Philippines as well as for other Southeast Asian countries is summarized in **Table 4.24**. It is noted that the Republic of the Philippines had applied FIT scheme for renewable energy such as wind, biomass (including WtE-ACC), solar and run-of river hydropower pursuant to ERC Resolution No. 10 Series of 2012. Application of the FIT for WtE-ACC project as one of biomass energy is already expired as the set installation target was achieved.

Table 4.24 FIT applied to WtE Project in the Southeast Asian Countries

Country	Enforcement	Tariff (US cent/kWh)	Condition, Remarks
Indonesia	2018	13.35	Capacity: < 20MW
		14.54 – (0.076 * [Capacity])	Capacity: > 20MW
Thailand	2015	20.9	Capacity: < 1MW
		19.2	Capacity: 1~3MW
		16.8	Capacity: > 3MW
Vietnam	2014	10.05	Applied for incineration
		7.28	Applied for landfill gas
Malaysia	2011	6.5 – 7.4	Applied for biomass/biogas
Philippines	**2013**	**13.3 (0.5% degression rate after 2years from effectivity of FIT)**	**Installation target – fully subscribed Period for qualification – ended on 31 December 2019**
Japan	2019	23.8	

Source: ITWG Subgroup Output1

Chapter 5. Lessons for WtE-ACC Facility in Philippines

5.1 Summary of Case Studies

The main results of the case studies regarding technical, institutional and financial aspects are described **Table 5.1** and **Table 5.2**.

Table 5.1 Summary of Technical Aspects of Case Studies

Item	Confirmations in the Case Study
(1) Capacity	- The capacity of WtE-ACC ranges from less than 100 ton/day and may reach to a few thousand ton/day, adopting multiple lines of combustion furnace in the case of large capacity facilities. - A maximum of 4,400 ton/day is confirmed. - The capacity is decided according to the waste amount estimated by the municipal solid waste management and facility plans. - A maximum treatment capacity of a single furnace of stoker type was confirmed 1,000 ton/day in the study.
(2) Combustion Technology	- The stoker type of furnace is adopted in 78% of cases (47 out of 60 cases). This trend is confirmed in all regions in the study. - The moving grate enables the movement of waste promoting a more efficient and complete combustion. - Fluidized bed yields a liquid-like state through contact with a fine solids and sand to promote combustion state.
(3) Area	- A range of 2 to 4 ha is needed for every 1,000 ton/day of generated waste, and additional space is necessary for larger capacity facilities. - The WtE-ACC facility can be constructed even in the urban area by minimizing area and appropriate pollution control measures.
(4) Target Waste	- Target waste of WtE-ACC is mostly municipal solid waste which is decided for every WtE-ACC facilities. The definition of target waste cannot be uniformly same for all facilities. - Segregated waste may be fed to the WtE-ACC facility while the furnace may combust most of type of substances. - Segregation is practiced all LGUs in Japan, Mechanical Biological Treatment (MBT) or MRF is commonly operated in EU for segregation before combustion. - While main target is municipal solid waste, some cases accept sewerage sludge or industrial waste in addition to the municipal solid waste.
(5) Physical Composition of the Target Waste	- Physical composition data obtained from Japan cases and Vietnamese case clarified that the combustion technology can offer flexibility of physical composition of municipal solid waste, but the LCV of the targeted waste must be checked during the facility planning stage to design the facility accordingly.
(6) Lower calorific value	- The range of average designed LCV is 4,200 (India case) to 14,000 kJ/kg (Finland case) which also verify the technical flexibility of combustion technology. - The value of the cases in Southeast and South Asian countries are lower than those in the developed countries. It is supposed that this is due to the condition of economy and application of separate waste collection.
(7) Energy Recovery	Electricity Generation Efficiency - Combined cycle is applied in some cases for high efficiency of electricity generation. In these cases, steam turbine generates electricity by using 1) exhausted gas from waste incineration, and 2) exhausted gas from gas

Item	Confirmations in the Case Study
	turbine generation by other energy sources at the same time. - Higher steam temperature and pressure, which enable high electricity generation efficiency are confirmed in cases of EU. These temperature and pressure may cause corrosion of boiler pipe in a shorter operation time. Maintenance measures may also help in keeping the boiler pipes in good condition. Thermal energy utilization - Hot water supply to spa/swimming pool and heat supply to botanical garden are practiced.
(8) Ash treatment	Bottom ash - Bottom ash is treated in a bottom ash treatment unit in a series of steps which separate metal from the ash. Iron scrap and non-ferrous metals are recycled after the separation. - Many facilities try to recycle bottom ash as cement material or construction material. - Bottom ash is utilized as a material for cement processing construction material as confirmed in Japan cases, - In the case of EU, it is used for construction material as substitute materials for aggregates. - Recycling of bottom ash may require additional cost to be accepted by off-takers as practiced in Japan. Fly ash - Fly ash is handled in methods such as ash melting, chemical agent, disposal in hazardous waste disposal site. - In some cases in EU, fly ash is being disposed in the closed mine as well as in landfill sites after stabilization.
(9) Pollution control (Exhausted Gas)	- Facility standards stricter than the environmental standards set by the government are adopted in most cases. - Application of the stricter standards may ease the public acceptance.
(10) Pollution control (Wastewater)	- In the closed system of wastewater, wastewater treatment facility is not required in the WtE-ACC. The facility does not discharge wastewater to public water body, which is recognized as a good practice for the environment, and also has positive repercussions to the O&M cost. - Discharge to sewerage system eases the operation load of wastewater treatment in the WtE-ACC facility.
(11) Waste segregation before combustion	- All cases of Japan apply source segregation of municipal solid waste. - In the cases of EU commonly apply Mechanical Biological Treatment (MBT) or MRF to segregate municipal solid waste to be treated by WtE-ACC.

Source: ITWG Subgroup Output1

Table 5.2 Summary of Institutional and Financial Aspects of Case Studies

Item		Confirmations in the Case Study
Financial scheme		- In the case of Japan, most of the collected case studies are Public Own & Operate or Public Own & Private Operate (subcontract) - In the case of EU, around half of the case studies are BOT, however, there are many cases with no clear description of project scheme
Development approach (Solicited or unsolicited)		- A solicited approach was taken in about 80% of cases (51 out of 60 cases). - In the case of solicited approach, LGUs are involved in the establishment of WtE-ACC facilities as early as the planning stage, therefore, they have detailed knowledge of the parameters and the capacity that will be developed. Therefore, fundamental plan of municipal solid waste management should be prepared in the early stage of LGUs.
Implementation schedule		- Planning (2-3 years), Design (around 1-2 years), Construction (2-4 years), - More than five years from planning to operation commencement - Operation period is around 20 to 30 years
Financial Aspect	- Subsidy from national government	- In the case of Japan, supporting municipalities for developing WtE-ACC facility to establish a sound material-cycle society - In the case of EU, there are some subsidies from EU or European Investment Bank (EIB)
	- Revenue	- In the case of Japan, most of the revenue come from the tax of local government, the benefit by selling electricity, heat energy and recyclable - In the case of EU, most revenue will be the benefit by selling electricity and heat energy, and local government compensate the deficit by availability payment
	- Capital Expenditure (CAPEX)	- The range of capital expenditure is from US$100,000 to US$700,000 per ton/day. - The local financial situation, type of WtE-ACC facilities, etc. will affect the capital expenditure.
	- Operation expenditure (OPEX)	- The range of OPEX is around from US$50/ton to US$100/ton. This will be affected by labor cost, utility cost as well as type of combustion technology, project scheme including contract condition, etc.
Public Involvement, IEC		- During the planning process, through the EIA or SEA, public consultation meetings have been held. - To obtain the community acceptance, architectural design or supplemental facility by utilizing surplus thermal has been considered and applied. - There are some cases of dissemination of environmental monitoring data through panel display.

Source: ITWG Subgroup Output1

5.2 Lessons

Through the analysis of case studies, the trend of best adaptable techniques and best environmental practices have been grasped. The following points will be mainly utilized for WtE-ACC development process in the Philippines as good practices.

(1) Target Waste

- The LGUs shall decide or check the target waste to be treated in their WtE-ACC facility according to their municipal solid waste management plan so that the responsibility to manage the municipal solid waste generated and collected in their jurisdiction can be taken.

- Same as stipulation by DAO2019-21, nowadays, the waste segregation practiced commonly before treatment by WtE-ACC facility. The segregation practice, methodology and technology in the countries where WtE-ACC facilities are already operated can be references to the LGUs in the Philippines, while LGUs have to evaluate if such ways are appropriate for their municipal solid waste management.

(2) Combustion Technology and Treatment Capacity

- Stoker (moving grate) is the most commonly adopted because of track record, historical success, and variety of treatment capacity. this technology is more reliable due to long term experience and can handle a large amount of solid waste. Since, the operation period of WtE-ACC facility is long as 20 years or more, the technology shall be evaluated carefully.

- One thousand (1,000) tons of solid waste per day can be treated by a single furnace of stoker type. The treatment capacity of a combustion furnace of fluidized bed combustion is much smaller (200ton/days is confirmed in the case study) than stoker type while it has strong point in a smaller space requirement than stoker type. The LGUs shall evaluate which type of furnace is appropriate for their municipal solid waste amount.

(3) Area

- The area can be minimized according to availability of land and the conditions of the surrounding area. Although it is confirmed that the area of 2 ha per 1,000 tons/day is necessary, it is also confirmed that the WtE-ACC facilities have been constructed and operated in the populated and urbanized area.

(4) Energy Recovery

- The electricity generation efficiency has been improved as the treatment capacity of WtE-ACC facilities become bigger.
- However, to achieve very high efficiency of electricity generation, higher cost could be required.
- The following procedure could contribute to improve the efficiency of energy recovery;
    - Increase of exchange capacity such as utilization of low temperature economizer
    - Increase of boiler temperature and pressure, effective utilization of steam
    - Increase of the efficiency of steam turbine system such as introduction of steam condensing turbine and combined cycle with thermal power plant, etc.
    - Increase of thermal energy by increase of waste quantity and LCV.

(5) Pollution Control

- Environmental standards of WtE-ACC facility is set as stricter than the National standards in the case of the developed countries. It means that such stricter standards can be met by installing appropriate pollution control technology and eases making public consensus for its development.

(6) Ash Handling

- Bottom ash and fly ash shall be separately handled and treated.
- In the case of bottom ash, after the separation of recyclable, the residue of bottom ash may be utilized as cement aggregate, or other construction use such as backfilling material, roadbed after its melting, baking and aging. While the solid waste amount for disposal can be reduced by these utilizations, such utilization sometime requires additional cost and could be revenue source depending on the market condition of the reused materials.
- Because fly ash contains heavy metal or other toxic materials, it should be stabilized by cement solidification, chemical treatment, or dispose at hazardous waste landfill site.

(7) Business Scheme

- During the planning and design stage, local government should prepare or evaluate an overall plan for the WtE-ACC facility, along with the technical specifications.

- It was confirmed that a solicited approach was adopted in almost all cases in the case study. This is the fact that the WtE-ACC projects took this approach could reach to the construction and operation. Proposals from the private sector are based on the private sector's technical and financial capacity, which may not be best for the improvement of solid waste management in the LGUs unless appropriately oriented before preparation of the proposal.

(8) Public Involvement and IEC

- During the planning process, public consultation should be implemented. The EIA including public consultation are executed in the WtE-ACC development, which facilitates the citizen's understanding on the project as well as situation of municipal solid waste management of their LGUs.

- As practiced in the developed countries, environmental monitoring reports for WtE-ACC operation should be regularly prepared and disclosed. The information relevant to WtE-ACC operation, such as air quality monitoring of exhaust gas or water quality monitoring of wastewater are to be reported.

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Appendix 1

Comparison of Case Study Data
in
the Target Countries

item		101	102	103	104	105
Name		Ota Incineration Plant	Shinkoto Incineration Plant	Suginami Incineration Plant	Maishima Incineration Plant	Higashisaitama
Location		Ota-ward, Tokyo, Japan	Koto ward, Tokyo, Japan	Suginami ward, Tokyo, Japan	Osaka, Japan	Higashisaitama, Japan
Implementing Body		Clean Authority of TOKYO	Clean Authority of TOKYO	Clean Authority of TOKYO	Osaka, Yao, Matsubara cities environment facilities association	Koshigaya city, Soka city, Yashio city, Misato city
Area (ha)		9.2	6.1	3.6	3.3	4.6
Capacity (t/day)		600t/d (300 x 2lines)	1800t/d (600 x 3lines)	600t/d (300 x 2lines)	900t/d (450 x 2lines)	800t/d (200 x 4 lines)
Heat Usage (MW)		Electric Power 22.8MW	Electric Power 50.0MW	Electric Power 24.2MW	Electric Power 32MW	Electric Power 24MW
Target Waste		Combustible municipal solid waste	Combustible municipal solid waste	Combustible municipal solid waste	Combustible municipal solid waste	Combustible municipal solid waste, sewerage sludge
Waste Quality (KJ/kg) (Plan)		14,800	10,501	8,854	8,768	7,572
Waste Quality (KJ/kg) (Actual)		-	11,849	10,363	10,768	8,458
History						
Original	Plan	2006	-	-	-	-
	Bid	2010	-	-	-	-
	Conts. St	2010	1994	2012	-	-
	Conts. Fin	2014	1998	2017	-	-
	Op. Start	2014	1998	2017	-	-
	Op. Fin	-	-	-	-	-
	Demolish	-	-	-	-	-
Actual	Plan	2006	-	-	-	-
	Bid	2010	-	-	-	-
	Conts. St	2010	1994	2012	-	1991
	Conts. Fin	2014	1998	2017	2001	1995
	Op. Start	2014	1998	2017	2001	1995
	Op. Fin	-	-	-	-	-
	Demolish	-	-	-	-	-
Capex		18.797 B-JPY	88.193 B-JPY	-	60.9 B-JPY	-
Fund Source of Capex		NG Subsidy (30%), Bond (50%), LG (20%)	NG Subsidy + LG	NG Subsidy + LG	NG Subsidy + LG	-
Opex		1.486 B-JPY/yr (2019)	3.33 B-JPY/yr (2019)	1.01 B-JPY/yr (2019)	1.7 B-JPY/yr (2018)	-
Fund Source of Opex		LGs' share (57%), TF (26%), Ener	LG	LG	LGs' + TF + Energy (1.1 B-JPY/yr (2018))	-
Fin. Scheme		Public Build (DB) and Own	Public Build (DB) and Own	Public Build (DB) and Own	Public Build (DB) and Own	Public Build (DB) and Own
Dev. Approach			Solicited	Solicited	Solicited	Solicited
	Collection	LG (Ota ward)	LG (Koto ward)	LG (Suginami ward)	LG	LG
	Transportation	LG (Ota ward)	LG (Koto ward)	LG (Suginami ward)	LG	LG

item		101	102	103	104	105
Name		Ota Incineration Plant	Shinkoto Incineration Plant	Suginami Incineration Plant	Maishima Incineration Plant	Higashisaitama
Coverage	Processing	LG (Clean Authority of TOKYO)	LG (Clean Authority of TOKYO)	LG (Clean Authority of TOKYO)	LG	LG
	Energy Sale	LG (Clean Authority of TOKYO)	LG (Clean Authority of TOKYO)	LG (Clean Authority of TOKYO)	LG	LG
	Bottom Ash	LG (Environmental Bearau of Metropolitan Tokyo)	LG (Environmental Bearau of Metropolitan Tokyo)	LG (Environmental Bearau of Metropolitan Tokyo)	LG	LG
	Fly Ash	LG (Environmental Bearau of Metropolitan Tokyo)	LG (Environmental Bearau of Metropolitan Tokyo)	LG (Environmental Bearau of Metropolitan Tokyo)	LG	LG
Process Type		Stoker Type	Stoker Type	Stoker Type	Stoker Type	Stoker Type
EPC/Tech		Takuma	Takuma	Hiz	Hiz	-
Pollution Control	Exhaust Gas	Stricker standard than National government (Scrubber + SCR + Bag Filter)	Stricter Standard (Scrubber + SCR + Bag Filter	Stricter Standard than National government (Scrubber + SCR + Bag Filter)	Stricter Standard than National government (Scrubber + SCR + Bag Filter)	(Scrubber＋bag filter)
	Waste Water	Discharge to Sewage	Discharge to Sewage	Discharge to Sewage	Discharge to Sewage	Discharge to Sewerage or other water courses
	Bottom Ash	Eco-cement	Eco-cement	Eco-cement or SLF	Eco-cement	Chemical treatment or melting
	Fly Ash	Provincial SLF after chemical treatment	Ash melting or provisional SLF after chemical treatment	Provisional SLF after ash treatment	Provincial SLF after chemcial treatment	Provincial SLF after chemcial treatment

item		106	107	108	109	110	111
Name		Tobuki Incineration Plant	Ukisima	Sunrise cener	Kushiro Wide-area Federation WtE facility	Funabashi city south incineration plant	Mito city incineration plant
Location		Hachoji city, Tokyo	Ukishima, Tokyo	Iwakuni, Hiroshima	Hokkaido, Kushiro	Chiba, Funabashi	Ibaragi, Mito
Implementing Body		Hachioji City	Kawasaki city	Iwakuni city	Kushiro Wide-area Federation	Funabashi city	Mito city
Area (ha)		2.1	6	1.4	2.5	3.3	4.79
Capacity (t/day)		300t/d (300t/d x 1 line)	900t/d(300t/d x 3 line)	160t/d (80t/d x 2 line)	240	339	330
Heat Usage (MW)		Electric Power 2.1MW	Electric Power 12.5MW	Electric Power 3.9MW	Electricity 4.4MW	Electricity 8.4MW	Electricity 9.55MW
Target Waste		Combustible municipal solid waste, bulky waste, etc	Combustible municipal solid waste	Combustible municipal solid waste, bulky waste, sewerage sludge, etc	Combustible waste, combustible residue	Combustible waste, combustible residue, combustible bulky waste, combustible disaster waste	Combustible waste, combustible residue, combustible disaster waste
Waste Quality (KJ/kg) (Plan)		8,255	9,600 – 11,300 kJ/kg	8,963	8,600	9,900	9,300
Waste Quality (KJ/kg) (Actual)		9,217	-	10,455	6,620	11,827	—
History							
Original	Plan	-	-	-	-	2012.3	2009.8
	Bid	-	-	-	-	2015.9	2012.1
	Conts. St	-	-	-	-	2016.3	2013.4
	Conts. Fin	-	-	-	-	2020.3	2016.1
	Op. Start	-	-	-	-	2020.4	2016.2
	Op. Fin	-	-	-	-	-	-
	Demolish	-	-	-	-	-	-
Actual	Plan	-	-	-	0	2012.3	2009.8
	Bid	-	-	-	0	2015.9	2015.1
	Conts. St	1994	1991	2015	2003.1	2016.3	2016.3
	Conts. Fin	1998	1995	2019	2006.3	2020.3	2020.3
	Op. Start	1998/-	1995	2019	2006.3	2020.3	2020.3
	Op. Fin	-	-	-	-	-	-
	Demolish	-	-	-	-	-	-
Capex		-	46.1 B-JPY	17.45 B-JPY	45 B-JPY	243 B-JPY（incl. desconstruction）	21.0 B-JPY（incl. recycle）
Fund Source of Capex		NG Subsidy + LG	NG Subsidy + LG	-	LG + electricity + recyclable	LG + electricity + recyclable	LG + electricity + recyclable
Opex		15,723 JPY/ton (2018)	-	-	9.98 B-JPY /15 year（inc. recycle)	10.6 B-JPY/15 year	21.7 B-JPY/20 year (incl. recycle)
Fund Source of Opex		LG	-	-	LG + electricity + recyclable	LG + electricity + recyclable	LG + electricity + recyclable
Fin. Scheme		Public Build (DB) and Own	Public Build (DB) and Own	Public Build (DB) and Own	DB+O（15 years - long term contract)	DBO（15 years)	DBO（20 years)
Dev. Approach		Solicited	Solicited	Solicited	Solicited	Solicited	Solicited
	Collection	LG	LG	LG	LG	LG	LG
	Transportation	LG	LG	LG	LG	LG	LG

item		106	107	108	109	110	111
Name		Tobuki Incineration Plant	Ukisima	Sunrise cener	Kushiro Wide-area Federation WtE facility	Funabashi city south incineration plant	Mito city incineration plant
Coverage	Processing	LG	LG	LG(?)	SPC	SPC	SPC
	Energy Sale	LG	LG	LG(?)	Federation	LG (Incentive fee for SPC)	SPC (LG for sales revenue)
	Bottom Ash	LG	LG	LG	Federation	LG	SPC
	Fly Ash	LG	LG	LG	Federation	LG	SPC
Process Type		Stoker Type	NKK type	Stoker Type	Fulidized bed combustion and gasification and melting	Stoker Type	Stoker Type
EPC/Tech		JFE	Nippon Steel (NKK)	JFE	MHI	JFE	Hiz
Pollution Control	Exhaust Gas	Stricter standard than National government	Stricter Standard than National government (Scrubber + Bag Filter)	Stricter Standard than National government (SCR + Bag Filter)	Stricter Standard than National government (SCR + Bag Filter)	Stricter Standard (Dry scrubber + NSCR + Bag Filter)	Stricter Standard (Dry scrubber + NSCR + Bag Filter)
	Waste Water	Discharge to Sewage	Discharge to Sewage	Closed system	Closed system	Reutilization of wastewater from plant and discharge to sewerage the remain and domestic wastewater	Closed system
	Bottom Ash	Eco-cement	No bottom ash	Cement utilization after chemcial treatment	Melting and recycling	Melting and recycling (cement, etc), final disposal	Recycling (cement, etc)
	Fly Ash	Utilized as eco-cement after agent treatment	Chemical treatment	Cement utilization after chemcial treatment	Final disposal after chemical treatment	Final disposal after chemical treatment	Final disposal after chemical treatment

item		112	113	114	115	116	117
Name		Yatsushiro environmental center	Miyanojin Clean Center	Yokkaichi Clean Center	Asakawa Seiryu Environmental Association	Tachibana Shori Center	Thermal Energy Center
Location		Kumamoto, Yatsushiro	Fukuoka, Kurume	Mie, Yokkaichi	Tokyo, Hino	Kanagawa, Kawasaki	Saitama, Saitama
Implementing Body		Yatsushiro city	Kurume city	Yokkaichi city	Asakawa Seiryu Envir	Kawasaki city	Saitama city
Area (ha)		5.55	7.4	3.5	1.1	2.45	2.4
Capacity (t/day)		134	163	336	228	600	420
Heat Usage (MW)		Electricity 2.88MW	Electricity 3.56MW	Electricity 9.0MW	Electricity 5.19MW	Electricity 9.0MW	Electricity 10.64MW
Target Waste		Combustible waste, combustible residue, combustible bulky waste, combustible disaster waste	Combustible waste, combustible residue in separation facility, combustible bulky waste, combustible disaster waste	Combustible waste, combustible bulky waste, cleaning waste, shreddered combustible waste, animal waste, sludge after leachte treatment, disaster waste	Combustible waste, combustible bulky waste, combustible shredder residue, disaster waste	Municipal solid waste	Combustible waste, combustible residue, shredder residue, disaster waste
Waste Quality (KJ/kg) (Plan)		9,200	9,700	10,100	9,200	9,500	9,600
Waste Quality (KJ/kg) (Actual)		9,508	10,562	9,299	-	-	-
History							
Original	Plan	2014.3	2011.12	2009.3	2014.3	2013.11	2015.3
	Bid	2014.1	2012.1	-	2016.6	2015	2017.1
	Conts. St	2015.3	2013.3	-	2016.1	2015	2018.4
	Conts. Fin	2017.3	2016.3	2015.3	2020.3	2022	2021.3
	Op. Start	2017.4	2016.4	2015.4	2020.4	2022	2021.4
	Op. Fin	-	-	-	-	-	-
	Demolish	-	-	-	-	-	-
Actual	Plan	2014.3	2011.12	2009.3	2014.3	2013.11	2015.3
	Bid	2014.1	2012.1	2012.3	2016.6	2017.2	2019.7
	Conts. St	2015.3	2013.3	2012.1	2016.11	2017.1	2020.3
	Conts. Fin	2018.9	2016.3	2016.3	2020.3	2023.6 (planned)	2025.3 (planned)
	Op. Start	2018.9	2016.3	2016.3	2020.3	2023.7 (planned)	2025.3 (planned)
	Op. Fin	-	-	-	-	-	-
	Demolish	-	-	-	-	-	-
Capex		15.8 BJPY（incl. O&M, recycle design）	18.0 B-JPY (incl. O&M, recycle design)	13.3 B-JPY (incl. recycle design)	15.6 B-JPY	29.8 B-JPY（inc. O&M and rec design）	51.6 B-JPY（inc. O&M, destruction and Rec design）
Fund Source of Capex		LG + electricity + recyclable	LG + electricity + recyclable	LG + electricity + recyclable	LG + electricity + recyclable	LG + electricity + recyclable	LG + electricity (recyclable by SPC)
Opex		-	-	15.99 B-JPY (incl. recycle)	9.17 B-JPY	-	-
Fund Source of Opex		LG + electricity + recyclable	LG + electricity + recyclable	LG + electricity + recyclable	LG + recyclable (electricity by SPC)	LG + electricity + recyclable	LG + electricity (recyclable by SPC)
Fin. Scheme		DBO（20 years）	DBO（20 years）	DBO（20 years）	DBO（20 years）	-	DBO（15 years）
Dev. Approach		Solicited	Solicited	Solicited	Solicited	Solicited	Solicited
	Collection	LG	LG	LG	LG	—	LG
	Transportation	LG	LG	LG	LG	—	LG

item		112	113	114	115	116	117
Name		Yatsushiro environmental center	Miyanojin Clean Center	Yokkaichi Clean Center	Asakawa Seiryu Environmental Association Combustible Waste	Tachibana Shori Center	Thermal Energy Center
Coverage	Processing	SPC	SPC	SPC	SPC	-	SPC
	Energy Sale	SPC	SPC (LG for a half of sales revenue)	SPC (LG for sales revenue)	Association	-	LG (Incentive fee for SPC)
	Bottom Ash	SPC	SPC	SPC（melting ash）	Association	—	SPC
	Fly Ash	SPC	LG	LG	Association	—	LG
Process Type		Stoker Type	Stoker Type	Stoker Type	Stoker Type	Stoker Type	Stoker Type
EPC/Tech		Hiz	Takuma	Nippon Steel	Hiz	MHI	Takuma
Pollution Control	Exhaust Gas	Stricter Standard (Dry scrubber + NSCR + Bag Filter)	Stricter Standard (Dry scrubber + NSCR + Bag Filter)	Stricter Standard (Dry scrubber + SCR + Bag Filter)	Stricter Standard (Dry scrubber + SCR + Bag Filter)	Stricter Standard (Dry scrubber + SCR + Bag Filter)	Stricter Standard (Dry scrubber + NSCR + Bag Filter)
	Waste Water	Closed system	Closed system for wastewater from plant and discharge to sewerage for domestic wastewater	Closed system for wastewater from plant and discharge to rainwater drainage for domestic wastewater	Reutilization and discharge to sewerage for the remain	Reutilization and discharge to sewerage of wastewater from plant and discharge to sewerage for	Reutilization and discharge to river of wastewater from plant and domestic wastewater
	Bottom Ash	Recycling (cement, etc)	Recycling (cement, etc)	Recycling after melting	Final disposal	Final disposal	Recycling (cement, etc)
	Fly Ash	Recycling after chemical treatment	Final disposal after chemical treatment	Recycling	Final disposal after chemical treatment	Final disposal after chemical treatment	Recycling or final disposal after chemical treatment

item		118	119	120	121	122	123
Name		Ozenji Treatment Center	Clean Center Rinkai Plant	Hamamatsu City New Incineration Plant (tentative)	Nerima Incineration plant	Kuwana Wide Area Cleaning Business Association Waste Treatment Facility	Toshima Incineration plant
Location		Ozenji, Kawasaki, Kanagawa	Oosaka, Sakai	Shizuoka, Hamamatsu	Tokyo, Nerima	Mie, Kuwana	Tokyo, Toshima
Implementing Body		Kawasaki city	Sakai city	Hamamatsu city	Clean Authority of TOKYO	Kuwana wide area federatoin	Clean Authority of TOKYO
Area (ha)		5.47	3	7.56	1.5	2.8	1.2
Capacity (t/day)		450	450	399	500t/d (250 x 2 incinerators)	174 t/day (87 t/day x2)	400t/day (200t/day x2)
Heat Usage (MW)		Electricity 7.5MW	Electricity 13.5MW	Electricity 15.12MW	Electricity 18.7MW	Electricity 3.08MW	Electricity 7.8MW
Target Waste		Combustible municipal solid waste	Domestic waste, bulky waste, general waste from business, waste from environmental cleansing activity, animal corpse	Combustible waste, combustible residue, sewerage sludge, animal corpse, disaster waste	Source segregated “Combustible Waste”	Combustible waste	Combustible waste
Waste Quality (KJ/kg) (Plan)		-	10,170	9,200	8,489	4160-10370 kJ/kg	9,709
Waste Quality (KJ/kg) (Actual)		-	9,971	-	10200 (max. 14,300)	-	11,828
History							
Original	Plan	-	2006.2	2014.3	-	-	-
	Bid	-	-	2015	-	-	-
	Conts. St	2007	2009.11	2016	-	-	-
	Conts. Fin	2012	2009.11	2016	-	-	-
	Op. Start	2012	2013.4	2020	-	-	-
	Op. Fin	-	-	-	-	-	-
	Demolish	-	-	-	-	-	-
Actual	Plan	-	2006.2	2014.3	-	-	-
	Bid	2006.2	2007.5	2017.12	-	-	-
	Conts. St	2007.9	2009.11	2018.2	2010, 12	2017	-
	Conts. Fin	2007.9	2009.11	2018.2	2015, 11	2019	1999
	Op. Start	2009.4	2013.4	2024.4 (planned)	2015, 11	2020	1999
	Op. Fin	-	-	-	-	-	-
	Demolish	-	-	-	-	-	-
Capex		29.8-JPY	42.3 B-JPY (inc. O&M , EIA)	72 B-JPY (inc. O&M, recycle)	-	21.4 B-JPY (incl. O&M and ash treatment)	-
Fund Source of Capex		-	-	LG + electricity (recyclable by SPC)	NG Subsidy + LG	-	NG Subsidy + LG
Opex		-	-	-	-	-	-
Fund Source of Opex		-	-	LG + electricity (recyclable by SPC)	-	-	-
Fin. Scheme		Public Build (DB) and Operate	BTO (20 years)	BTO (20 years)	Public Build (DB) and Own	DBO (20 years)	Public Build (DB) and Own
Dev. Approach		Solicited	Solicited	Solicited	Solicited	Solicited	Solicited
	Collection	LG	LG	LG	LG (Nerima ward)	LG	LG (Toshima ward)
	Transportation	LG	LG	LG	LG (Nerima ward)	LG	LG (Toshima ward)

item		118	119	120	121	122	123
Name		Ozenji Treatment Center	Clean Center Rinkai Plant	Hamamatsu City New Incineration Plant (tentative)	Nerima Incineration plant	Kuwana Wide Area Cleaning Business Association Waste Treatment Facility	Toshima Incineration plant
Coverage	Processing	LG	SPC	SPC	LG (Clean Authority of TOKYO)	SPC	LG (Clean Authority of TOKYO)
	Energy Sale	LG	SPC	SPC (LG for sales revenue, incentive fee for SPC)	LG (Clean Authority of TOKYO)	SPC	LG (Clean Authority of TOKYO)
	Bottom Ash	LG	LG（landfill）／SPC（recycle）	SPC	LG (Environmental Bearau of Metropolitan Tokyo)	LG	LG (Environmental Bearau of Metropolitan Tokyo)
	Fly Ash	LG	LG（landfill）／SPC（recycle）	LG	LG (Environmental Bearau of Metropolitan Tokyo)	LG	LG (Environmental Bearau of Metropolitan Tokyo)
Process Type		Stoker Type	Shaft type	Shaft type	Stoker Type	Stoker Type	Fluidized bed combustion
EPC/Tech		Ebara	Nippon Steel	Nippon Steel	JFE	Ebara	IHI
Pollution Control	Exhaust Gas	Stricter Standard (Dry scrubber + SCR + Bag Filter)	Stricter Standard (Dry scrubber + SCR + Bag Filter)	Stricter Standard (Dry scrubber + SCR + Bag Filter)	Stricter Standard (Scrubber + SCR + Bag Filter)	Stricter Standard (Scrubber + SCR + Bag Filter)	Stricter Standard (Scrubber + SCR + Bag Filter)
	Waste Water	Discharge to sewerage	-	Closed system	-	Closed system	-
	Bottom Ash	No bottom ash	Recycling after melting , final disposal	Melting, recycling	Eco cement	―	No bottom ash
	Fly Ash	Provincial SLF after chemical treatment	Recycling or final disposal after chemical treatment	Final disposal after chemical treatment	Chemical treatment	―	Chemical treatment

item		124	125	126	127	128	129
Name		Shibuya Incineration plant	Saitama city Sakura Environmental Center	Musashino Clean Center	Funabashi city north incineration plant	Hatsukaichi Energy Clean Center	Yokohama city, Kanazawa Incineration Plant
Location		Tokyo, Shibuya	Saitama city	Tokyo, Musashino city	Chiba Funabashi	Hiroshima, Hatsukaichi city	Kanagawa, Yokohama,
Implementing Body		Clean Authority of TOKYO	Nippon steel	Ebara	Clean koubou (Ebara)	Hatsukaichi Environmental service	Yokohama city
Area (ha)		0.9	2.6	1.7	4.8	1.7	7
Capacity (t/day)		200 t/day	380 t/day (190 x 2 line)	120 t/day (60 t/day x2)	381 t/day (127 t/day x 3)	150 t/day (750 t/day x 2)	1200 t/day (400 t/day x 3)
Heat Usage (MW)		Electricity 4.2MW	Electricity 8.5MW	Electricity 2.65MW	Electricity 8.8MW	Electricity 3.1MW	Electricity 35MW
Target Waste		Combustible waste	Combustible waste, residual, sewerage sludge	Combustible waste, residual	Combustible waste, bulky waste, waste treatment residue, sewerage sludge	Combustible waste	Combustible waste, bulky waste, waste treatment residue, sewerage sludge
Waste Quality (KJ/kg) (Plan)		9,787	9,536	8,413	6,400	-	9,825
Waste Quality (KJ/kg) (Actual)		11,887	11,120	9,717	8,290	-	9,690
History							
Original	Plan	-	-	-	-	-	-
	Bid	-	-	-	-	-	-
	Conts. St	-	-	-	-	-	-
	Conts. Fin	-	-	-	-	-	-
	Op. Start	-	-	-	-	-	-
	Op. Fin	-	-	-	-	-	-
	Demolish	-	-	-	-	-	-
Actual	Plan	-	-	-	-	-	-
	Bid	-	-	-	-	-	-
	Conts. St	1998	2010	2014	-	2016.7	1995
	Conts. Fin	2001	2015	2017	-	2019.3	2001
	Op. Start	2001	2015	2017	2017	2019.4	2001
	Op. Fin	-	-	-	-	2039.3	-
	Demolish	-	-	-	-	-	-
Capex		13.3 B Yen	-	-	21.4 B-Yen (incl. O&M)	19.58 B-JPY (20 years contract)	-
Fund Source of Capex		NG Subsidy + LG	-	-	-	-	-
Opex		1.40 B-YEN/year (2018)	-	-	-	-	-
Fund Source of Opex		-	-	-	-	-	-
Fin. Scheme		Public Build (DB) and Own	DBO	DBO (20 year)	DBO (15 years)	DBO	Public Build (DB) and Own
Dev. Approach		Solicited	Solicited	Solicited	Solicited	Solicited	Solicited
	Collection	LG (Shibuya ward)	LG	LG	LG	LG	LG
	Transportation	LG (Shibuya ward)	LG	LG	LG	LG	LG

item		124	125	126	127	128	129
Name		Shibuya Incineration plant	Saitama city Sakura Environmental Center	Musashino Clean Center	Funabashi city north incineration plant	Hatsukaichi Energy Clean Center	Yokohama city, Kanazawa Incineration Plant
Coverage	Processing	LG (Clean Authority of TOKYO)	SPC	SPC	SPC	SPC	LG
	Energy Sale	LG (Clean Authority of TOKYO)	SPC	SPC	SPC	SPC	LG
	Bottom Ash	LG (Environmental Bearau of Metropolitan Tokyo)	LG	LG	LG	LG	LG
	Fly Ash	LG (Environmental Bearau of Metropolitan Tokyo)	LG	LG	LG	LG	LG
Process Type		Fluidized bed combustion	Shaft type	Stoker Type	Stoker Type	Fluidized bed combustion	Stoker Type
EPC/Tech		Ebara	Nippon steel	Ebara	Ebara	Koberco	JFE
Pollution Control	Exhaust Gas	Stricter Standard (Scrubber + SCR + Bag Filter)	-	Stricter Standard (Dry scrubber + NSCR + Bag Filter)	Stricter Standard (Dry scrubber + SCR + Bag Filter)	Stricter Standard (Dry scrubber + SCR + Bag Filter)	Stricter Standard (Dry scrubber + SCR + Bag Filter)
	Waste Water	Discharge to water course after treatment	-	Utilization in facility and discharge to sewerage	Closed for wastewater from plant, discharge to water course for domestic wastewater	Closed system	Discharge to Sewage
	Bottom Ash	No bottom ash	Ash Metling	Eco cement	Chemical treatment	No bottom ash	Ashi metling
	Fly Ash	Chemical treatment	Chemical treatment	Chemical treatment	Chemical treatment	Cement solidification	Chemical treatment, cement solidification

item		130	201	202	203	204	205
Name		Yokohama city, Tsurumi Incineration Plant	Tuas Incineration Plant	Tuas South WTE Plant	Senoko WTE Plant	Keppel Seghers Tuas WTE Plant	Nong Khaem WtE plant
Location		Kanagawa, Yokohama, Tsurumi	Tuans, Singapore	South Tuas, Singapore	Senoko, Singapore	Tuas, Singapore	Nong Kaem, Thailand
Implementing Body		Yokohama city	National Environmental Agency (NEA) in Singapore	National Environmental Agency (NEA) in Singapore	Keppel Seghers	Keppel Seghers	C&G Environmental Protection Holdings Limited (C&G)
Area (ha)		6.1	—	10.5	7.5	1.6	-
Capacity (t/day)		1200 t/day (400 t/day x 3)	1700t/d (5 units)	3000t/d	2100-2310t/d	800t/d	500 t/d
Heat Usage (MW)		Electricity 22MW	Electric power 30MW	Electric power 36MW	Electric power 36 MW	Electirc power 22MW	Electric power 9.8 MW
Target Waste		Combustible waste, bulky waste, waste treatment residue	Combustible municipal solid waste	Municipal solid waste	Municipal solid waste	Municipal solid waste	Municipal solid waste
Waste Quality (KJ/kg) (Plan)		11,646	-	-	-	-	?
Waste Quality (KJ/kg) (Actual)		11,252	-	-	-	-	?
History							
Original	Plan	-	-	-	-	-	-
	Bid	-	-	-	-	-	-
	Conts. St	-	-	-	-	-	-
	Conts. Fin	-	-	-	-	-	-
	Op. Start	-	-	-	-	-	-
	Op. Fin	-	-	-	-	-	-
	Demolish	-	-	-	-	-	-
Actual	Plan	-	-	-	-	-	-
	Bid	-	-	-	-	-	-
	Conts. St	-	-	-	-	-	-
	Conts. Fin	-	-	2000	1992	2006	2014
	Op. Start	1995	-	2000	1993	2009	2014
	Op. Fin	-	-	-	-	2034	2034
	Demolish	-	-	-	-	-	-
Capex		-	-	708.76 million US$	-	-	900 million THB
Fund Source of Capex		-	-	NEA	NEA	T/F + Electric bill	BMA
Opex		-	-	(TF 77 SID/ton)	-	(TF 77 SID/ton)	1000 THB /ton
Fund Source of Opex		-	-	NEA	NEA	T/F + Electric bill	Tipping fee from BMA, energy sale
Fin. Scheme		Public Build (DB) and Own	Public Build (DB) and Own	Public Build (DB) and Own	Public Build (DB) and Own	BOT	BOT
Dev. Approach		Solicited	Solicited	Solicited	Solicited	Solicited	Solicited
	Collection	LG	NEA	NEA	NEA	NEA	C&G
	Transportation	LG	NEA	NEA	NEA	NEA	C&G

item		130	201	202	203	204	205
Name		Yokohama city, Tsurumi Incineration Plant	Tuas Incineration Plant	Tuas South WTE Plant	Senoko WTE Plant	Keppel Seghers Tuas WTE Plant	Nong Khaem WtE plant
Coverage	Processing	LG	NEA	NEA	NEA	Keppel Seghers	C&G
	Energy Sale	LG	NEA	NEA	NEA	Keppel Seghers	C&G
	Bottom Ash	LG	NEA	NEA	NEA	NEA	BMA
	Fly Ash	LG	NEA	NEA	NEA	NEA	BMA
Process Type		Stoker Type	Stoker Type	Stoker type	Stoker type	Stoker type	Stoker type
EPC/Tech		MHI	MHI	MHI	Keppel Segher	Keppel Segher	New Sky /Hiz
Pollution Control	Exhaust Gas	-	-	Keep national standard (electrostatic precipitators, catalystic bag filter)	keep national standard (Flue gas reactor+activated carbon dosing + bag filter)	Keep Standard (Flue gas reactor + Activated carbon dosing + Bag Filter)	-
	Waste Water	Discharge to Sewage or water course after treatment (coagulation process and sand filter or chelate)	-	Closed loop system (No wastewater to be discharged)	Closed loop system (No wastewater to be discharged)	Closed loop system (No wastewater to be discharged)	-
	Bottom Ash	No bottom ash	-	Provincial SLF	Provincial SLF	Provincial SLF	-
	Fly Ash	Chemical treatment, cement solidification	-	Provincial SLF	Provincial SLF	Provincial SLF	-

Item		206	207	208	209	210
Name		Maoli WtE Plant	Can Tho solid waste treatment plant	Laogang solid waste treatment plant (phase I)	Jabalpur WtE facility	Phuket WtE facility
Location		Maoli Taiwan	Can Tho city, Vietnam	Laogang, Shanghai city, China	Jabalpur city, India	Phuket municipality, Thailand
Implementing Body		ECOVE Miaoli Energy Corporation	EB Environmental Energy (Can Tho) Limited	Shanghai Laogang Solid Waste Utilization Co., Ltd	Jabalpur MSW PVt., Ltd.	Phuket municipality
Area (ha)		3.9	5.3	97	4.4	-
Capacity (t/day)		500 t/d	400t/d	3000t/d (750t/d x 4)	600t/d	500 t/day (250 t/day x 2)
Heat Usage (MW)		Electric power 11.8 MW	Electric power 75 MW	Power 60MW	Electric power 11.5 MW	Electric power 2.5 MW (for 1line)
Target Waste		Municipal solid waste and industrial waste	-	Municipal solid waste	Combustible waste	Municipal solid waste
Waste Quality (KJ/kg) (Plan)		2300kcal/kg	6280 kJ/kg	7100 KJ/kg	900-1100 kcal/kg	More than 1800 kcal/kg
Waste Quality (KJ/kg) (Actual)		-	-	-	-	Less than 1400 kcal/kg
History						
Original	Plan	-	-	-	-	-
	Bid	-	-	-	-	-
	Conts. St	-	-	-	-	-
	Conts. Fin	-	-	-	-	-
	Op. Start	-	-	-	-	-
	Op. Fin	-	-	-	-	-
	Demolish	-	-	-	-	-
Actual	Plan	-	-	-	-	-
	Bid	-	-	-	-	-
	Conts. St	-	2017	-	-	-
	Conts. Fin	2008	2019	-	-	-
	Op. Start	2008	2019	2014	2016	1999.5 (only 1 line)
	Op. Fin	2028	2029	-	-	-
	Demolish	-	-	-	-	-
Capex		-	48 million US$ (incl. O&M)	30 B-JPY	INR 90 Million	25 million US$ for 1 line
Fund Source of Capex		ECOVE Energy Miaoli Company + NG (?)	CEIL Fund and loan from ADB	-	-	-
Opex		-	around 15 US$ / ton	-	10.3 Mil INR/month	55 to 75vmillion bhats /year for 250
Fund Source of Opex		ECOVE Energy Miaoli Company	CEIL Fund and loan from ADB	-	-	Subsidy+tipping fee+electricity sale
Fin. Scheme		BOT	BOO (22 years)	-	BOT	-
Dev. Approach		Solicited	-	Solicited	-	-
	Collection	LG	LG	LG	-	-
	Transportation	LG	LG	LG	-	-

Item		206	207	208	209	210
Name		Maoli WtE Plant	Can Tho solid waste treatment plant	Laogang solid waste treatment plant (phase I)	Jabalpur WtE facility	Phuket WtE facility
Coverage	Processing	ECOVE Energy Miaoli Company	LG	-	-	-
	Energy Sale	ECOVE Energy Miaoli Company	LG	-	-	-
	Bottom Ash	-	LG	-	-	-
	Fly Ash	-	LG	-	-	-
Process Type		Stoker type	Stoker type	Stoker type	Stoker type	Stoker type
EPC/Tech		CTCI	-	Hiz	Hiz	MHI
Pollution Control	Exhaust Gas	Semi dry scrubber+ activated carbon +bag filter	Dry scrubber + SNCR+bag filter	-	-	-
	Waste Water	-	No discharge of waste water by using on-site	-	-	-
	Bottom Ash	-	Recycled as brick material or road construction	-	-	-
	Fly Ash	-	Landfill after chelate and cement stabilization	-	-	-

item		301	302	303	304	305
Name		Afval Energie Bedrijf Amsterdam (AEB)	Klemetsrud Combined Heat and Power (CHP) plant	Issy-les-Moulineaux WtE plant (Isseane) - *NEW	ASM Brescia 'Termoutilizzatore'	Zabalgarbi / Bizkaia WtE Plant
Location		Australhavenweg, Western Docklands, Amsterdam	Klemetsrud, Norway	Issy-LesMoulineaux, Paris, France	Brescia, Italy	Bilbao, Province of Bizkaia, Spain
Implementing Body		AEB - Local Government (w/ city districts and 19 municipality partners), contract will expire in 2022	Fortum Oslo Varme	SYCTOM (Public Authority), Operator: TSI (Private)	A2A S.p.A. (Company of municipalized services)	Owner and Operator: Zabalgarbi S.A (a public-private partnership) Private (65%), Public (35%)
Area (ha)		-	-	3.8	16 (2.3 ha for WTE)	2.7
Capacity (t/day)		4400 t/d	1080 tpd 400,000 tpa Line 1: 10tph Line 2: 10 tph Line 3: 25 tph	510000t/y* (new plant thoughput, some references cited 460,000 - the plant was upgraded in 2016)	2400t/d (730000 - 800000t/y)	220,000 - 250,000 t/y (720 t/d x 1 line) (30 t/h x 1 line)
Heat Usage (MW)		Electric power125 MW 1,000,000 MWh (2008) Heat usage 250,000 GJ heat (2008)	Power: ~130MW Thermal Capacity: Line 1 = 27.8 MW Line 2 = 27.8 MW Line 3 = 66.7 MW	Steam Production: 200 t/h Electric Power Output: 52 MW Heat Output: 150 t/h	Electricity Power : 100MW	Power 99.5 MWe(Net 95MWe) Efficiency appears to be around 42%
Target Waste		Municipal Solid Waste, Commercial Waste	Municipal, Residual, Commercial, & Hospital Waste	Residual Waste	Municipal Solid Waste, Industrial (Non-Hazardous) Waste, Biomass & Dried Sludge	Municipal Solid Waste
Waste Quality (KJ/kg)		average calorific value of 10MJ/kg	Line 1: 8.3 Line 2: 8.3 Line 3: 12	8 MJ/kg (min), 11.7 MJ/kg (max)	6300 - 13800 kJ/kg (LHV)	Low Heat Value (LHV): 8.000 kJ/Kg
History						
Original	Plan	-	-	-	-	-
	Bid	-	-	-	-	-
	Conts. St/Fin	-	-	-	-	-
	Op. Start/Fin	-	-	-	-	-
	Demolish	-	-	-	-	-
Actual	Plan	1998	-	1998	-	1996
	Bid	2001	Line3:2008	2000	-	-
	Conts. St/Fin	2004/2007	Line 1&2 1983/1986	(2001-Civil Works) 2003/2007	-	1999/2004
	Op. Start/Fin	2008/2027	Line 1&2 1985 Line3 :2011	2007/	1998 (MSW), 2004 (Biomass)/	2005/2030
	Demolish	-	-	-	-	-
Capex		€ 450 million (1993) € 370 million (2004)	€330M (Line 3)	600 million EUR ex. VAT for Isséane, including 50 million EUR for the site alone	~£320M	€154M
Fund Source		Loan from "green" financing and the European Investment Bank (EIB)	-	Public Authorities	-	Initial finance + Loan from EU
Opex		•Turnover > € 180 million, Profit > € 12 million	-	-	-	-
Fund Source		Sales + Bank Loans + State Aid (from City of Amsterdam)	-	-	-	-

item		301	302	303	304	305
Name		Afval Energie Bedrijf Amsterdam (AEB)	Klemetsrud Combined Heat and Power (CHP) plant	Issy-les-Moulineaux WtE plant (Isseane)	ASM Brescia 'Termoutilizzatore'	Zabalgarbi / Bizkaia WtE Plant
Fin. Scheme		Design-Build-Operate (DBO)	-	Design-Bid-Build	-	PPP (Joint Venture?)
Dev. Approach (Solicited/Unsolicited)		Solicited (1993), Unsolicited (2007)	-	Solicited	-	-
Coverage	Collection	AEB + LG* AEB has six permanent waste collection points in the city of Amsterdam	Private	SYCTOM	A2A	LG contract private companies
	Transportation	AEB + LG*	Private	SYCTOM	A2A	LG contract private companies
	Processing	AEB	Klemetsrud CHP	TSI	A2A	Zabalgarbi
	Energy Sale	Joint Venture with Energy company in Amsterdam	District Heating – Fortum Oslo Varme Electricity – sold to Kinect Energy Group (Bergen Energi AS)	Sold to: Electricité de France (Electricity) Compagnie Parisienne de Chauffage Urbain (Heat)	A2A	Zabalgarbi
	Bottom Ash	AEB	-	TSI	A2A	Zabalgarbi
	Fly Ash	AEB	-	TSI	A2A	Zabalgarbi
Process Type		Moving grate	Incineration, Stroker Line 3: Reciprocating Grate	Water - cooled grate	Moving reverse thrust grate	Moving grate
EPC/Tech		MNC, FLSmidth Airtech A/S, Siemens Fabricom GTI	Furnace- Moss-Rosenberg (lines 1 and 2), Hitachi Zosen Inova (line 3) Boiler: W&E/Moss- Rosenberg (lines 1 and 2), Hitachi Zosen Inova (line 3) Flue Gas Treatment System: Babcock Borsig Power + Peabody (lines 1 and 2), Hitachi Zosen Inova (line 3)	AE&E Von Roll Inova (Equipment) Hitachi Zosen Inova AG (combustion part, boiler, flue gas treatment)	Ansaldo, Martin, and ABB (Eqiupment)	Constructions Industrielles de la Méditerranée (CNIM) / Martin GmbH (grate incinerator)/SENER Ingeniería y Sistemas,S.A. as
Pollution Control	Exhaust Gas	Emission level is < 20% allowed EU Directive. It was not the emission limits under Dutch law (Incineration of Waste Materials Act) that constituted the criteria for designing the flue gas cleaning system. SNCR, ESP and Wet and dry scrubbers	Stricter than emission standard in Norway; Smoke from chimney is 99.78% pure water vapor	Plant standards (Ministerial order of 20 Sept. 2002): Stricter than EU & local standards *ESP and SCR DeNOX System	Minimum emission requirement: Waste Incineration Directive (WID) of Autorizzazione Integrata Ambientale (A.I.A.) Standards *SNCR, activated carbon and dry lime scrubbing	The Zabalgarbi plant performs well within WID limits for air emissions.
	Waste Water	Closed system	Treated then channeled into drainage system (Line 3	Discharged to sewerage after treatment	No industrial water effluent from plant	No information of wastewater handling but surface water sampling is carried out
	Bottom Ash	Reprocessed to be Sand - lime bricks, concrete	Used for road maintenance and other construction needs	Aggregate for Road Construction	used in building and civil engineering applications or reused in authorised landfill applications	Aggregate for construction industry, separatio of metal from bottom ash
	Fly Ash	Treated to be used as Asphalt concrete	Transported to Noah Langøya	Disposed in landfill after treatment	Deep Mine Disposal (APC Residues)	After stabilization, storage in an authorized facility

item		306	307	308	309	310
Name		Wien-Spittelau	Amager Bakke	Incineration Line 6 / The Energy Tower	Lahti Gasification Facility (Kymijärvi II)	Allington Energy from Waste (EfW) Incinerator
Location		Spittelau, Vienna, Austria	Copenhill, Copenhegan, Denmark	Roskilde, Denmark	Lahti, Finland	Allington Energy from Waste (EfW) Incinerator
Implementing Body		Fernwärme Wien GmbH	Amager Ressourcecenter (ARC)	Argo (Formerly Kara/Noveren)	Lahti Energia (owned by City of Lahti)	Kent Enviropower Ltd[
Area (ha)		-	4.1	1.6	25 m2 per 1,000 tpa of waste processed	7 (27 ha used in park land in 34 ha)
Capacity (t/day)		250000 t/y (360 t/d x 2 = 720 t/d)	35 t/h x 2 lines = 70 t/h 1680 t/d 400,000 – 560,000 t/a	30 t/h (1 line) 200,000 t/a to 350,000 t/a	250,000 t/a of SRF	1500 t/d (ISWA excel sheet) 500,000 t/a
Heat Usage (MW)		Electric power : 6 MW Thermal Capacity: 60 MW	Steam Output: 141.1 t/h Electrical Efficiency Rate: 28% Electricity:66MW Heat:27.6MW	Thermal Capacity/line: 81.3 MW Electricity: 19 MW Heat: 52 MW	Electricity: 50MW District heat: 90 MW	Power capacity: 43MW[1] Supplied to grid: 34MW Thermal capacity: 53.8MW[2] Electric efficiency: 27%
Target Waste		Municipal waste (domestic waste and industrial wastes similar to household waste)	Residual Waste	CO2-neutral organic waste & non- recyclable plastics (incinerable waste + resot-treated wood)	Household waste (origin sorted), Industrial waste, demolition wood, waste wood from industry	Non-hazardous MSW, Commercial and Industrial
Waste Quality (KJ/kg)		9,500 kJ/kg (average heating value) [Waste Thermal Value: 8,200 – 9,600 kJ/kg]	11,500 KJ/kg LHV range: 8-15 MJ/kg	Steam output/line: 96.7 t/h Steam Generating Efficiency: 82% Overall efficiency: 34% Total Energy Efficiency Rate: ~100%	LHV: 13-20 MJ/kg, as fired Predicted Design LHV: 16,100 KJ/kg Actual Average LHV: 14,200 KJ/kg	6.5 – 12.5 MJ/kg
History						
Original	Plan	-	-	-	-	-
	Bid	-	-	-	-	-
	Conts. St/Fin	-	-	-	-	-
	Op. Start/Fin	-	-	-	-	-
	Demolish	-	-	-	-	-
Actual	Plan	2009	2009	2005	1999	-
	Bid	-	-	2008	2000	2008
	Conts. St/Fin	2012/2014	-	2009/2012	2004/	2011/2013
	Op. Start/Fin	2015/	2017/2037	2012/	2008/	2014/
	Demolish	-	-	-	-	-
Capex		Spittelau 2.0: €144 million	~$525M-$670M	€175 Million (DKK 1.293 Billion)	€160 Million	> £ 150 M[
Fund Source		EIB: €70 million	Financed by city's municipal council (loan)	Argo (KARA/Noveren)	Subsidy Grant + Loan(€7 million grant from E, €15 million as a 'new technology' subsidy from Finland's, Ministry of Employment, European Investment Bank (€70 million) and the Nordic Investment Bank (€50 million)	20% KEL,
Opex		-	$30/ton waste	-	-	-
Fund Source		-	Municipal Tax	Revenue (sale of heat & electricity, use of bottom ash, gate fee)		-

item		306	307	308	309	310
Name		Wien-Spittelau	Amager Bakke	Incineration Line 6 / The Energy Tower	Lahti Gasification Facility (Kymijärvi II)	Allington Energy from Waste (EfW) Incinerator
Fin. Scheme		PPP (BOT or BOO, etc?)	—	Public Own Operation	DBO?	-
Dev. Approach (Solicited/Unsolicited)		Solicited	Solicited		Solicited	Solicited
Coverage	Collection	LG	LG	Päijät-Häme Waste Management Ltd (PHJ)	LG	
	Transportation	LG	LG	Päijät-Häme Waste Management Ltd	LG	
	Processing	Fernwärme Wien GmbH	ARC	Kymijärvi II	KEL	
	Energy Sale	Fernwärme Wien GmbH	ARC	Kymijärvi II	KEL	
	Bottom Ash	Fernwärme Wien GmbH	ARC	Kymijärvi II	-	
	Fly Ash	Fernwärme Wien GmbH	ARC	Sent for post- processing to an external contractor	-	
Process Type		reverse - acting grate	Grate Fired	Martin Reverse-Acting Grate	Circulating fluidized bed	Rotating fluidized bed
EPC/Tech		For Spittelau 2.0: Firing Technique, Grate MH Power Systems Europe Service GmbH (former: XERVON Energy GmbH) Construction Works Züblin Baugesellschaft mbH – Porr Technobau und Umwelt GmbH	Babcock & Wilcox	>Architect: Erick van Egeraart >Martin – Boiler, Grate >LAB – Flue gas treatment >MAN Diesel & Turbo – Turbine >Ramboll A/S, Bascon A/S - engineer	>Lahti Energia >Valmet (formerly, Metso Power) - technology provider (Makron, Solmex - installation)	Boiler/ incinerator system: Lurgi Turbine/ Generator Systems: Siemens EPC: Lurgi, Hochtief
Pollution Control	Exhaust Gas	The emission limit values in accordance with EU Waste Incineration Directive ESP+wet scrubber +SCR	Stricter (less 50%) than Euro Zone Baseline Electrostatic precipitator Front-end scr Wet flue gas cleaning	Stricter than EU WID Standard a dry APC system and NOx control using SCR	Emission meet than EU standards	
	Waste Water	Discharge to water course (Danube Canal) after treatment	-	Minimal Liquid Effluent	Discharge to water course after treatment	
	Bottom Ash	Used as slag concrete or in landfill engineering (perimeter wall formation)	Used as road material after treatment	Reused as road construction material	Used as road aggregate after treatment	
	Fly Ash	The fly ash are transported abroad by train in covered skips or silo transporters and deposited in a decommissioned salt mine.	Lime is used to neutraliza residual product from other industries, not sure about fly ash including heavy metal	Treated as hazardous waste	Landfill after treatment	

item		311	312	313	314	315
Name		Brussels Waste- to-Energy plant*	SYSAV (Sysav South Scania Waste) waste-to-energy plant*	Lejonpannan (CHP Plant)	Dåva kraftvä rmeverk (Deaf 1)	Mainz Waste-to- Energy Plant
Location		Brussels / Bruxelles, Belgium	Malmö (City), Skå ne, Sweden	Linköping (municipality), Sweden	Umeå, Sweden	Rhineland-Pfalz, Germany
Implementing Body		Bruxelles-Energie (Bruxelles-Propret é owns 60% of the shares of Bruxelles-Energie and Sita, group SUEZ Environment, 40%)	SYSAV (Sydskånes avfallsaktiebolag, in translation: South Scania Waste Company, Ltd). - municipal enterprise owned by many municipalities	Tekniska verken i Linköping AB (TVL) - municipality- owned	Umeå Energi AB (municipality- owned) *Umeå Energi AB is a subsidiary of Umeå municipal company AB, which is owned by Umeå municipality	Entsorgungsgesell schaft Mainz mbH (EGM)[1]
Area (ha)		-	-	1.693	-	-
Capacity (t/day)		~1300 - 1440* (3 lines of 19t/h each)	630000 t/y	230000 t/y	200000 t/y (20 t/h) for Dava 1, 24000 t/y for Dava 2	340,000 tons per year Line 1: 16.2 t/h, Line 2: 16.2 t/h, Line 3: 17.8 t/h[4]
Heat Usage (MW)		Annual objectives with a maximum capacity of 20 MW (power capacity)	Electricity : 250000MWh /year Thermal : 1400000 MWh /year	83-84 * Power Capacity Heat Output: 510 GWh/yr Electricity: 137 GWh/yr	Power: 65 MW (district heating 55 MW + electricity 10 MW) for DEAF 1, Power 105 MW (district heating 75 MW + electricity 300 MW) for DEAF 2	Gross heat load (136MW) Superheated steam pressure: 43.3bar[3]
Target Waste		Non-Recyclable Household Waste	Municipal Solid Waste, Industrial Waste	Rubbish (Household Garbage, Industrial Waste & waste from abroad)	household and business waste, forest debris	MSW (Domestic, Bulk, Commercial) from the City of Mainz, approx. 500,000 residents[1,,3]
Waste Quality (KJ/kg)		3 lines of 19t/h @ a calorific power inferior to 9.000 KJoules per kilo Heat Output: 2000 kWhhth/1 ton of waste Electricity Output: 500 kWhe/1 ton of waste	-	10500kJ/kg	-	9815 kJ/kg
History						
Original	Plan	-	-		-	-
	Bid	-	-		-	-
	Conts. St/Fin	-	-	2013/2015	-	-
	Op. Start/Fin	-	-	2016 (take over)/	-	-
	Demolish	-	-		-	-
Actual	Plan	-	-		-	2006/2008
	Bid	-	-		-	2008/2011
	Conts. St/Fin	1984	-	2013/2015	2000, 2010/	2012/2014
	Op. Start/Fin	-	1973 (1st and 2nd), 2003 (3rd), 2008 (4th)	2015 (test run), 2016(take over)	-	2015/2035
	Demolish	-	-	-	-	-
Capex		-	-	SEK 1 billion (1.2 billion specifically) ~ (EUR 111 million)	-	-
Fund Source		-	-	Nordic Investment Bank (NIB) - SEK 450 M, TVL (remaining)	-	-
Opex		-	Turnover: 750 Millions SEK	-	-	-
Fund Source		-	-	-	-	-

item		311	312	313	314	315
Name		Brussels Waste- to-Energy plant	SYSAV (Sysav South Scania Waste) waste-to-energy plant	Lejonpannan (CHP Plant)	Dåva kraftvä rmeverk (Deaf 1)	Mainz Waste-to- Energy Plant
Fin. Scheme		-	-	-	-	-
Dev. Approach (Solicited/Unsolicited)		Solicited	Solicited	Solicited	Solicited	Solicited
Coverage	Collection	-	-	TVL	-	9.71
	Transportation	-	-	TVL	-	*2500-3000 t/d *3000 t/d, 1000000 t/y (3 lines x 1000 t/d)
	Processing	-	Sysav	TVL	Umeå Energi AB	*95MW *284,400 lb/h (per boiler) x 3 Boilers
	Energy Sale	-	SYSAV sells heate energy and electricity	-	Umeå Energi AB	Unprocessed Municipal Solid Waste
	Bottom Ash	-	Sysav	-	-	Net Electric Energy Generation divided by Total Processed Waste: 575 net kWh/ton PW (FY 2019 Goal)
	Fly Ash	-	Sysav	-	-	
Process Type		Stoker	Stoker	Forward moving grate	Stoker	Reciprocating stok
EPC/Tech		-	-	Peab as general contractor, Steinmüller Babcock Environment GmbH for boiler, Fincanteri SpA for the turbine and Ahlstom for flue gas purification and condensation	-	Martin GmbH supplier consortium
Pollution Control	Exhaust Gas	Emission meet than EU standards	Cleaned by Sysav Stricter than EU Wet scrubber + electrostatistic precipitater +SCR	-	Wet scrubber + bag filter	-
	Waste Water	-	Discharged sea after wastewater treatment	-	-	-
	Bottom Ash	Use as material for road earthwork in Netherland after separation of ferrous material for steel industry	Separated metal scrap are separated and recycled.	-	-	-
	Fly Ash	Landfilled in salt mine cavities in Germany	Neutralisation of slurry lime and fly ash including heavy metal are deposited in a special cell of landfill site	-	-	

添付資料3

item		316	317	318	319	320
Name		Pfaffenau Waste Incineration Plant	Riikinvoima Ekovoimalaitos WtE Plant	Palm Beach Renewable Energy Facility 2	SEMASS Resource Recovery Facility	Montgomery County Ressource Recovery Facility
Location		Vienna, Austria	Riikinvoima Oy Riikinnevantie 153d 78210 Varkaus	Florida, West Palm Beach, USA	Massachusetts, West Wareham, USA	Maryland, Baltimore, USA
Implementing Body		MVA Pfaffenau (Municipal department 48 of Vienna)	Owned by 8 municipal waste management companies and Varkauden Aluelämpö	Owner: Solid Waste Authority of Palm Beach County Operator: Palm Beach Resource Recovery Corporation, a subsidiary of Babcock &Wilcox Power Generation Group, Inc	Covanta SEMASS, L.P.	John Hancock Life Insurance Company
Area (ha)		-	-	9.71	40	14
Capacity (t/day)		250,000 tons per year 2 incineration lines	145,000 tons annually	*2500-3000 t/d *3000 t/d, 1000000 t/y (3 lines x 1000 t/d)	3000 t/d (1000 t/d x 3 lines)	1830 t/d (610 t/d x 3 lines)
Heat Usage (MW)		Power capacity 14MW Heat capacity 50MW	Distric heating / year 180 GWh Electricity generation / year 90 GWh Electric power: 54MW	*95MW *284,400 lb/h (per boiler) x 3 Boilers	Electric Power : 78MW	Rated Capacity (Turbine): 63MW Net Production: <55MW
Target Waste		Residual waste and bulky waste	Sorted mixed waste	Unprocessed Municipal Solid Waste	Municipal Solid Waste	Municipal Solid Waste
Waste Quality (KJ/kg)		-	-	Net Electric Energy Generation divided by Total Processed Waste: 575 net kWh/ton PW (FY 2019 Goal)	11,630 KJ/kg	-
History						
Original	Plan	-	-	-		
	Bid	-	-	-		
	Conts. St/Fin	-	-	-	-	-
	Op. Start/Fin	-	-	-	-	-
	Demolish	-	-	-	-	-
Actual	Plan	-	-	-	-	-
	Bid	-	-	-	-	-
	Conts. St/Fin	2014/2016	2006/2008	-	-	-
	Op. Start/Fin	2017/	2008/	1989/	-	-
	Demolish	-	-	-		
Capex		-	-	$672,000,000		-
Fund Source		-	-	Bond 90% and 10% Investment from others	-	-
Opex		-	-	$2 5,322,389 (2017 actual cost for Operating Contract	-	$30.8 million/20 years
Fund Source		-	-	-	-	Energy sale, tipping fee, sales of ferrous metal, etc

item		316	317	318	319	320
Name		Pfaffenau Waste Incineration Plant	Riikinvoima Ekovoimalaitos WtE Plant	Palm Beach Renewable Energy Facility 2	SEMASS Resource Recovery Facility	Montgomery County Resource Recovery Facility
Fin. Scheme		-	-	Florida, West Palm Beach, USA	-	-
Dev. Approach (Solicited/Unsolicited)		-	-	Owner: Solid Waste Authority of Palm Beach County Operator: Palm Beach Resource Recovery Corporation, a subsidiary of Babcock &Wilcox Power Generation Group, Inc	Solicited	Solicited
Coverage	Collection	MVA Pfaffenau	-	-	-	
	Transportation	MVA Pfaffenau	-	-	-	
	Processing	MVA Pfaffenau	-	-	-	
	Energy Sale	-	-	-	-	
	Bottom Ash	MVA Pfaffenau	-	-	-	
	Fly Ash	MVA Pfaffenau	-	-	-	
Process Type		-	CFB	-	-	Reverse Reciprocating Stoker
EPC/Tech		-		-	-	-
Pollution Control	Exhaust Gas	Electrostatic precipitator (removes dust) Wet scrubbers Active coat filter for the separation of organic toxics Catalyzer where nitrogen oxide is filtered	Purification states: - SNCR plant (selective non-catalytic reduction) Spray absorber with admixing of milk of lime Activated coke Fabric filter Scrubber	cleaning system consists of ANDRITZ TurboSorp (ESP)- a semi dry flue gas cleaning system and bagfilter [2]	Dry scrubbers, carbon injection for mercury control + electrostatic precipitators + bag filter	Meet the local regulatory emission limit but not meet EU regulation for HCl and NOx, Semi - dry scrubbers, Thermal DeNOx system, carbon injection, bag filter
	Waste Water	Treated in in- house treatment facility and then sent to main Vienna waterways	-	-	-	Utilized in adjacent power plant after treatment
	Bottom Ash	Metals is collected from bottom ash. Ash is solidified, and ash slag is used as cement material	-	-	Separation of recyclable metals from bottom ash, treated and recovered as raw materials for asphalt, block, etc	Used as road bed material at Landfill site after stabilization
	Fly Ash	Collected in funnels and dumped in ash silo, then deposited together with the bottom ash	-	-	Landfilled after treatment	Used as road bed material at Landfill site after stabilization

Appendix 2

Case Study Sheets

Ota Incineration Plant / Researcher: JET

Name	Ota Incineration Plant	Location	Ota ward, Tokyo, Japan
Impl. Body	Clean Authority of TOKYO	Footprint	9.2ha
Capacity	600t/d (300 x 2lines)	Heat Usage	Power 22.8MW
Target Waste	Source segregated "Combustible Waste"	Waste Quality	14,800 KJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	2006	-	2010	2010	2014	2014	2039	25 yrs
Actual	2006 2010rev	2008.4 (H20.4)	2010 (H22)	2010.6 (H22.6)	2014.9 (H26.9)	2014.9	(25 yrs)	

Capex	18.797 B-JPY	Source ('12-14)	NG Subsidy (30%), Bond (50%), LG (20%)
Opex	1.486 B-JPY/yr (2019)	Source ('18-19)	LGs' share (57%), TF* (26%), Energy (17%)
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG (ward)	LG (ward)	LG	LG	LG	LG

Process Type	Incineration (Stoker),	EPC / Tech	Takuma (JPN)	(Demolish & Build)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Scrubber + SCR + Bag Filter)	Discharge to Sewage	Eco-cement	Provincial SLF after chemical treatment	

Ota Incineration Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
Smooth Implementation	According to the planned schedule of planning, design, bidding, construction and operation, the actual activities have been implemented without significant delay.
Build trust in the relationship with residents	From planning stage, environmental consideration has been implemented and monitoring report is periodically published to the public.
Strong ownership of LG (Solicited x Budget)	LG adopt the solicited approach for tender process as well as their planning and budget preparation with support of central government.

Shinkoto Incineration Plant / Researcher: JET

Name	Shinkoto Incineration Plant	Location	Shinkoto ward, Tokyo, Japan
Impl. Body	Clean Authority of TOKYO	Footprint	6.1ha
Capacity	1800t/d (600 x 3lines)	Heat Usage	Power 50.0MW
Target Waste	Combustible municipal solid waste	Waste Quality	10,501 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-		-	-
Actual	-	-	-	1994	1998	1998	-	-

Capex	88.193 B-JPY	Source	NG Subsidy + LG
Opex	3.33 B-JPY/yr (2019)	Source	LG + TF + Energy
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG (ward)	LG (ward)	LG	LG	LG	LG

Process Type	Stoker Type	EPC / Tech	Takuma (JPN)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Scrubber + SCR + Bag Filter)	Discharge to Sewage	Eco-cement	Ash melting or provisional SLF after chemical treatment	

Shinkoto Incineration Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Relatively small operation cost	The WTE facility was developed with largest capacity WTE in Metropolitan Tokyo. The operation cost is lower than other WTEs in Metropolitan Tokyo.
2. Utilization of surplus heat after electricity generation	The surplus heat after electricity generation is utilized by providing adjacent public facilities such as hot water pool, botanical garden, cultural center.

Suginami Incineration Plant / Researcher: JET

Name	Suginami Incineration Plant	Location	Suginami ward, Tokyo, Japan
Impl. Body	Clean Authority of TOKYO	Footprint	3.6 ha
Capacity	600t/d (300 x 2lines)	Heat Usage	Power 24.2MW
Target Waste	Combustible municipal solid waste	Waste Quality	8,854 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-	-
Actual	-	-	-	2012	2017	2017	-	-

Capex	-	Source	NG Subsidy + LG
Opex	1.01 B-JPY/yr (2019)	Source	LG + TF + Energy
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG (ward)	LG (ward)	LG	LG	LG	LG

Process Type	Stoker type	EPC / Tech	Hiz (JPN)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Scrubber + SCR + Bag Filter)	Discharge to Sewage	Eco-cement or SLF	SLF after chemical treatment	

Suginami Incineration Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Relatively small operation cost	The WTE facility was developed with largest capacity WTE in Metropolitan Tokyo. The operation cost is lower than other WTEs in Metropolitan Tokyo.
2. Utilization of surplus heat after electricity generation	The surplus heat after electricity generation is utilized by providing adjacent public facilities such as hot water pool, botanical garden, cultural center.
3. Implementation of site tour	Site tours are periodically implemented to disseminate the WtE facility
4. IEC through of museum of waste management history or hot water pool	In the WTE facility, there is museum of Tokyo Gomi Senso (Experience to tackle with waste issues in Tokyo), which describe the background, opposition of the WTE facility by the residents

Maishima Incineration Plant / Researcher: JET

Name	Maishima Incineration Plant	Location	Osaka, Japan
Impl. Body	Osaka, Yao, Matsubara cities environment facilities association	Footprint	3.3ha
Capacity	900t/d (450 x 2lines)	Heat Usage	Power 32MW
Target Waste	Combustible municipal solid waste	Waste Quality	8768 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original		-						
Actual		-			2001	2001		

Capex	60.9 B-JPY	Source	NG Subsidy + LG
Opex	1.7 B-JPY/yr (2018)	Source	LGs' + TF + Energy (1.1 B-JPY/yr (2018))
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	LG (DB)	LG	LG (Cement)	LG > Province

Process Type	Stoker type	EPC / Tech	Hiz (JPN)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
<u>Stricter</u> Standard (Scrubber + SCR + Bag Filter)	Discharge to Sewage	Eco-cement	Provincial SLF after chemical treatment	Comply with local ordinances

Maishima Incineration Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Artificial and harmonized design	The exterior of the Maishima WTE facility was designed by famous artist in Viennes. His intentions were to symbolize the harmony of technology, ecology and art by creating a structure with roots in the local area.
2. IEC with surrounding community	The plant prepare the open day for public

Higashisaitama Incineration Plant / Researcher: JET

Name	Higashisaitama Incineration Plant	Location	Higashisaitama, Japan
Impl. Body	Koshigaya city, Soka city, Yashio city, Misato city	Footprint	4.6 ha
Capacity	800t/d (200 x 4 lines)	Heat Usage	Power 24MW
Target Waste	Combustible municipal solid waste, sewerage sludge	Waste Quality	7572 KJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-	-
Actual	-	-	-	1991	1995	1995	-	-

Capex	-	Source	-
Opex	-	Source	-
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	LG (DB)	LG	LG (Cement)	LG > Province

Process Type	Stoker type	EPC / Tech	-

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Scrubber + Bag Filter	Discharge to Sewage or other water courses	Chemical treatment or melting	Provincial SLF after chemicial treatment	

Higashisaitama Incineration Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Artificial and harmonized design	In the stack of WE facility, there is viewing platform for visitors and harmonized design with surrounding environment. 
2. IEC for surrounding community and visitors	The plant prepare the open day for public and provide virtual tour for the facility.

Tobuki Incineration Plant / Researcher: JET

Name	Tobuki Incineration Plant	Location	Hachioji City
Impl. Body	Hachioji City	Footprint	2.1 ha
Capacity	300 t/day (100 t/day x 3)	Heat Usage	2.1MW ele. Thermal ene.
Target Waste	Combustible waste	Waste Quality	8,255 kJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	1994	1998	1998	-	-

Capex	-	Fund Source	NG Subsidy + LG
Opex	15,723 JPY / ton (2018)	Fund Source	-
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
LG	LG	LG	LG	LG	LG

Process Type	Stoker type	EPC / Tech	JFE	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Far below the national standard value (Less than 10%)	Discharge to sewerage	Utilized as eco-cement	Utilized as eco-cement after chemical treatment	

Tobuki Incineration Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Utilization of thermal energy	Steam produced using the heat from waste combustion is utilized for air conditioning and heated water supply within the plant. In addition, the heat is supplied to the Incombustibles Treatment Center and to the neighboring waste heat utilization facilities. Power is also generated by a steam turbo-generator with an output of 2,080 kW, which will compensate for the power consumption in the plant.
2. Effective utilization of residue	Bottom ash is utilized for eco- cement and fly ash is utilized for the material of eco cement after regent treatment.

Ukishima Incineration Plant / Researcher: SWMD

Picture

Name	UKISHIMA INCINERATION PLANT	Location	Kawasaki City, Japan
Impl. Body	Kawasaki City	Footprint	Refuse Combustion plant : 6.00 ha Bulky Wastes Processing- 0.22 ha Special Combustion Capacity- 0.07 ha
Capacity	Refuse Combustion Capacity- 900 t/day (300 t/day x 3), Bulky waste processing : 50t/day, special waste combustion facility : 300kg/day	Heat Usage	Power : 12.5 MW
Target Waste	Combustible MSW, Bulky Wastes	Waste Quality	9,600 – 11,300 kJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	1991	1995	1995	-	-

Capex	Total Project Cost: Y46.1 B (429.2 Mil USD)	Fund Source	LG subsidy from NG
Opex	Not available Mil USD/year	Fund Source	LG
Fin. Scheme	Design Build	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	LG (DB)	LG	LG (Cement)	LG > Province

Process Type	Incineration (Stoker)	EPC / Tech	NKK	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard than NG (Scrubber + Bag Filter)	Discharge to Sewage	No treatment	Provincial SLF after chemical treatment	

Ukishima Incineration Plant / Researcher: SWMD

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Pollution control	The measured monitoring data of exhausted gas (NOx, SOx, HCl, dust) are much less than standard.
2. Environmental Education	Kawasaki Eco Gurashi Miraikan was developed with the plant to implement the environmental education of solid waste management including the facility explanation

Sunrise Clean Center / Researcher: JET

Name	Sunrise Clean Center	Location	Iwakuni, Japan
Impl. Body	Sunrise Clean Center (SCC) managed by Iwakuni city	Footprint	1.4 ha
Capacity	160 t/day (80t/day x 2)	Heat Usage	Power 3.9MW Heat
Target Waste	Combustible municipal solid waste, bulky waste, sewerage sludge, etc	Waste Quality	10,455 kJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	2015	2019	2019	2039	-

Capex	17.45 B-PY	Fund Source	-
Opex	-	Fund Source	-
Fin. Scheme	DBO	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
Iwakuni city	Iwakuni city	SPC	SPC	Iwakuni city	Iwakuni city

Process Type	Stoker type	EPC / Tech	JFE	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Catalytic reactor and bag filter	After treatment	Cement utilization after chemical treatment	Cement utilization after chemical treatment	

Sunrise Clean Center / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Hight of stack	The height of stack is 26 m which is lower than normal incineration plant in Japan (more than 59 m) for restriction of Iwakuni air force base. The bottom of stack is located underground to keep the length of stack for the velocity of exhausted gas.
2. Utilization of incineration ash	In the process of facility, bottom ash and fly ash is used as cement ingredient which contribute the reduction of disposal of residue.

Kushiro Wide-area Federation WtE facility / Researcher: JET

Name	Kushiro Wide-area Federation WtE facility	Location	Kushiro, Hokkaido, Japan
Impl. Body	Kushiro Wide-area Federation	Footprint	2.5 ha
Capacity	240 t/d	Heat Usage	Power 4.4 MW
Target Waste	Combustible waste, combustible residue	Waste Quality	8,600 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-	-
Actual	-	-	-	2003	2006	2006	-	-

Capex	45 B-JPY-	Source	LG + electricity + recyclable
Opex	9.98 B-JPY /15 year	Source	LG + electricity + recyclable
Fin. Scheme	DB+O (15 yr)	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	SPC	Federation	Federation	Federation

Process Type	Fulidized bed combustion and gasification and melting	EPC / Tech	MHI

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (SCR + Bag Filter)	Closed system	Melting and recycling	SLF after chemical treatment	

EJEC

Funabashi city south incineration plant / Researcher: JET

Name	Funabashi city south incineration plant	Location	Funabashi, Chiba, Japan
Impl. Body	Funabashi city	Footprint	3.3 ha
Capacity	339 t/d	Heat Usage	Power 8.4 MW
Target Waste	Combustible waste, combustible residue, combustible bulky waste, combustible disaster waste	Waste Quality	9,900 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-	-
Actual	2012.3	-	2015.9	2016.3	2020.2	2020.3	-	-

Capex	24.3 B-JPY	Source	LG + electricity + recyclable
Opex	10.6 B-JPY/15 year	Source	LG + electricity + recyclable
Fin. Scheme	DBO (15yr)	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	SPC	LG (incentive fee for SPC)	LG	LG

Process Type	Stoker type	EPC / Tech	JFE

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + NSCR + Bag Filter)	Reuse and sewerage discharge	Melting and recycling	SLF after chemical treatment	

NIPPON KOEI

EJEC

添付資料3

Mito city incineration plant / Researcher: JET

Name	Mito city incineration plant	Location	Mito, Ibaragi, Japan
Impl. Body	Mito city	Footprint	4.79 ha
Capacity	339 t/d	Heat Usage	Power 9.6 MW
Target Waste	Combustible waste, combustible residue, combustible disaster waste	Waste Quality	9,300 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-	-
Actual	2009.8	-	2015.1	2016.3	2020.2	2020.3	-	-

Capex	21.0 B-JPY	Source	LG + electricity + recyclable
Opex	21.7 B-JPY/20 year	Source	LG + electricity + recyclable
Fin. Scheme	DBO (20 yr)	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	SPC	SPC (for sales revenue)	SPC	SPC

Process Type	Stoker type	EPC / Tech	JFE

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + NSCR + Bag Filter)	Closed system	Recycling (cement, etc.)	Final disposal after chemical treatment	

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EJEC

Yatsushiro environmental center / Researcher: JET

Name	Yatsushiro environmental center	Location	Yatsushiro, Kumamoto, Japan
Impl. Body	Yatsushiro city	Footprint	5.55 ha
Capacity	134 t/d	Heat Usage	Power 2.9 MW
Target Waste	Combustible waste, combustible residue, combustible bulky waste, etc.	Waste Quality	9,200 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-	-
Actual	2013.3	-	2014.1	2015.3	2018.8	2018.9	-	-

Capex	15.8 B-JPY	Source	LG + electricity + recyclable
Opex	-	Source	LG + electricity + recyclable
Fin. Scheme	DBO (20 yr)	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	SPC	SPC	SPC	SPC

Process Type	Stoker type	EPC / Tech	Hiz

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + NSCR + Bag Filter)	Closed system	Recycling (cement, etc.)	Recycling after chemical treatment	

NIPPON KOEI
EJEC

Miyanojin Clean Center / Researcher: JET

Name	Miyanojin Clean Center	Location	Kurume, Fukuoka, Japan
Impl. Body	Kurume city	Footprint	7.4 ha
Capacity	163 t/d	Heat Usage	Power 3.6 MW
Target Waste	Combustible waste, combustible residue in separation facility, combustible bulky waste, combustible disaster waste	Waste Quality	9,700 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-	-
Actual	2011.12	-	2012.1	2013.3	2016.2	2016.3	-	-

Capex	18.0 B-JPY	Source	LG + electricity + recyclable
Opex	-	Source	LG + electricity + recyclable
Fin. Scheme	DBO (20 yr)	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	SPC	SPC (LG for a half of sales revenue)	SPC	SPC

Process Type	Stoker type	EPC / Tech	Takuma

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + NSCR + Bag Filter)	Closed system	Recycling (cement, etc.)	Final disposal after chemical treatment	

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EJEC

Yokkaichi Clean Center / Researcher: JET

Name	Yokkaichi Clean Center	Location	Mie, Yokkaichi, Japan
Impl. Body	Yokkaichi city	Footprint	3.5 ha
Capacity	336 t/d	Heat Usage	Power 9.0 MW
Target Waste	Combustible waste, combustible bulky waste, cleaning waste, sludge after leachate treatment, etc.	Waste Quality	10,100 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-	-
Actual	2009.3	-	2011.3	2012.1	2016.2	2016.3	-	-

Capex	13.3 B-JPY	Source	LG + electricity + recyclable
Opex	15.99 B-JPY (incl. recycle)	Source	LG + electricity + recyclable
Fin. Scheme	DBO (20 yr)	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	SPC	SPC (LG for sales revenue)	SPC	SPC

Process Type	Stoker type	EPC / Tech	Nippon Steel

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + NSCR + Bag Filter)	Closed system for plant wastewater	Recycling after melting	Recycling	

NIPPON KOEI
EJEC

Asakawa Seiryu Environmental Association Combustible WTF / Researcher: JET

Name	Asakawa Seiryu Environmental Association Combustible Waste Treatment Facility	Location	Hino, Tokyo, Japan
Impl. Body	Asakawa Seiryu Environmental Association	Footprint	1.1 ha
Capacity	228 t/d	Heat Usage	Power 5.2 MW
Target Waste	Combustible waste, combustible bulky waste, combustible shredder residue, disaster waste	Waste Quality	9,200 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-	-
Actual	2014.3	-	2016.6	2016.11	2020.2	2020.3	-	-

Capex	15.6 B-JPY	Source	LG + electricity + recyclable
Opex	9.17 B-JPY	Source	LG + recyclable (electricity by SPC)
Fin. Scheme	DBO (20 yr)	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	SPC	Federation	Federation	Federation

Process Type	Stoker type	EPC / Tech	HIz

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + SCR + Bag Filter)	Reutilization and discharge to sewerage	Recycling after melting	Final disposal	Final disposal after chemical treatment

Tachibana Shori Center / Researcher: JET

Name	Tachibana Shori Center	Location	Kawasaki, Kanagawa, Japan
Impl. Body	Kawasaki city	Footprint	2.45 ha
Capacity	600 t/d	Heat Usage	Power 9.0 MW
Target Waste	Municipal solid waste	Waste Quality	9,500 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	2023.6	2023.7	-	-
Actual	2013.11	-	2016.2	2017.1	-	-	-	-

Capex	29.8 B-JPY	Source	LG + electricity + recyclable
Opex	-	Source	LG + recyclable (electricity by SPC)
Fin. Scheme	-	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
-	-	-	-	-	-

Process Type	Stoker type	EPC / Tech	MHI

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + SCR + Bag Filter)	Reutilization and discharge to sewerage	Recycling after melting	Final disposal	Final disposal after chemical treatment

Thermal Energy Center / Researcher: JET

Name	Thermal Energy Center	Location	Saitama, Saitama, Japan
Impl. Body	Saitama city	Footprint	2.4 ha
Capacity	420 t/d	Heat Usage	Power 10.6 MW
Target Waste	Municipal solid waste	Waste Quality	9,600 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	2025.2	2025.3	-	-
Actual	2015.3	-	2019.7	2020.3	-	-	-	-

Capex	51.6 B-JPY (incl. O&M and demolition cost)-	Source	LG + recyclable (electricity by SPC)
Opex		Source	
Fin. Scheme	DBO (15 yrs)	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	SPC-	LG (Incentive fee for SPC)-	SPC	LG

Process Type	Stoker type	EPC / Tech	Takuma

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + NSCR + Bag Filter)	Reutilization and discharge to river	Recycling (cement, etc.)	Recycling or final disposal after chemical treatment	

Ozenji Treatment Center / Researcher: JET

Name	Ozenji Treatment Center	Location	Kawasaki, Kanagawa, Japan
Impl. Body	Kawasaki city	Footprint	5.47 ha
Capacity	450 t/d	Heat Usage	Power 7.5 MW
Target Waste	Combustible MSW	Waste Quality	-

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-	-
Actual	-	-	-	2007	2012	2012	-	-

Capex	29.8 B-JPY	Source	-
Opex	-	Source	-
Fin. Scheme	Public Build (DB) and Operate	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	LG	LG	LG	LG

Process Type	Stoker type	EPC / Tech	Ebara

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + SCR + Bag Filter)	Discharge to Sewage	No bottom ash?	Provincial SLF after chemical treatment	-

Clean Center Rinkai Plant / Researcher: JET

Name	Clean Center Rinkai Plant	Location	Sakai, Oosaka, Japan
Impl. Body	Sakai city	Footprint	3 ha
Capacity	450 t/d	Heat Usage	Power 13.5 MW
Target Waste	Combustible MSW	Waste Quality	10,170 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-	-
Actual	2006.2	-	2007.5	2009.11	2013.3	2013.4	-	-

Capex	42.3-JPY	Source	-
Opex	-	Source	-
Fin. Scheme	BTO (20yrs)	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	SPC	SPC	LG	LG

Process Type	Shaft type	EPC / Tech	Nippon Steel

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + SCR + Bag Filter)	-	Recycling after melting , final disposal	Recycling or final disposal after chemical treatment	-

Hamamatsu City New Incineration Plant (tentative) / Researcher: JET

Name	Hamamatsu City New Incineration Plant (tentative)	Location	Hamamatsu, Shizuoka, Japan
Impl. Body	Hamamatsu city	Footprint	7.56 ha
Capacity	399 t/d	Heat Usage	Power 15.1 MW
Target Waste	Combustible waste, combustible residue, sewerage sludge, etc.	Waste Quality	9,200 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	2024.3	2024.4	-	-
Actual	2014.3	-	2017.12	2018.2	-	-	-	-

Capex	42.3-JPY	Source	LG + electricity (recyclable by SPC)
Opex	-	Source	LG + electricity (recyclable by SPC)
Fin. Scheme	BTO (20yrs)	Dev. approach	Solicited

Coverage (SOW)

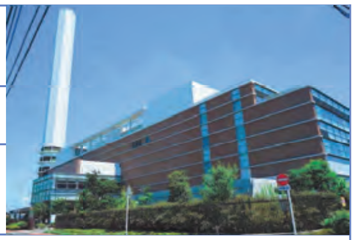
Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	SPC	SPC (LG for sales revenue, incentive fee for SPC)	LG	LG

Process Type	Shaft type	EPC / Tech	Nippon Steel

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + SCR + Bag Filter)	Closed system	Melting, recycling	Final disposal after chemical treatment	-

Nerima Incineration Plant / Researcher: SWMD



Name	Nerima Incineration Plant	Location	Yahara, Nerima ward Japan
Impl. Body	Clean Authority of TOKYO	Footprint	1.5 ha
Capacity	500t/d (250 x 2 incinerators)	Heat Usage	Power :18.7MW
Target Waste	Combustible Waste	Waste Quality	8,489 kJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-	-
Actual	-	-	-	Dec. 2010	Nov. 2015	Nov. 2015	-	-

Capex	Approx. 18.9 B Yen		LG with subsidy from NG
Opex	-		-
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG (ward)	LG (ward)	LG	LG	LG	LG

Process Type	Stoker Type Incinerator	EPC / Tech	JV with JFE

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Scrubber + SCR + Bag Filter)	-	Eco-cement	Provincial SLF after chemical treatment	Comply with local ordinances

Nerima Incineration Plant / Researcher: SWMD

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Pollution control	The measured monitoring data of exhausted gas (NOx, SOx, HCl, dust) are much less than standard.
2. Heat Utilization	Surplus heat energy is utilized for surrounding community such as swimming pool, the community center for children and the community center for senior citizen

Kuwana Wide Area Cleaning Business Association Waste Treatment Facility / Researcher: JET

Name	Kuwana Wide Area Cleaning Business Association Waste Treatment Facility	Location	Kuwana city
Impl. Body	Kuwana wide area federatoin	Footprint	2.8 ha
Capacity	174 t/day (87 t/day x2)	Heat Usage	Power 3.08MW Heat
Target Waste	Combustible waste	Waste Quality	4160-10370kJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	2017	2019	2020	-	-

Capex	21.4 B-JPY (inc. O&M and ash treatment)	Fund Source	-
Opex	-	Fund Source	-
Fin. Scheme	DBO	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
LG	LG	SPC	SPC	LG	LG

Process Type	Stoker	EPC / Tech	Ebara	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Scrubber + SCR + Bag Filter)	Closed system	-	-	

Kuwana Wide Area Cleaning Business Association Waste Treatment Facility / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Boiler temperature and pressure are high	Due to the boiler temperature is 450 C and its pressure 6.0 MPa, utilization of low temperature economizer and lower pressure of turbine exhausted gas, high efficient electric power generation system is utilized.
2. Closed system of wastewater from plant	Utilization of wastewater from plant cause reduction of environmental impacts for surrounding environment3.
3. DBO project	This is one of DBO projects in Japan, which utilize the technology of fluidized bed combustion.

Toshima Incineration Plant / Researcher: JET

Name	Toshima Incineration Plant	Location	Toshima ward, Tokyo, Japan	
Impl. Body	Clean Authority of TOKYO	Footprint	1.2 ha	
Capacity	400 t/day (200t/day x2)	Heat Usage	Power: 7.8MW Heat	
Target Waste	Combustible waste	Waste Quality	9709 KJ/kg	

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original							
Actual				1999	1999		

Capex	-	Fund Source	MG Subcidy +LG
Opex	-	Fund Source	-
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited / Unsolicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash

Process Type	Fluidized bed combustion	EPC / Tech	IHI	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Scrubber + SCR + Bag Filter)	-	No bottom ash	Chemical treatment	

Toshima Incineration Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. An example of fluidized bed combustion	This is one of WtE facilities which utilized fluidized bed combustion technology in Japan, to minimize the area with consideration of surrounding environment.
2. Implementation of site tour	Site tours are periodically implemented to disseminate the WtE facility
3. harmonized design with surrounding environment	The WtE facility is located in the center of urban area. Therefore, the facility design was considered though harmonization with surrounding environment.
4. High stack	There is many high building around the WTE facility. Therefore, the stack is 210 m to consider the dispersion of exhaust gas emission ,which is highest stack in Japan.

Shibuya Incineration Plant / Researcher: JET

Name	Shibuya Incineration Plant	Location	Shibuya ward, Tokyo, Japan	
Impl. Body	Clean Authority of TOKYO	Footprint	0.9 ha	
Capacity	200 t/day	Heat Usage	Power 4.2MW	
Target Waste	Combustible waste	Waste Quality	9709 KJ/kg	

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	1998	2001	2001	-	-

Capex	13.8 B-JPY	Fund Source	NG Subsidy, LG
Opex	1.40 B-JPY/year (2018)	Fund Source	-
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited / Unsolicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash

Process Type	Fluidized bed combustion	EPC / Tech	Ebara	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Scrubber + SCR + Bag Filter)	Discharge to water course after treatment	No bottom ash-	Chemical treatment	

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Shibuya Incineration Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. WtE facility in center of Urban area with compact design	The WtE facility is constructed in the center of urban area in Metropolitan Tokyo.
2. An example of fluidized bed combustion	This is one of WtE facilities which utilized fluidized bed combustion technology in Japan, to minimize the area with consideration of surrounding environment.

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EJEC

Sakura Environmental Center / Researcher: JET

Name	Sakura Environmental center	Location	Saitama city
Impl. Body	Nippon steel	Footprint	2.6 ha
Capacity	380 t/day (190 x 2 line)	Heat Usage	Power 8.5 MW Heat
Target Waste	Combustible waste, residual, sewerage sludge	Waste Quality	9536 KJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	2010	2015	2015	-	-

Capex	Mil USD	Fund Source	-
Opex	Mil USD/year	Fund Source	-
Fin. Scheme	DBO	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
LG	LG	SPC	SPC	SPC	SPC

Process Type	Shaft type	EPC / Tech	Nippon steel	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
-	-	-	-	-

Sakura Environmental Center / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. DBO project	This is one of DBO projects in Japan, which utilize the technology of shaft type combustion technology
2. IEC through of environmental education center	In the WTE facility, there is environmental education center for disseminating 3R activities or selling used home equipment
3. Surplus thermal energy utilization facility	Hot water bath and hot water pool are prepared. In addition, Restaurant and community center are operated by utilizing thermal energy

Musashino Clean Center / Researcher: JET

Name	Musashino clean center	Location	Musashino city
Impl. Body	Musashino E- service	Footprint	1.7 ha
Capacity	120 t/day (60 t/day x 2)	Heat Usage	Power : 2.6MW Heat
Target Waste	Combustible waste, residue	Waste Quality	9717 kJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	2014	2017	2017	-	-

Capex	-	Fund Source	-
Opex	-	Fund Source	-
Fin. Scheme	DBO	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
LG	LG	SPC	SPC	LG	LG

Process Type	Stoker type	EPC / Tech	Ebara	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + NSCR + Bag Filter)	Utilization in facility and discharge to sewerage	Eco cement	Chemical treatment	

Musashino Clean Center / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. DBO project	This is one of DBO projects in Japan, which utilize the technology of stoker technology for combustion furnace
2. harmonized design with surrounding environment	The WtE facility is located in suburban area. The facility design was considered though harmonization with surrounding environment.
2. IEC through of environmental education center	In the WTE facility, there is environmental education center for disseminating 3R activities or selling used home equipment

Funabashi Hokubu Clean Plant / Researcher: JET

Name	Funabashi Hokubu Clean Plant	Location	Funabashi city, Japan
Impl. Body	Clean koubou (Ebara)	Footprint	4.8 ha
Capacity	381 t/day (127 t/day) x 3	Heat Usage	Power 8.8 MW Heat
Target Waste	Combustible waste, bulky waste, waste treatment residue, sewerage sludge	Waste Quality	6400 KJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	2017	2017	2032	
Actual	-	-	2013	2017	2017	2032	

Capex	21.4 B-JPY inc. 15 yr-O&M	Fund Source	LG + NG subsidy (?)
Opex	-	Fund Source	LG + Sales profit
Fin. Scheme	DBO	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
LG	LG	SPC	SPC	LG	LG

Process Type	Stoker	EPC / Tech	EBARA ENVIRONMENTAL PLANT CO.,LTD	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + SCR + Bag Filter)	Closed for wastewater from plant, discharge to water course for domestic wastewater	Chemical treatment	Chemical treatment	

EJEC

Funabashi Hokubu Clean Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Utilization of thermal energy for local community	WTE provides thermal energy for the recreation facility for community, including hot spa, hot water pool, sports facility.
2. Reduction of Environmental burden	The reduction of environmental burden like low CO and low NOx is implemented by constant high temperature combustion with low air ratio

Hatsukaichi energy clean center / Researcher: JET

Name	Hatsukaichi energy clean center	Location	Hatsukaichi city
Impl. Body	Hatsukaichi Environment Service	Footprint	1.7 ha
Capacity	150 t/d (75 t/d x 2)	Heat Usage	Power 3.14 MW Heat
Target Waste	Combustible waste, bulky waste, sewerage sludge	Waste Quality	- KJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	2019.3	2019.4	2039. 3	-
Actual	-	-	2016.7	2019.3	2019.4	-	-

Capex	19.58 B-JPY (20 years contract)	Fund Source	-
Opex		Fund Source	-
Fin. Scheme	DBO	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
LG	LG	SPC	SPC	LG	LG

Process Type	Fluidized bed combustion	EPC / Tech	KOBERCO	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + SCR + Bag Filter)	Closed system	No bottom ash	Cement solidification	

Hatsukaichi energy clean center / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. DBO project	This is one of DBO projects in Japan, which utilize the technology of stoker technology for combustion furnace
2. Boiler temperature and pressure are high	Due to the boiler temperature is 450 ℃ and its pressure 6.0 MPa, utilization of low temperature economizer and lower pressure of turbine exhausted gas, high efficient electric power generation system is utilized.

Kanazawa Incineration Plant / Researcher: JET

Name	Kanazawa Incineration plant	Location	Kanazawa ward
Impl. Body	Yokohama city	Footprint	7 ha
Capacity	1200 t/day(400t/day x 3)	Heat Usage	Power: 35MW Heat:
Target Waste	Combustible waste, bulky waste, waste treatment residue	Waste Quality	9825 kJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	1995	2001	2001	-	-

Capex	-	Fund Source	-
Opex	-	Fund Source	-
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
LG	LG	LG	LG	LG	LG

Process Type	Stoker type	EPC / Tech	JFE	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter Standard (Dry scrubber + SCR + Bag Filter)	Discharge to Sewage	Ash melting	Chemical treatment, cement solidification	

Kanazawa Incineration Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Implementation of site tour	Site tours are periodically implemented to disseminate the WtE facility
2. harmonized design with surrounding environment	The WtE facility is located in the center of urban area. Therefore, the facility design was considered though harmonization with surrounding environment.

Tsurumi Incineration Plant / Researcher: JET

Name	Tsurumi Incineration Plant	Location	Tsurumi ward
Impl. Body	Yokohama city	Footprint	6.1 ha
Capacity	1200 t/day (400 t/day x3)	Heat Usage	Power : 22MW
Target Waste	Combustible waste, bulky waste, waste treatment residue	Waste Quality	11646 KJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	-	1995	1995	-	-

Capex	-	Fund Source	-
Opex	-	Fund Source	-
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited / Unsolicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
LG	LG	LG	LG	LG	LG

Process Type	Stoker type	EPC / Tech	MHI	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
-	Discharge to Sewage or water course after treatment	No bottom ash	Chemical treatment, cement solidification	

Tsurumi Incineration Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Implementation of site tour	Site tours are periodically implemented to disseminate the WtE facility
2. harmonized design with surrounding environment	The WtE facility is located in the center of urban area. Therefore, the facility design was considered though harmonization with surrounding environment.

Tuas Incineration Plant for BAT/BEP / Researcher: JET

Name	Tuas Incineration Plant	Location	Tuas, Singapore
Impl. Body	National Environmental Agency (NEA)	Footprint	-
Capacity	1700 t/day	Heat Usage	30 MW for Power
Target Waste	Municipal solid waste	Waste Quality	-
Capex	-	Fund Source	-
Opex	-	Fund Source	-
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited
Process Type	Incineration (Stoker)	EPC / Tech	Mitsubishi heavy Industry

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	
Actual	-	-	-	-	-	-	

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
NEA	NEA	NEA	NEA	NEA	NEA

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
-	-	-	-	

Tuas Incineration Plant for BAT/BEP / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Prevention of air pollution	The flue gas from incineration is treated in the pollution treatment plant to remove pollutants such as HCl and dioxin and the clean gas exits through the 150m tall chimney
2. Recycle of ferrous metal	Ferrous metal is extracted from the incineration ash by electro-magnetic separators and sold as scrap to a local steel mill

NIPPON KOEI
EJEC

Tuas South WTE Plant for BAT/BEP / Researcher: JET

Name	Tuas South WTE Plant	Location	South Tuas in Singapore
Impl. Body	National Environmental Agency (NEA)	Footprint	10.5 ha
Capacity	3000 t/day	Heat Usage	36 MW for Power
Target Waste	Municipal solid waste	Waste Quality	KJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	
Actual	-	-	-	2000	2000	-	

Capex	708.76 million US$	Fund Source	National Environment Agency (NEA)
Opex	-	Fund Source	National Environment Agency (NEA)
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
NEA	NEA	NEA	NEA	NEA	NEA

Process Type	Incineration (Stoker)	EPC / Tech	Mitsubishi heavy Industry (Build)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Keep Standard(electrostatic precipitators, catalytic bag filter)	Closed loop system	Provincial SLF	Provincial SLF	-

Tuas South WTE Plant for BAT/BEP / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Rainwater storage for utilization	Rainwater is collected for utilization as a part of water source.
2. Satisfy the environmental regulation in Singapore	The environmental monitoring records satisfy the mission standard in Singapore, the record regarding particulate substance and sulfide and dioxin is far less than the standard value.
3. metal recovery	Scrap Metal is recovered by two magnetic separators to each incinerator unit

Senoko WTE Plant for BAT/BEP / Researcher: JET

Name	Senoko WTE Plant	Location	Senoko, Singapore
Impl. Body	Keppel Seghers	Footprint	7.5 ha
Capacity	2100 – 2310 t/day	Heat Usage	36 MW for Power
Target Waste	Municipal solid waste	Waste Quality	-

History / Capex

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	
Actual	-	-	-	1992	1993	-	

Opex	-	Fund Source	National Environment Agency (NEA)
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
NEA	NEA	NEA	NEA	NEA	NEA

Process Type	Incineration (Stoker)	EPC / Tech	Keppel Segher	(Demolish & Build)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
keep national standard (Flue gas reactor+activated carbon dosing + bag filter)	Closed loop system (No wastewater to be discharged)	Provincial SLF	Provincial SLF	Comply with local ordinances

Senoko WTE Plant for BAT/BEP / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Satisfy the environmental regulation in Singapore	The environmental monitoring records satisfy the mission standard in Singapore as well as international standard, the record regarding particulate substance and sulfide and dioxin is far less than the standard value.
2. Recycle of ferrous metal	Ferrous metal is extracted from the incineration ash by electro-magnetic separators and sold as scrap to a local steel mill

NIPPON KOEI
EJEC

Keppel Seghers Tuas WTE Plant / Researcher: JET

Name	Keppel Seghers Tuas WTE Plant	Location	Tuas in Singapore
Impl. Body	Keppel Seghers	Footprint	1.6 ha
Capacity	800 t/day	Heat Usage	22MW for Power
Target Waste	Municipal solid waste	Waste Quality	-

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	-	2006	2009	2034	-

Capex	-	Fund Source	T/F + Electric bill
Opex	- (TF 77 SGD)	Fund Source	T/F + Electric bill
Fin. Scheme	BOT	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
NEA	NEA	SPC(Keppel)	Keppel	NEA	NEA

Process Type	Incineration (Stoker)	EPC / Tech	Keppel Segher

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Keep Standard (Flue gas reactor + Activated carbon dosing + Bag Filter)	Closed Circulated Cooling Water	SLF	SLF	

Keppel Seghers Tuas WTE Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Compact design due to limited area	The WTE facility was developed with the compact design with the limitation of land availability. The total area is 1.6 ha for the WTE capacity of 800 ton/day.
2. Continuous service with PPP scheme without major incidents	Government buys services for incineration of waste with Take-or-Pay payment structure with guaranteed waste amount to make the project bankable. Keppel Seghers provides both equity and debt financing in the condition of service contract with NEA

Nong Khaem WTE Plant / Researcher: JET

Name	Nong Khaem WTE plant	Location	Nong Khaem, Thailand
Impl. Body	C&G Environmental Protection Holdings Limited (C&G)	Footprint	-
Capacity	500 t/day	Heat Usage	Power 9.8MW
Target Waste	Municipal solid waste	Waste Quality	-

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	2014	2014	2034	-
Actual	-	-	-	-	-	-	-

Capex	THB900 million	Fund Source	Bangkok Metropolitan Authority (BMA)
Opex	1000 Bahts/ton	Fund Source	Tipping fee from BMA + energy sale
Fin. Scheme	BOT	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
C&G	C&G	C&G	C&G	BMA	BMA

Process Type	Stoker type	EPC / Tech	New Sky /Hiz	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
-	-	-	-	-

Nong Khaem WTE Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. First WtE plant in Metropolitan Bangkok.	This is first WtE plant in Metropolitan Bangkok which operates until now. However, it is not sufficiently disseminated about operation and maintenance information such as environmental monitoring or receiving waste amount or characteristics, etc

Miaoli WtE plant / Researcher: JET

Name	Miaoli WtE plant	Location	Miaoli, Taiwan
Impl. Body	ECOVE Miaoli Energy Corporation	Footprint	3.9 ha
Capacity	500 t/day	Heat Usage	11. 8MW Power
Target Waste	MSW and Industrial Waste	Waste Quality	2300 kcal/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	-	2008	2008	2028	-

Capex	-	Fund Source	-
Opex	-	Fund Source	-
Fin. Scheme	BOT	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
LGU	LGU	ECOVE Miaoli Energy Corporation	ECOVE Miaoli Energy Corporation	-	-

Process Type	Stoker	EPC / Tech	CTCI

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
-	-	-	-	-

Miaoli WtE plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Successful BOT project of WTE in Taiwan	Miaoli WtE plant is successful BOT project in Taiwan. The energy generation rate increase like 476 kWh per ton of waste in 2008 versus 563 kWh in 2016. At the same time, WtE plan has reduced the amount of bottom ash and fly ash generated between 2008 and 2016 by 5.5% and 4%, respectively
2. Environmental education and community acceptance.	ECOVE has held many environmental educational workshops including solid waste management and the environment of surrounding wetland. This helps the local community better understand the importance of the environment and how to help protect it.
3. High operation rate	The boiler availability of the plant (95%) is higher than other facilities in Taiwan, and similar to the average of European countries

Can Tho SWT Plant / Researcher: JET

Name	Can Tho solid waste treatment plant	Location	Can Tho, Vietnam
Impl. Body	EB Environmental Energy (Can Tho) Limited	Footprint	5.3 ha
Capacity	400t/d	Heat Usage	Power 7.5MW
Target Waste	-	Waste Quality	6280 KJ/kg

History		Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
	Original	-	-	-	2017	2019	2019	2041	-
	Actual	-	-	-				-	-

Capex	48 M-US$	Fund Source	Asian development bank
Opex	around 15 US$ / ton	Fund Source	SPC (CEIL) Fund
Fin. Scheme	BOO	Dev. approach	Solicited

Coverage (SOW)	Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
	LG	LG	LG (DB)	LG	LG (Cement)	LG > Province

Process Type	Incineration (Stoker),	EPC / Tech	Chinese company

Pollution Control	Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
	Dry scrubber + SNCR+bag filter	No discharge of waste water by using on-site	Recycled as brick material or road construction-	Landfill after chelate and cement stabilization	

Can Tho SWT Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
First commercial operating facility of waste to energy in Vietnam	Before the commercial operation, the trial operation has been implemented and the result is that the Vietnamese operation standard has been kept during the operation but not for EU standard in all the day.

添付資料3

Laogang SWT Plant (Shanghai, China)

Name	Laogang solid waste treatment plant (phase I)	Location	Laogang, Shanghai, China
Impl. Body	Shanghai Laogang Solid Waste Utilization Co., Ltd.	Footprint	97 ha
Capacity	3000t/d (4 lines)	Heat Usage	Power 60MW
Target Waste	Combustible waste	Waste Quality	7100 KJ/kg

History

	Dev. Plan	Demolish	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Plan	-	-	-	-	-	-	-	-
Actual	-	-	-		2013	2014	-	-

Capex	300 M-US$	Fund Source	-
Opex	-	Fund Source	-
Fin. Scheme	BOT	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Incineration	Power sale	Bottom ash	Fly ash
LG	LG	LG (DB)	LG	-	-

Process Type	Incineration (Stoker)	EPC / Tech	HIz

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Keep standard (SNCR, Dry + Wet scrubber)	-	-	-	Comply with local ordinances

Laogang SWT Plant (Shanghai, China)

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
One of large scale WtE incineration facilities in China	This is one of largest incinerators operated in China currently, facilities has been operated.
Renewable energy	Wind power generation is also implemented in the area as well as this waste to energy plant which has high energy efficiency (15%) system.

Jabalpur WtE facility / Researcher: JET

Name	Jabalpur WtE facility	Location	Jabalpur city, India	
Impl. Body	Jabalpur MSW PVt., Ltd.	Footprint	4.4 ha	
Capacity	600 t/day (150,000 t/year?)	Heat Usage	11.5 MW Power	
Target Waste	Combustible waste	Waste Quality	900-1100 kcal/kg	

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	-	-	2016	-	-

Capex	INR 90 Million	Fund Source	-
Opex	10.3 Mil INR/month	Fund Source	-
Fin. Scheme	BOT	Dev. approach	-

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash

Process Type	BOT	EPC / Tech	Hiz	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
-	-	-	-	-

Jabalpur WtE facility / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. One of continuous operation of WtE plant in India	Incineration plant is under operation continuously. However, there is no information of difficulty of the operation or some solution process under the operatio
2. Real time data transfer to local governments or public	Data is automatically handled and is presented in live screen to pubic

Phuket WtE facility / Researcher: JET

Name	Phuket WtE facility	Location	Phuket
Impl. Body	Phuket municipality	Footprint	-
Capacity	500 t/day (250 t/day x 2)	Heat Usage	Power 2.5 MW Heat :
Target Waste	Municipal solid waste	Waste Quality	More than 1800 kcal/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original							
Actual					1999.5		

Capex	-	Fund Source	-
Opex	-	Fund Source	-
Fin. Scheme	Public Build (DB) and Own	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy sale	Bottom ash	Fly ash
LG	LG	LG	-	LG	LG

Process Type	Stoker type	EPC / Tech	MHI	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
-	-	-	-	-

Phuket WtE facility / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. One of most long operated incinerators in Thailand	Since June 1999, the first Waste to Energy Plant of the country has begun its municipal solid waste disposal service to 18 localities in Phuket Province. It provides the service for more than 20 years.
2. Trying to control the waste characterization	Heating value quality of waste can be improved by reducing organic proportion in the mixed waste and trying to separate the waste at source for efficient process

Afval Energie Bedrijf WtE facility / Researcher: JET

Name	Afval Energie Bedrijf Amsterdam (AEB)	Location	Australhavenweg, Amsterdam
Impl. Body	AEB owned by Local Government (19 municipality partners)	Footprint	-
Capacity	4400 t/day	Heat Usage	Electric power125MW Heat usage 250,000 GJ
Target Waste	Municipal Solid Waste, Commercial Waste, Sludge	Waste Quality	10,000 KJ/kg (ave. cal. value)

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	1998	2001	2004	2007	2008	2027	-

Capex	€370 million (2007 expansion)	Fund Source	Debt (Green finance € 80 million, EIB, € 170 million)
Opex	• Turnover > € 180 million • Profit > € 12 million • Gate fee ~ € 67/ton	Fund Source	Sales + Bank Loans + State Aid (from City of Amsterdam)
Fin. Scheme	DBO	Dev. approach	1993 (solicited), 2007 (unsolicited)

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
AEB + LG	AEB + LG	AEB	JV with Ene. Comp.	AEB	AEB

Process Type	Stoker	EPC / Tech	MNC, FLSmidth Airtech A/S, Siemens Fabricom GTI

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Emission level is < 20% allowed EU Directive, Stricter than Dutch Limits SNCR, ESP and Wet and dry scrubbers	No waste water	Reprocessed to be Sand-lime bricks, concrete	Treated to be used as Asphalt concrete	

Afval Energie Bedrijf WtE facility / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. High Capacity	The plant can process 4400 t/d, an average 1,400,000 tones of waste + 100,000 tones of sludge per year.
2. High Thermal Efficiency	The newest two lines of the Amsterdam moving grate combustion plant utilizes reheat Rankine steam cycle which produces electricity with a net efficiency of >30%. The annual availability is reported to be >90%.
3. Efficient Transport of Waste due to Plant Accessibility	Waste are shipped partly through barges and through railway. The presence of link roads and a railway makes the site easily accessible.

添付資料3

Klemetsrud Combined Heat and Power (CHP) plant / Researcher: JET

Name	Klemetsrud Combined Heat and Power (CHP) plant	Location	Oslo, Norway
Impl. Body	Fortum Oslo Varme	Footprint	
Capacity	1080 tpd, 400,000 tpa (Line 1: 10tph, Line 2: 10 tph, Line 3: 25 tph)	Heat Usage	Power: ~130MW Thermal Capacity: Line 1 = 27.8 MW Line 2 = 27.8 MW Line 3 = 66.7 MW
Target Waste	Municipal, Residual, Commercial, & Hospital Waste	Waste Quality	Line 1: 8.3 MJ/kg, Line 2: 8.3 MJ/kg, Line 3: 12 MJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	Line 3: 2008	Line 1&2: 1983	Line 1&2: 1986	1985 (line 1&2), 2011 (line 3)	-	-

Capex	€330M (Line 3)	Fund Source	-
Opex	-	Fund Source	-
Fin. Scheme	-	Dev. approach	-

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
Private	Private	Klemetsrud CHP	District Heating -Fortum Oslo Varme, Electricity – Kinect Energy Group	-	

Process Type	Incineration, Stroker Line 3: Reciprocating Grate	EPC / Tech	Furnace- Hitachi Zosen Inova (line 3), etc

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter than emission standard in Norway; Smoke from chimney is 99.78% pure water vapor	Treated then channeled into drainage system (Line 3)	Used for road maintenance and other construction needs[1]	Transported to Noah Langøya	

Klemetsrud Combined Heat and Power (CHP) plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
Sorting strategy	Source- sorting makes it easier for the plant to generate different kinds of energy outputs used for different purposes. All wastes are collected together, but with the use of the optical sorting technology, the waste is sorted accordingly with 98% precision. (green bags are sent to biogas facility, blue bags are sent to Germany for material recovery)
Energy produced in the facility is well utilized in the community	Electricity- supplied to Oslo schools Heating- distributed in Oslo’s district heating network Biogas from food waste- fuel for Oslo buses and waste mgmt vehicles Biofertilizer- used in agricultural industry
Pioneering CCS	A Carbon Capture and Storage (CCS) initiative is currently underway to achieve “carbon negativity”

Issy-les-Moulineaux WtE plant / Researcher: JET

Name	Issy-les-Moulineaux WtE plant (Isseane)	Location	Issy-LesMoulineaux, Paris, France
Impl. Body	SYCTOM (Public Authority), Operator: TSI (Private)	Footprint	3.8 ha
Capacity	460,000 t/y- 510,000 t/y 1,680t/d (2 x 35t/h x 24h/d)	Heat Usage	Power: 52 MW Dist. Heat: 150 t/h
Target Waste	Residual Waste	Waste Quality (LHV)	8.0-11.7 MJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	1998	2000	2001	2007	2007	-	-

Capex	600 Mil EUR ex. VAT for Isséane, including 50 million EUR for the site alone	Fund Source	Public Authorities
Opex	-	Fund Source	-
Fin. Scheme	Design-Bid-Build	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
SYCTOM	SYCTOM	TSI	Sold to: Electricité de France (Electricity), Compagnie Parisienne de Chauffage Urbain (Heat)	TSI	TSI

Process Type	Water-cooled grate	EPC / Tech	AE&E Von Roll Inova (Equipment), Hitachi Zosen Inova AG (combustion part, boiler, flue gas treatment) Architect: AIA Associés, Dubosc et Landowski.

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter than EU & local standards, (ESP and SCR-DeNOX)	discharged to Sewer	Recycled as Aggregate	Treated then disposed to landfill	

Issy-les-Moulineaux WtE plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Compact design due to limited area and local government requirements	This plant is widely known for its innovative design, as it has been built partially underground and the chimney has been designed in such a way that no large stack is visible. Equipment are operated underground, with design limited the height of the buildings to + 21 m. With its structural design, plant produces neither noise nor odor emissions.

添付資料3

ASM Brescia ‘Termoutilizzatore’ / Researcher: JET

Name	ASM Brescia ‘Termoutilizzatore’	Location	Brescia, Italy
Impl. Body	A2A S.p.A (Public Enterprise)	Footprint	16 ha (2.3ha for WTE)
Capacity	2400t/d (730000 - 800000t/y)	Heat Usage	Thermal Capacity : 100 MW (Biomass)
Target Waste	MSW, Industrial Waste, Biomass & Dried Sludge	Waste Quality	6300 - 13800 kJ/kg (LHV)

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-		-
Actual	-	-	-	-	1998(MSW), 2005 (Biomass)		-

Capex	350M EUR (=£320M)	Fund Source	CIP6 (Subsidy from National Gov. for RE)
Opex	7,179 M-EUR/yr	Fund Source	CIP6 (Subsidy from National Gov. for RE)
Fin. Scheme	DBO	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
A2A	A2A	A2A	A2A	A2A	A2A

Process Type	Moving reverse thrust grate	EPC / Tech	Ansaldo, Martin, and ABB, (Equipment)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Autorizzazione Integrata Ambientale (A.I.A.) Standards	Closed System	Used in const. material, Used in landfilling applications	Deep Mine Disposal (APC Residues)	

ASM Brescia ‘Termoutilizzatore’ / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. High Thermal Efficiency	The link-up with the existing Lamarmora plant makes it possible to operate the district heating section “in series” with the heat exchangers of the existing turbo-generators. This optimizes the global efficiency of the entire plant. The plant has >27% electrical net efficiency.
2. Data Transparency	To ensure transparency for information on the operations of the plant, the City Council of Brescia established a "Waste Incinerator Observatory", for monitoring and communicating its activities.

Zabalgarbi, Bizkaia WtE Plant / Researcher: JET

Name	Zabalgarbi, Bizkaia WtE Plant		Location		Bilbao, Province of Bizkaia, Spain		
Impl. Body	Zabalgarbi S.A. (Private 65%, Public 35%)		Footprint		2.7 ha (plant only)		
Capacity	220,000 - 250,000 t/y (720 t/d x 1 line) (30 t/h x 1 line)		Heat Usage		Power 99.5 MWe (Net 95MWe) Elec. Efficiency: 42%		
Target Waste	Municipal Solid Waste		Waste Quality		LHV: 8.000 kJ/Kg		

History		Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
	Original	-	-	-	-	-	-	-
	Actual	1996	-	1999	2004	2005	2030	-

Capex	154M-EUR	Fund Source	Initial finance + Loan from EU
Opex	-	Fund Source	-
Fin. Scheme	-	Dev. approach	-

Coverage (SOW)	Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
	LG contract private	LG contract private	Zabalgarbi	Zabalgarbi	Zabalgarbi Use for const.	Zabalgarbi Process+Disposal

Process Type	Moving Grate (Martin)	EPC / Tech	Constructions Industrielles de la Méditerranée (CNIM)

Pollution Control	Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
	Applied EU Directive (EU2000/76) Wet scrubber + others	No data	Recycled for Construction Industry	Treated then put to authorized storage	

Zabalgarbi, Bizkaia WtE Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. High Energy Efficiency	This facility is an example of a modern plant utilizing the exhaust heat from an adjacent gas turbine power plant to perform reheating of the steam produced by the heat recovery boiler and operate with a thermal efficiency >40%.

Wien-Spittelau WtE facility / Researcher: JET

Name	Wien-Spittelau	Location	Spittelau, Vienna, Austria
Impl. Body	Fernwärme Wien GmbH	Footprint	-
Capacity	250, 000 t/y (360 t/d x 2 lines= 720 t/d)	Heat Usage	Electric power : 6 MW, Thermal Capacity: 60 MW
Target Waste	Municipal Waste (domestic waste and industrial wastes similar to household waste)	Waste Quality	9,500 kJ/kg (average heating value) [Waste Thermal Value: 8,200 – 9,600 kJ/kg]

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-		-	-
Actual	2009	-	2012	2014	2015	-	-

Capex	€144 million	Fund Source	'Green Bond' from European Investment Bank (EIB): €70 million, etc
Opex	-	Fund Source	-
Fin. Scheme	PPP (BOT or BOO)	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
LG	LG	Fernwärme Wien GmbH	Fernwärme Wien GmbH	Fernwärme Wien GmbH	Fernwärme Wien GmbH

Process Type	Reverse-acting grate	EPC / Tech	Data for 2015 Plant: Furnace: MH Power Systems Europe Service GmbH

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
The emission limit values in accordance with EU Directive ESP+wet scrubber +SCR	Treated then passed into the receiving water course (Danube Canal)	Used as slag concrete or in landfill engineering (perimeter wall formation)	Deposited in a decommissioned salt mine	

Wien-Spittelau WtE facility / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Public acceptance via innovative architectural treatments	This plant is the first facility that used architectural treatment to gain public acceptance. The age of the plant would exclude it from inclusion based on performance. However, public perception and acceptance of WtE plants is very important.

Amager Bakke WtE Plant / Researcher: JET

Name	Amager Bakke	Location	Copenhill, Copenhegan, Denmark
Impl. Body	Amager Ressourcecenter (ARC)	Footprint	4.1 ha
Capacity	35 t/h x 2 lines = 70 t/h 1680 t/d 400,000 – 560,000 t/a	Heat Usage	Steam Output: 141.1 t/h Electrical Efficiency Rate: 28%
Target Waste	Residual Waste	Waste Quality	11,500 KJ/kg LHV range: 8-15 MJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	2009	-	-	-	2017	2037	-

Capex	~$525M-$670M	Fund Source	Financed by city's municipal council (loan)
Opex	$30/ton waste	Fund Source	Municipal Tax
Fin. Scheme	Design-Build-Operate or Public Own & Operate	Dev. approach	Solicited (WTE) *Ski Area @ rooftop was only proposed by BIG

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
LG	LG	ARC	ARC	ARC	ARC

Process Type	Grate Fired	EPC / Tech	• Ramboll (Engineer), Babcock & Wilcox (furnace/boiler) • Bjarke Ingels Group (BIG) (roof and architecture) • SIemes Danmar A/S (turbine/generator and CMS/electrical system) • LAB, France (flue gas treatment)

Pollution Control

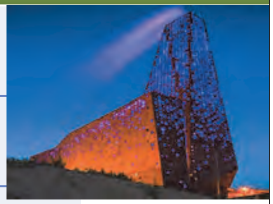
Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter (less 50%) than Euro Zone Baseline, Electrostatic precipitator + Front-end scr Wet flue gas cleaning	-	Used as road material after treatment	Used as substitute for lime to neutralize residual products from other industries	

Amager Bakke WtE Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
Architecture (Utilized as a Mixed-Used Building)	A WTE facility, which is visually attractive, that also provides a space for community recreation and interactions, with a ski slope that runs all the way down from the top of the building and a rock wall that can be climbed all the way up the face of the building.
Public Acceptance	Allows the community surrounding the facility to gain more appreciation for the purpose it serves by also offering a venue for recreational activities. This facility had also gained public interest as a tourist spot.
Energy Efficiency	It utilizes more than 100% (actual – 107%) of the fuel's energy content, with a 28% electrical efficiency rate.
Environmental Pollution	Designed to emit less than 50% of the Euro Zone Baseline Actual air emissions generally below 10% of limit values

Incineration Line 6 of The Energy Tower / Researcher: JET



Name	Incineration Line 6 of The Energy Tower	Location	Roskilde, Denmark
Impl. Body	Argo (Formerly Kara/Noveren)	Footprint	0.74 ha floor area 1.6 ha site area
Capacity	30 t/h (1 line) 200,000 t/a to 350,000 t/a	Heat Usage	Thermal Capacity/line: 81.3 MW, Electricity: 19 MW, Heat: 52 MW
Target Waste	CO_2-neutral organic waste & non-recyclable plastics (incinerable waste + resot-treated wood)	Waste Quality	-

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	2008	2011	2014 (Argo took over)	2013 (test operation)	-	-

Capex	€175 Million (DKK 1.293 Billion)	Fund Source	Argo (KARA/Noveren)
Opex		Fund Source	Revenue (sale of heat & electricity, use of bottom ash, gate fee)
Fin. Scheme	Public Own Operation	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
LG(contract w/ private)	LG (contract w/ private?)	Argo	Sold to electric company	Argo	Argo

Process Type	Martin Reverse-Acting Grate	EPC / Tech	Architect: Erick van Egeraart, Martin – Boiler, Grate, etc

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
<u>Stricter than Euro WID Directive & controls imposed by Danish Govt</u>	-	Reused as Road Construction Material	-	

EJEC

Incineration Line 6 of The Energy Tower / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
Public Acceptance	The plant's architecture had been designed specifically to add value to an otherwise purely industrial complex and to provide historic comment as a modern counterpart of the city's prime historical monument, the Roskilde Cathedral. Since then, the plant has been the symbol of the community's commitment to a clean energy environment, through imaginative architectural success. It is also valued by the community for its heat and power through low emission combustion and low gate costs.

Lahti Gasification Facility (Kymijärvi II) / Researcher: JET

Name	Lahti Gasification Facility (Kymijärvi II)	Location	Lahti, Finland
Impl. Body	Lahti Energia (owned by City of Lahti)	Footprint	25 m^2 per 1,000 tpa of waste processed
Capacity	250,000 t/a of SRF	Heat Usage	Electricity: 50MW District heat: 90 MW
Target Waste	Household waste (origin sorted), Industrial waste, demolition wood, waste wood from industry	Waste Quality	Predicted Design LHV: 16,100 KJ/kg Actual Average LHV: 14,200 KJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	2005	2008	2009	2012	2012	-	-

Capex	€160 Million	Fund Source	Subsidy Grant + Loan
Opex	--	Fund Source	Sale Revenue
Fin. Scheme	DBO	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
Päijät-Häme Waste Management Ltd (PHJ)	Päijät-Häme Waste Management Ltd (PHJ)	Kymijärvi II Fuel preparation by other company (PHJ)	Kymijärvi II	Kymijärvi II	Sent for post-processing to an external contractor

Process Type	Circulating fluidized bed	EPC / Tech	Lahti Energia, >Valmet (formerly, Metso Power) - technology provider (Makron, Solmex - installation)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Stricter than EU WID Standard a dry APC system and NOx control using SCR	Minimal Liquid Effluent	Reused as road construction material	Treated as hazardous waste	

Lahti Gasification Facility (Kymijärvi II) / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
Technology • Corrosion Control • Power Generation Efficiency	Kymijärvi II is the world's first gasification plant, and one of the largest, that uses only recycled household and industrial waste as fuel. The gasifier produces biogas with close to zero impurities as a result of the process of cooling and cleaning, thus no impurities causing corrosion end up in the boiler. Consequently, this allows the steam pressure and temperature to be kept high, allowing more efficient electricity generation rate. Electric efficiency is over 30% and total CHP efficiency of 87.5%.

Allington Energy from Waste Incinerator/ Researcher: JET

Name	Allington Energy from Waste (EfW) Incinerator	Location	Maidstone, Kent, London, UK[1,2,3]
Impl. Body	Kent Enviropower Ltd[1]	Footprint	34 ha, 27 ha is to be used as parkland[4]
Capacity	1500 t/d (ISWA excel sheet) 500,000 t/a[1] 34.5 MW[2] (+ 35 MW) 3 lines[2]	Heat Usage	Power capacity:43MW Grid Supply:34MW Thermal capacity: 53.8MW Electric efficiency: 27%
Target Waste	Non-hazardous MSW, Commercial and Industrial	Waste Quality	6.5 – 12.5 MJ/kg

History		Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
	Original							
	Actual	1999	2000	Apr 2004		2008		

Capex	> £ 150 M	Fund Source	20% KEL, 80% loans
Opex		Fund Source	
Fin. Scheme		Dev. approach	

Coverage (SOW)	Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
	Kent County	Kent City Council	KEL	KEL	Specialist Contractor	Specialist Contractor

Process Type	Rotating fluidized bed	EPC / Tech	Boiler/ incinerator system: Lurgi, Turbine/ Generator Systems: Siemens, EPC: Lurgi, Hochtief

Pollution Control (technology used to minimize pollution)	Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
	Emissions meet (some better) than EU standards Lowest in 5 of the 9 emission limits among other UK plants[7]	(annual report 2018)	Low amt ; only 10% of MSW input Construction Industry[1] Used as road aggregates[2]	APC residues- landfill after treatment[1]	

Allington Energy from Waste Incinerator/ Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
One of the largest fluidized bed MSW incineration plants in the world[1]	The plant was supplied by Lurgi Lentjes with technology licensed from the Ebara Corporation of Japan.
Close communication with local residents	The proponents of the project and the proposed extension involves consultations that they encourage through online submission of questionnaires and attendance to public dialogues Following the controversy of the contentions regarding the fluidized bed technology, a community liaison committee was formed to strengthen the ties of the project with the community
High throughput compared to other plants using fluidized bed technology	Another plant in Baldovie, Dundee, UK, uses the same technology but yields a lower throughput compared to the Allington plant
High electrical efficiency	Allington's electrical efficiency is at 27%, but the net efficiency is reduced to 21%

Brussels WtE plant / Researcher: JET

Name	Brussels Waste-to-Energy plant	Location	Brussels / Bruxelles, Belgium
Impl. Body	Bruxelles-Energie	Footprint	-
Capacity	~1300 - 1440 t/day (3 lines of 19t/h each)	Heat Usage	Capacity: 20 MW
Target Waste	Non-Recyclable Household Waste	Waste Quality	calorific power inferior to 9.000 KJ/kg Heat Output: 2000 kWhhth/1 ton of waste Electricity Output: 500 kWhe/1 ton of waste

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original			1984				
Actual							

Capex		Fund Source	
Opex		Fund Source	
Fin. Scheme		Dev. approach	

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
-	-	-	-	-	-

Process Type	Stoker	EPC / Tech	Martin

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Electric precipitator Scrubber + ammonia injection,	Closed system	-	-	

Brussels WtE plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Compliance	Bruxelles - Energie meets environmental norms imposed by European Union and Brussels Region.
2. Energy recovery	Energy recovery is implemented through the conversion from non recyclable household waste to electric power generation and heating network in community for 6500 households in Brussels.
3. Reuse of wastewater	The water used in the flue gas wash is treated in the water treatment plant and in an evapo-crystallization plant. The water is then reused.

添付資料3

SYSAV WtE Plant / Researcher: JET

Name	SYSAV (Sysav South Scania Waste) WtE Plant	Location	Malmö (City), Sweden
Impl. Body	Sysav	Footprint	
Capacity	(25 t/h x 1 line) + (29 t/h x 1 line) + (12 t/h x 2) 8200 h/y operations 630000 t/y	Heat Usage	Electricity : 250000MWh /year Thermal : 1400000 MWh /year
Target Waste	MSW, Industrial Waste	Waste Quality	

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	-	-	1973 (1st and 2nd), 2003 (3rd), 2008 (4th)	-	-

Capex	-	Fund Source	-
Opex	Annual Report 2009 Turnover: 750 Millions SEK	Fund Source	-
Fin. Scheme	-	Dev. approach	-

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
LG & Sysav?	-	Sysav	-	Sysav	Sysav

Process Type	CHP Incineration	EPC / Tech	Ramboll ++
			(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
-	Processed by Sysav	Neutralisation @ Norway	Neutralisation @ Norway	-

SYSAV WtE Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
Metal recycle	The slag generated in the process of combustion is comprised of stone, scrap metal, glass and other stable materials. It drops down into a water-filled trough for cooling. The slag is collected in a bunker for subsequent sorting and recycling
Optimum combustion process	For the combustion to be efficient and complete, combustion air comprising primary air and secondary air is blown into the furnace. This helps mix the flue gases properly to achieve optimal combustion

添付資料3

Lejonpannan (CHP Plant) / Researcher: JET

Name	Lejonpannan (CHP Plant)	Location	Linköping, Sweden
Impl. Body	Tekniska verken i Linköping AB (TVL)	Footprint	1.693 ha
Capacity	1x30.22 t/h 230,000 t/y	Heat Usage	Steam Mass Flow: 107.8 Mg/h Capacity: 84MW
Target Waste	MSW & Biomass	Waste Quality	10,500 KJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original			2013	2015	2016		
Actual				2015	2015		

Capex	$120 Million	Fund Source	TVL, Nordic Investment Bank (NIB)
Opex	-	Fund Source	-
Fin. Scheme	-	Dev. approach	-

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
TVL		TVL			

Process Type	Forward moving grate	EPC / Tech	Technical Works	(Remarks if any)

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
-	-	Slag used for landfills & roads	-	

Lejonpannan (CHP Plant) / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
1. Environmental Impact	The plant features how its operations contribute to the environmental health with suitable pollution abatement system.
2. Architecture	Tekniska verken's CHP plant Lejonpannan has been nominated in the Construction of the Year 2017. The plant is designed with special feature like façade consists largely of glass.
3. Utilization of surplus energy for community heating.	The trash-powered plant generates electricity and heats water for home and commercial use, harnesses 90 percent of total energy. This supplies hot water for bathrooms, kitchens and central radiator heating. This centralized system of "district heating" warms many buildings in Sweden.

Dåva kraftvärmeverk (Deaf 1) / Researcher: JET

Name	Dåva Kraftvärmeverk	Location	Umeå, Sweden
Impl. Body	Umeå Energi AB (municipality-owned)	Footprint	ha
Capacity	200000 t/y (20 t/h)	Heat Usage	Power: 65 MW (district heating 55 MW + electricity 10 MW)
Target Waste	Household and industrial/business waste, forest debris	Waste Quality	-

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	-	-	2000,2010	-	-

Capex	-	Fund Source	-
Opex	-	Fund Source	-
Fin. Scheme	-	Dev. approach	-

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
-	-	-	Umeå Energi AB	-	-

Process Type	-	EPC / Tech	-

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
-	-	-	-	-

Dåva kraftvärmeverk (Deaf 1) / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
Energy efficiency	It is one of the world's most energy-efficient and environmentally-adapted waste facilities as the main fuel and owned by Umeå Energi. It has an effect of 65 MW, of which 85% will be district heating and 15% electricity. In the plant, both heat and electricity are extracted and in addition, heat is recovered from the flue gases.
Heat and electricity utilization for community	The heat produced can heat about 18000 houses for a whole year. Gross electricity generation is sufficient to supply about 6,500 household

MHKW Mainz WtE Plant / Researcher JET

Name	MHKW Mainz Waste-to-Energy Plant	Location	Rhineland-Pfalz, Germany[1]
Impl. Body	Entsorgungsgesellschaft Mainz mbH (EGM)	Footprint	The facility is part of Energie Park Mainz
Capacity	340,000 tons per year Line 1: 16.2 t/h Line 2: 16.2 t/h Line 3: 17.8 t/h	Heat Usage	Gross heat load (136MW) Superheated steam pressure: 43.3bar
Target Waste	MSW (Domestic, Bulk, Commercial) from the City of Mainz, approx. 500,000 residents	Waste Quality	Calorific value: 9815 kJ/kg

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	-	-	2008	-	-

Capex	-	Fund Source	
Opex	-	Fund Source	
Fin. Scheme	-	Dev. approach	

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
-	-	-	-	-	-

Process Type	-	EPC / Tech	Martin GmbH supplier consortium

Pollution Control (technology used to minimize pollution)

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
SNCR, Spray absorber with admixing of milk of lime, activated coke, fabric filter		Metal is recycled, construction material for wet ash extractor	Utilize for construction	

MHKW Mainz WtE Plant / Researcher JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
Well-planned collection system	Household collection is regular and well routed, ensuring timely and sufficient feed to the waste to energy facility.
Recognized as a highly efficient wte plant	A European Framework Directive on Waste was adopted into German law stipulating that WTE plants with high degree of energy efficiency must receive recycler status, and Mainz was given one.
Well-used residual waste	- Rainwater is collected, along with operational cleaning water, to be used as process water for exhaust purification process - Steam produced in the facility is supplied to a nearby power plant - Heated water is distributed to the city
Waste characterization upon receipt of waste directs the MARTIN system to alter reciprocating grates	Upon receipt of waste, the plant checks the contents to see if the waste corresponds to the declaration and is approved for incineration in the Mainz WTE.

添付資料3

Pfaffenau WI Plant / Researcher: JET

Name	Pfaffenau Waste Incineration Plant	Location	Vienna, Austria
Impl. Body	MVA Pfaffenau (Municipal department 48 of Vienna)	Footprint	
Capacity	~770 tons/day 250,000 tons per year 2 incineration lines	Heat Usage	Power capacity 14MWRated Thermal capacity 2x40MW
Target Waste	Residual waste and bulky waste	Waste Quality	

History

	Plan		Bid	Const. St/Fin		Operation St/Fin	
Original	-	-	-	-	-	-	-
Actual	-	-	2006	2008	Sep 2008	-	-

Capex	-	Fund Source	-
Opex	-	Fund Source	-
Fin. Scheme	-	Dev. approach	-

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
MVA Pfaffenau	MVA Pfaffenau	MVA Pfaffenau		MVA Pfaffenau	MVA Pfaffenau

Process Type	-	EPC / Tech	

Pollution Control (technology used to minimize pollution)

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Electrostatic precipitator, wet scrubbers, active coat filter for the separation of organic toxics, catalyzer where nitrogen oxide is filtered	Treated in in-house treatment facility and then sent to main Vienna waterways	After separation of metals, ash is solidified, and ash slag is used as cement material	Collected in funnels and dumped in ash silo, then deposited together with the bottom ash	

Pfaffenau WI Plant / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
Significantly low emission values	The plant performs way better than the already stringent emission standards of EU- the emission of dust is 90 percent below the permitted limit. The value for sulfur dioxide is 95 percent below. Thanks to combined heat and power, the efficiency of the system is a high 76 percent.
Generated electricity powers households and the plant itself[2]	The plant practically closes the loop; where the generated power from the waste processed is also being utilized not only for distribution to households in Vienna, but also to power the plant itself.
Construction only took 2.5 years[3]	The facility was equipped with advance technologies and equipment that make it possible for them to reach such low levels of toxic emissions, but it only took 2.5 years for this to happen. A design competition was even held to ensure that the facility will have aesthetically pleasing design.
Large focus on waste reduction and segregation[3]	Instead of focusing solely on the incineration process, the plant follows Viennese principles of waste reduction and segregation, weeding out all recyclables in the collected wastes, and processing only purely residual wastes.
Close cooperation with local municipality	The plant's closest client is the 48th municipal department of Vienna (MD 48), one of the largest among Vienna's municipal departments, and they have been in close ties since the inception of the facility.

Riikinvoima Ekovoimalaitos / Researcher: JET

Name	Riikinvoima Ekovoimalaitos	Location	Riikinvoima Oy Riikinnevantie 153d 78210 Varkaus
Impl. Body	Owned by 8 municipal waste management companies and Varkauden Aluelämpö Oy:	Footprint	-
Capacity	145,000 tons annually	Heat Usage	District heating / year 180 GWh Electricity generation / year 90 GWh
Target Waste	Sorted mixed waste	Waste Quality	-

History

	Plan	Bid	Cons. St/Fin		Op. St/Fin		Demolish
Original							
Actual			Oct 2014	July 2016	Feb 2017		

Capex	-	Fund Source	-
Opex	-	Fund Source	-
Fin. Scheme	EPC model	Dev. approach	

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
Concerned Municipality	Concerned Municipality	Riikinvoima Ekovoimalaitos	-	-	-

Process Type	CFB	EPC / Tech	Andritz

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Cleaning system consists of ANDRITZ TurboSorp (ESP)- a semi dry flue gas cleaning system and bagfilter	-	-	-	Metals gathered in pretreatment facility are sent to industry for reusing

Riikinvoima Ekovoimalaitos / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
Speedy establishment of facility	The establishment of this WtE facility was mostly pushed by a new regulation imposed in EU where landfilling of organic waste is banned. A speedy construction process was key to making sure that compliance to this new regulation is observed right away.
Close partnership with local municipalities	The facility is co-owned by 8 municipal waste management centers and this was key to the fast establishment of the facility.
Rigorous sorting process and pre-treatment stations	Finland emphasizes the importance of waste segregation and sorting to make sure that they are getting the most out of their wastes- recyclables are recovered, metals are separated for reusing (through magnets, vortex current separator, and sieving), leaving only non-recyclables for incineration.

添付資料3

Palm Beach Renewable Energy Facility 2 / Researcher: JET

Name	Palm Beach Renewable Energy Facility 2 (PBREF #2)	Location	Florida, West Palm Beach, USA
Impl. Body	Owner: Solid Waste Authority (SWA) of Palm Beach County (Province), Operator: (CPBRR)	Footprint	9.71 ha
Capacity	3000 t/d (3 lines x 1000 t/d)	Heat Usage	Electric Power Capacity: 95MW
Target Waste	Residential and Commercial Municipal Solid Waste including organic/vegetative waste (PBREF2 is a mass burn facility)	Waste Quality	Waste Average HHV 4,600 Btu per pound. Operator guarantees

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	2006-2008	2008-2011	2012	2015	2015	2035	-
Actual	2006-2008	2008-2011	2012	2015	2015	2035	-

Capex	~$672,000,000	Fund Source	Bond 90% and 10% Investment from others
Opex	$2 5,322,389 (2017 actual cost for Operating Contract Expense)	Fund Source	Opex is funded from operating revenues including; Assessments, Tipping Fees, Electricity Sales,, Recycling and Other
Fin. Scheme	Design-Build-Operate (20-year O&M)	Dev. approach	Solicited

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
Private company under SWA	SWA	PBRRC	Sold to: Florida Power & Light	SWA	SWA

Process Type	Direct mass burning (B&W Volund DynaGrate traveling grates)	EPC / Tech	SWA / Arcadis B&W / KBR / CDM Smith

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
<u>**Stricter** than USEPA Standards</u> SCR, CEMS, and combustion control	treated and disposed of on site by deep well injection	Removal of ferrous metals through an ash management building to be recovered for resale on the scrap metal market		

Palm Beach Renewable Energy Facility 2 / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
High Capacity	Initially the authority built and operated the 2000 ton per day PBREF-1 waste to energy plant in 1989, but in late 2015 it opened the first new waste to energy facility in the in the US for 20 years with the PBREF-2, bringing total capacity to 5000 tons per day.
Waster Conservation	REF 2 features a unique rooftop rainwater collection system that includes a 2 million gallon cistern. This system provides a portion of the water necessary to operate the facility, reducing REF 2's use of treated water.
Wider waste management system	PBREF#2 is located on a 1,320-acre campus which has two WTE facilities, two landfills, a biosolids drying facility powered by landfill gas, and a Recovered Material Processing Facility for processing dual stream recyclables. PBREF#2 is a mass burn facility. Post-recycled municipal solid waste is unloaded directly into "the Pit," which is designed to handle approximately 26,000tons/23,600,000 kg (assuming 500 #/CY density) of waste or 5,200 curbside trucks of garbage.

SEMASS / Researcher: JET

Name	Southeastern Massachusetts Resource Recovery Facility (SEMASS)	Location	Massachusetts, West Wareham, USA	
Impl. Body	Covanta SEMASS, L.P (current, as of 2017)	Footprint	35 ha	
Capacity	1000 t/d x 3 lines = 3000 t/d	Heat Usage	Gross Elec. Capacity: 78 MW	
Target Waste	MSW (before PRF process)	Waste Quality	11,630 KJ/kg	

History		Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
	Original							
	Actual					1989		

Capex	-	Fund Source	-
Opex	-	Fund Source	-
Fin. Scheme	-	Dev. approach	-

Coverage (SOW)	Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash

Process Type	Refuse Derived Fuel	EPC / Tech	Energy Answers Corporation (EAC, Albany, NY)

Pollution Control	Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
	Dry scrubbers, carbon injection, electrostatic precipitators, bag filter		Treated and recovered as used as raw materials	Landfilled after treatment	

SEMASS / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
Processing of municipal solid waste to Process Refuse Fuel (RPF)	the Facility converts Municipal Solid Waste (MSW) into process refuse fuel (PRF). The received MSW is shredded by rotary hammer-mill shredders. The PRF is then conveyed, first under a magnet to remove ferrous metal, then on to the boiler where it is combusted.
Large capacity of plant	The plant is the largest Energy form Waste facility in the Commonweath of Massachusetts The facility won the ASME Large CombusϴonFacility Award in 2007. It processes more than one million tons of trash per year
Pollution Control	Complies with Federal Maximum Achievable，Control Technology (MACT) Standards of USEPA and continuous monitoring to satisfy the standards

MCRR Facility / Researcher: JET

Name	Montgomery County Resource Recovery (MCRR) Facility	Location	Maryland, Dickerson, USA
Impl. Body	Owner: Northeast Maryland Waste Disposal Authority (public) Operator: Covanta Montgomery, Inc. (private)	Footprint	14 ha
Capacity	610 t/d x 3 lines = 1830 t/d	Heat Usage	Rated Capacity (Turbine): 63MW Net Production: <55MW
Target Waste	Municipal Solid Waste	Waste Quality	-

History

	Plan	Bid	Const. St/Fin		Op. Start/Fin		Demolish
Original	-	-	-	-	-	-	-
Actual	-	-	-	-	1995	-	-

Capex	-	Fund Source	-
Opex	$30.8 million	Fund Source	-
Fin. Scheme		Dev. approach	-

Coverage (SOW)

Collection	Transp.	Processing	Energy Sale	Bottom ash	Fly ash
-					

Process Type	Reverse reciprocating stoker	EPC / Tech	

Pollution Control

Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other
Hydrated lime injection, carbon injection, bag filter	-	Used for road bed material after treatment-	After mixing lime, disposed to prevent the leaching heavy metal-	-

MCRR Facility / Researcher: JET

Description of salient features as the case study of BAT/BEP

Salient Features	Explanation
Reduction of thermal NOx as well as the reduction of particulate by bag filter in Air pollution control system	A thermal DeNOx system uses aqueous ammonia to remove nitrous oxides. At the end of the air pollution controls are a series of baghouse cells which remove 99.9% of particulates matter entrained in the flue gas.
Waste transportation by railway	The waste processed at the facility is initially transported to the Shady Grove transfer station in Derwood where it is compacted into intermodal steel waste containers and then loaded into railcars for delivery to the facility. this railway transportation system allows the county to eliminate traffic on the road near the facility

February 19, 2021

MR. CATO KJOLSTAD
Head, Public Affairs
Fortum Oslo Varme
Oslo, Norway

Dear **Mr. Cato Kjølstad**:

Greetings!

The Environmental Management Bureau (EMB) of the Department of Environment and Natural Resources (DENR) is currently implementing the Technical Cooperation Project (TCP) on the **Capacity Development on Improving Solid Waste Management through Advanced/Innovative Technologies** in collaboration with the Japan International Cooperation Agency (JICA). This project is aimed at improving the Solid Waste Management (SWM) System in the Philippines through the adoption of Waste-to-Energy (WTE) and other SWM technologies.

Part of the legal mandate of the DENR-EMB is to oversee the proper solid waste management in the Philippines in compliance to the Republic Act 9003 otherwise known as the ***Ecological Solid Waste Management Act***. Under this TCP, we are exploring the viability of WTE Techniques on Appropriately Controlled Combustion with Power Generation to help in managing the waste generated in the country while addressing the need for a more sustainable means of providing energy.

One of the major outputs required under this project is a thorough analysis of Best Available Technologies (BAT) and Best Environmental Practices (BEP) being utilized by the existing WTE facilities in other countries. These sets of information will be used as basis and references for the development of technical standards for WTE facilities in the Philippines.

The JICA Experts Team (JET) has done preliminary research on the BAT/BEP implemented in your facility, and we would like to ask for validation and confirmation of the information we have already gathered, and hopefully to ask for further details on the data we have not been able to collect.

Among all Waste-to-Energy facilities that we have come across in our preliminary research, the Klemetsrud Combined Heat and Power (CHP) plant has stood out for pioneering the Carbon Capture and Storage (CCS) technology in the world.

More than the adoption of advanced technologies, the well-utilized by-products and efficient sorting strategy in the waste feed are something that we would also like to emulate as we introduce Waste-to-Energy technologies in the Philippines through a TCP with JICA. To allow us to do that, we have gathered pertinent information on your facility’s history, financial setup, and technical framework, but we hope that you can help us verify the correctness of the information we have gathered, and to also supply missing data as seen in Attachment 1.

Here is a quick guide to the template to aid you in validating and filling out the form:

Name	Official Name of facility	Location	Complete Address	Picture
Implementing Body	Office/ Organization in charge of operations	Footprint	Total Land Area	
Capacity	Tonnage of waste received Number of lines in facility	Heat Usage	Power Capacity Generated Electricity Thermal Capacity	
Target Waste	Type of waste/s processed in facility	Waste Quality	Electric Efficiency Waste Calorific Value Steam Output	

History *year/date when the milestone activities are achieved		Plan	Bid	Construction Start/Finish	Operation Start/Finish	Demolish
	Original					
	Actual					

Capex	Total capital expenditure	Fund Source	Source of capital expenditure
Opex	Annual operational expenditure	Fund Source	Source of operational expenditure
Fin. Scheme	Financial scheme: e.g. 70-30 public-private ownership, etc	Dev. approach	Developmental approach, e.g. EPC, etc.

Coverage(SOW) *entity in charge of performing pertinent activities	Collection	Transportation	Processing	Energy Sale	Bottom ash	Fly ash
	Periodic collection of wastes from households and collection points	Sending of collected wastes to the WtE facility	Processing of wastes for energy generation	Management of generated power	Processing of collected bottom ash from the facility	Processing of collected fly ash from the facility

Process Type	Incineration technology implemented, e.g. CFB, etc	EPC / Tech	Supplier of pertinent equipment in the process (boilers, emission monitoring system, etc.)

Pollution Control *technologies and measures used to ensure the quality of by-products	Exhaust Gas	Wastewater	Bottom ash	Fly ash	Other

Kindly check Attachment 1 for the filled-out form prepared by JET and verify the data that have been gathered. Feel free to edit, leave comments, and supply missing information on the attachment as needed.

Your kind cooperation on this endeavor will significantly contribute to the implementation and development of WtE projects in the Philippines, leading to a more responsible waste management practice worldwide. We thank you in advance for your time and we would appreciate receiving your response on or before **05 March 2021**.

Should you have questions or clarifications on this request, please contact the JICA Experts Team through Mr. Satoshi Higashinakagawa or Ms. Andrei Mallare .

We look forward to your immediate and favorable response on this request.

Very truly yours,

ENGR. WILLIAM P. CUÑADO
Director

添付資料 4: WTE事業の計画・形成・評価、契約管理マニュアル

DRAFT Manual for Planning, Formulation, Evaluation and Contract Management of WTE project in the Republic of the Philippines

Ver. 6.1

ITWG Subgroup 1

November 2022

Table of Contents

Chapter 1 Rationale

1.1 Background

(Increasing necessity of WTE to address waste problem in urbanized areas)

The issue on Solid Waste Management (SWM) has become a serious social problem in Metropolitan Manila and in major urban cities in the Republic of the Philippines (hereinafter "Philippines") and is recognized as one of the top priority issues to be solved. The Government of the Philippines enacted the Republic Act (RA) 9003 more commonly known as the Ecological Solid Waste Management Act (hereinafter "RA9003") in 2000 that stipulates that open and controlled dumpsites shall be closed, phased out and rehabilitated, and alternative sanitary landfill sites shall be developed and operated as final disposal sites. It also aims to reduce the amount of waste to be disposed of at final disposal sites by reducing waste at the generation source and by recycling the waste. While SWM is a responsibility of Local Government Units (LGUs), the number of LGUs with capacity to conduct appropriate management is still limited because of technical and economic difficulties such as impractical SWM master plans and insufficient financial resources on SWM. The number of landfills which have been converted into a sanitary manner from open dumping is also limited.

(Incineration ban, Section 20 of RA8769, Supreme Court Decision in 2003, National Solid Waste Management Commission (NSWMC) Resolution 2016-66, DAO2019-21, which require LGUs to procure appropriately controlled WTE (ACC-WTE))

On the other hand, waste incineration was recognized to be practically prohibited by the Clean Air Act (RA8749) enacted in 1999. However, in July 2002, the Department of Environment and Natural Resources (DENR) notified that only incineration emitting hazardous and toxic gas was prohibited after the ruling of a decision by the Supreme Court of the Philippines in January 2002. With this, the NSWMC, in cooperation with the Ministry of Environment Japan (MOEJ), developed and issued "Guidelines Governing the Establishment and Operation of Waste to Energy (WTE) Technologies for Municipal Solid Waste (MSW)" as NSWMC Resolution 669 in 2016 which was eventually converted into a Department Administrative Order (DAO) by the DENR. The DAO provides for the environmentally-sound evaluation, establishment, operation and decommissioning or closure of WTE technologies for MSW management. However, technical standards as well as design criteria for the technologies are not indicated since DENR cannot promote specific technologies. It must be noted that DENR and the Environment Management Bureau (EMB) do not have sufficient knowledge in the review, monitoring and evaluation of WTE-related projects since they have not yet been engaged in any WTE project.

(Background of JICA TCP)

Under these circumstances, DENR requested the Japanese Government for a Technical Cooperation Project (TCP) for Capacity Development on Improving Solid Waste Management through Advanced/Innovative Technologies. Upon request, a mission was dispatched twice, and an agreement was made for the basic framework of the project. Based on the Record of Discussion (R/D) signed by both parties on November 7, 2017, this TCP will be implemented for three years and started on March 2019.

(Citing the contents of activity 2-5 in Progress Report (2))

On April 2021, "Activity 2-5 Define the points and issues to be addressed for formulating WTE project in target LGUs" of the progress report, this TCP snapshots the points and issues in formulating WTE projects in Philippines as Table 1-1 below. These are the JICA Expert Team's (JET) opinions and suggestions from the technical point of view. It is critical for LGUs to pay attention to these points and issues because big projects using PPP scheme tend to be decided by political reasons without enough discussions and evaluation on the technical aspect.

Table 1-1 Points and Issues Associated in Formulating WTE Project by LGUs in Philippines

Points and Issues	Explanation and how to address the Points/Issues
1. Tipping fees for waste	- Most LGUs have not shouldered the cost for SWM at reasonable level even at this moment. Accordingly, LGUs do not accept the increase of T/F (tipping fees) associated with WTE from present landfill cost, - The reason why the cost shouldered by LGU could be lower than reasonable level is that some components of SWM still need improvements to meet environmental compliance. - The cost of SWM will be bigger since land prices for SWM facility increases with economic development, and therefore strict environmental measures will be required accordingly to be more consciousness on the environment.

Points and Issues	Explanation and how to address the Points/Issues
2. Misunderstanding on Solid waste Management-Public Private Partnership (SWM-PPP) Projects	- In many cases, it is a misunderstanding in the Philippines that "waste can be converted to money through PPP scheme". There are 2 types of PPP projects, one is ***revenue generated and revenue sharable PPP*** projects (such as toll road, power generation, water distribution projects) and another one is ***service fee payment-based PPP*** (such as SWM projects, where service fee shall be paid by the LGU to a private entity in the form of the T/F). These 2 types are written in a mixed shape in so many documents. - Thus, LGUs as well as the National Government shall understand the following: · SWM-PPP projects are not ***revenue sharable PPP projects***, and LGUs shall pay T/F throughout the project period to the private investor to recover their initial investment. · Private investor is eligible to recover its initial investment cost through project duration by T/F. *It means that the total government expenditure (In Japan, it is called "Public Sector Comparator") through project period is mostly same in both cases that LGUs procure the project in a Build-Operate-Transfer (BOT) scheme or Design-Build-Operate (DBO) scheme.
3. Responsibility of LGUs	- It is necessary to clarify the real meaning of "primary responsibility of LGU" in RA9003 pertaining to the role of the LGUs in SWM · Waste Treatment and Cleanness Law (1970) in Japan stated that "even if LGs contract out the construction, and Operation and Management (O&M) of SWM to private entities, LGUs still have all responsibilities of it." This means that LGUs shall have an avoidance/recovery plan before the operation start of a SWM facility so as to keep the continuous operation of SWM in their jurisdiction in the event that a private company fails to comply with environmental standards or is bankrupt and cease to operate for any reasons. · LGUs shall realize the responsibility of securing the environmental compliance of concessionaries in the SWM-PPP project while EMB regional office is one of the organizations for monitoring.
4. Needs of technical expertise in LGUs	- LGUs in the Philippines do not have experts on WTE technology. They need expertise to evaluate proposals that sometimes have misleading and unrealistic claims. LGU's shall have the technical readiness before undertaking the deliberation of proposed PPP project. - Some LGUs who do not have technical capability tend to contract out all of activities in managing MSW to one company. This high reliance on one private firm has a lot of risks such as; · Anytime, the private company can cease operation by their sole discretion if the project doesn't generate profit, · LGUs shall find successors/alternative options immediately but it is quite difficult to find it in particular patented/complex facility, · Then, private company requests LGUs to increase processing cost (T/F) and LGUs shall agree it considering the risks above.
5. Applicability of Solicited Approach	- LGUs will always face difficulties in evaluating unsolicited proposals without idea of a "proper" development approach of WTE. - Same as other public service infrastructure, solicited approach shall be considered for WTE. This is the way for LGU to specify and require private investor to offer the WTE project that the LGU needs. - With regard to the capacity of facility, LGU must know its MSW stream and how much of waste they can supply to the WTE. This is also same for the composition (quality) of waste, - As an example, in March 2020, JET stayed for 3 days in Cebu City for the study on "setting up the capacity of WTE in Cebu." the team reported that combustible matter in 2019 was 500t/d, and is forecasted to reach 600t/d in 2035. The proposal then from a private proponent planned for 800t/d of MSW value estimate, which is too big for Cebu City.

Points and Issues	Explanation and how to address the Points/Issues
	- With regard to the scope of project, LGUs shall decide what components LGU manages and what components are contracted out to the private sector,
6. Definition of waste category (Residual, Recyclable, Biodegradable) 7. Segregation obligation in RA9003 8. Waste category in WACS	- In Section VIII and IX, IRR of RA9003, there are the basic requirements for segregation; "Responsibility for sorting and segregation of *biodegradable* and *non-biodegradable* wastes shall be at the household level" and "Waste segregation and collection shall be conducted at the barangay level specifically for *biodegradable/compostable* and *reusable/recyclable* wastes. The collection and disposal of *non-recyclable/non-recoverable* materials and *special wastes* shall be the responsibility of the city or municipality." - Some terms in this provision are not clear, including: · What is difference between *"non-recyclable/non-recoverable"* and *"residual"*? · It is common practice that "residual" waste includes not only "non-recyclable/non-recoverable" materials but also "*biodegradable, reusable/recyclable"* material if there are no appropriate segregation/recovery system nor sufficient demand in the local market of recyclables and compost. · JET recommends to define *"Residual waste"* as "waste which cannot be reduced, reused and recycled, economically and/or technically, in the LGU's waste treatment system including material recovery and utilization industries and other circumstances", which means that LGU can define materials classified into the residual waste based on their SWM plan. <u>"Residual waste" is defined in the WTE technical standards that was developed in the TCP in fulfillment of Activity 1-4.</u> · With this definition, LGU can understand the meaning and necessity of Waste Analysis and Characterization WACS for "Residual waste" to consider how to control/manage/minimize *"Residual waste"*. - In this context, it should be discussed for the WACS procedure. Present NSWMC's categorization for WACS is 4 items; *Biodegradable, Recyclable, Special Waste and Residual Waste (Categorized in downstream usage basis).* It is recommended that WACS categorization should be in material basis and not the usage basis. [1]
9. Accumulated data of solid waste quantity and quality	- When LGUs consider putting up any facility such as WTE or MRF, it is recommended to have ***"at least"*** statistic quantity data of MSW disposal because SWM processing facility shall need the information of "Target Waste" quantity. Additionally, waste classification survey in WACS in continuous manner is also required to prepare appropriate WTE project capacity. - In addition, only WACS data is not usable. It should be a study report basis which includes implemented period (season, time), detail sampling and analytical procedure, etc. - <u>Under the limited business activity caused by COVID-19, these self-data accumulation activities are strongly recommended to LGUs to consider.</u>
10. Address to Environmental NGOs	- As for the environmental NGOs, they sometimes put all incineration technologies in one basket. For instance, when they hear burning, they are automatically against it. It is suggested that a program must be developed to educate the LGUs on how to consult with the NGOs.
11. Change of administration/ Long-term WTE development plan	- Political (e.g., New elected government official might cause a change of direction) risk is the biggest risk for the private investor. It shall be taken by LGU side (and guaranteed by NG, etc.) for long-term contract. - In case of QCBS, the Consortium's unsolicited proposal has gone through Swiss Challenge during the previous administration. Currently, the new administration is conscientiously studying the project taking into consideration the recently passed

[1] In Japan, WACS category is at least 5 kinds and can be divided into more like 14 to 16 kinds, which are (1) Paper and textile, (2) Plastic, rubbers, (3) Wood, bamboos, (4) Kitchen waste, (5) Inert, because usage can be changed based on the recycling market. (Demand of plastic is drastically changed recent years. If it is categorized in "recyclables", composition of plastic at the landfill can't be monitored in the present WACS statistics.)

Points and Issues	Explanation and how to address the Points/Issues
	Ordinances on Plastic Bag Ban and Single-Use Plastic/Disposable Materials Ban while exhausting all efforts on Waste Minimization/Reduction and Avoidance. - It is recommended for LGUs to have a consistent long-term MSWM Plan including WTE development backed by LGUs' budgetary plan, and it should be published/uploaded from time to time so that the citizens, politicians and investors can understand,
12. Handling of ETV Statement/Report	- As written in Activity 1-4 above, ETV statement or report is the evaluation result on the claim that the applicant requested to validate, and ETV does not endorse, approve or authorize for use any product that it evaluates. Therefore, end user of WTE, which is normally LGU, shall understand such ETV policies and is needed to analyze how the proposed technology is reliable.

Note: The table originated in Progress Report (1) on Feb 2020, and underlined parts were added in the Progress Report (2).

Source: Progress Report (2), the Project for Capacity Development on Improving Solid Waste Management through Advanced/Innovative Technologies in the Republic of the Philippines (JET, April2021)

1.2 Objective of the Manual (for the development of WTFs)

1) Objective of this Manual

To provide a practical guide to LGs who don`t have the experience to plan, formulate, evaluate and contract management for the WTE facility. There is a similar guide in Japan which is "Planning and Design Guidelines for WTF Development (2017, JWMA)" written for WTFs including WTEs. So, when the reading LGU will consider WTE, WTF can be read as WTE.

For the purpose of addressing the points and issues explained in "1.1 Background", in particular "4. Needs of technical expertise in LGUs" and "5. Applicability of Solicited Approach" in Table 1-1 and as the one of the deliverables of TCP, Manual for Planning, Formulation, Evaluation and Contract Management of WTE project in the Republic of the Philippines (hereinafter called as "this Manual") is developed under "Activities 1-6 : Prepare manual for planning, evaluation, formulation and supervision for WTE projects and improve evaluation criteria of EMB for 10-year SWM plans". This Manual aims to be a reference guide for LGUs when they face such development needs of WTEs by introduction of planning, formulation, evaluation, contract management.

2) Structure of the Manual / Corresponding to WTE/WTF development phase

The structure of this manual is divided to 6 chapters and appendixes as below;

0

Rationale**,** provides background and objective of formulation of this manual,

Chapter 2 Planning Phase, whose main message is planning tagged with budgeting plan, is the most important factor to implement WTE/WTF project, so this chapter covers long-term MSW management master plan (10-year SWM plan), and specific project conceptual plan. One of the important elements of conceptual plan, selection of candidate site for WTE/WTF, is also discussed,

Chapter 3 Formulation Phase, covers a lot of factors associated with the project formulation. Technology selection, target waste quantity/quality identification as the technical aspects, financial model and business scheme formulation as financial aspects, appropriate public-private role demarcation and value chain analysis are also important in the legal aspect. All of these aspects shall be sorted in the Feasibility Study before entering into the bidding process. Success of bidding process really depends on the quality of FS.

Chapter 4 Evaluation Phase, is a break chapter where there is discussion on how to evaluate one or more unsolicited proposals raised from private entities,

Chapter 5 Contract Management Phase, covers how LGUs shall supervise the design, construction works to be done in the construction sub-phase as well as monitor the operational performance in the operation sub-phase. Considering most of WTE projects will be done by BOT/BOO scheme, it is also important to know how much intervention can be appropriate for the investor's specification to the EPC/O&M contractors.

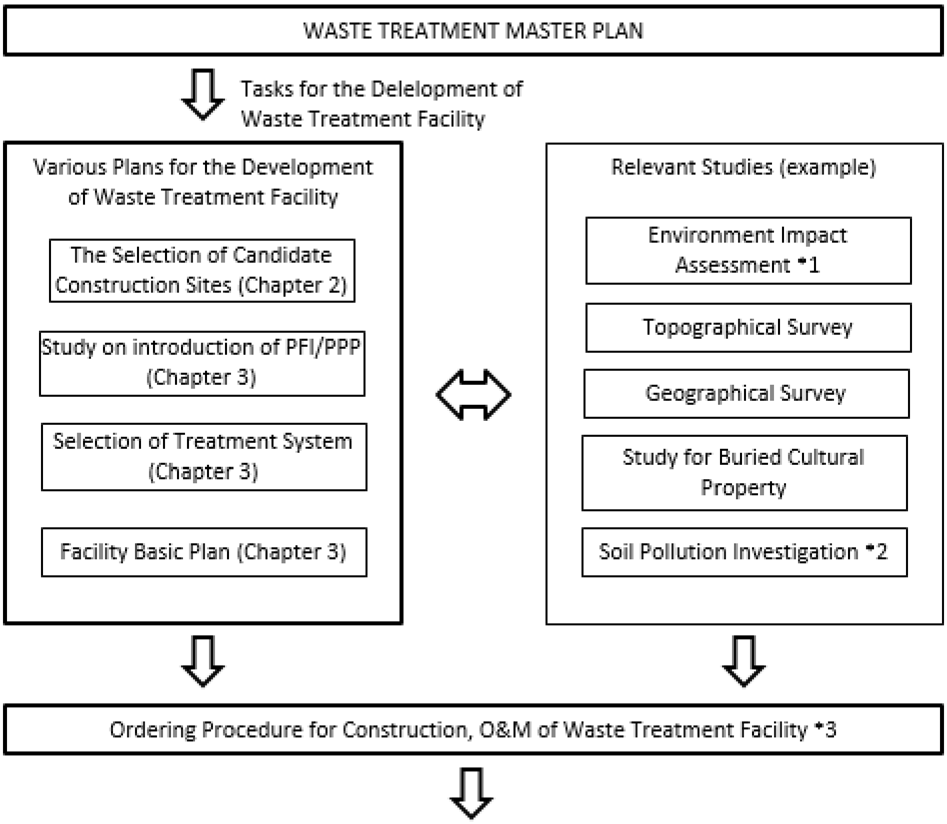
Chapter 6 Dismantling of WTE-ACC, shows the explanation of dismantlement of WTE facility in Japanese case. It is 15 to 20 years from now so just show the example in Japan.

There are a lot of examples and suggestable issues associated in the development of this guide. However, considering the readability of the document, the following items are moved to the appendix;

APPENDIX A: CONSIGNMENT OF PROFESSIONAL ENGINEER
APPENDIX B: Applications/Notifications to THE GOVERNMENTS (EXAMPLE IN JAPAN)
APPENDIX C: GENERAL STRUCTURE OF WTE/WTF
APPENDIX D: AN EXAMPLE OF WASTE TREATMENT TECHNOLOGY SELECTIONS IN JAPAN
APPENDIX E: WTE-ACC AS A STABLE POWER SOURCE CASES IN JAPAN
APPENDIX F: SAFETY MEASURES
APPENDIX G: RESPONSIVENESS TO DISASTER WASTE

As shown in Figure 1-1 The chapters in this Manual are those intended to specify the measures related to WTF development flow starting from the LG's **MSW Treatment Master Plan**, in Philippines which is called as **10-year SWM plan** introduced in "Chapter 2.2 Legal requirement to LGUs in MSWM", especially for the 2.5 The selection of candidate construction sites-. Then, Study on PFI[2] and other PPP schemes, Selection of the Waste Treatment System are compiled into the **Feasibility Study (**Chapter 3 , hereinafter called as "F/S"**)**. In addition, for these plans and studies to be formulated, there may be cases where it must be necessary to have results of topographical and geological surveys, and facility basic plan ready, and cases where it must be necessary to provide information to conduct surveys of environmental impacts, etc. Therefore, in formulating F/S, it is important to not only be consistent with the higher-level plan, but also to consider the status of relevant surveys before cooperating to carry things out.

[2] Private Finance Initiative (PFI) which introduce private finance into the public project such as BOT, BTO, BOO, and others



Note 1) Required in EIA rule and regulation both national and provincial government,
Note 2) Investigation required by Soil Pollution Control Law,
Note 3) There are cases conbined and/or separate contract of construction and O&M

Source: JICA Expert Team based on Planning and Design Guidelines for WTF Development (2017, JWMA)

Figure 1-1 The positioning of the Master Plan, F/S and other activities for the development of WTFs

3) Standard WTE Development Timeline

Table 1-2 illustrates the standard timeline for the introduction of WTE facility in the case of Japan. Based on the MSW Treatment Master Plan (10-year SWM Plan), **Facility Conceptual Plan** and **F/S** will be formulated to shape the project outline to obtain approval from LG and relevant authorities. In which Study for PFI/PPP Applicability (Business Scheme) including market sounding, Topographic Survey, Geological Survey, EIA and utilities study must be conducted. Once all project setup is in place, the bid process can start. Construction of WTE usually takes 3-4 years which includes the design, construction and commissioning stages. After that, commercial operation can start. The total process from Master Plan to commercial operation usually takes 10 years. However, if necessary, surveys, studies and decisions can be done in parallel and appropriately, some part of time can be shortened.

The purposes of each activity and their timing are shown in Table 1-3 . The Selection of potential construction site and selection of treatment/processing methods are usually carried out at the **Facility Conceptual Plan** stage however, they are sometimes conducted in a part of **F/S.**

It should also be noted that the plans and studies stipulated here shall be approved by Local Government Council or appropriate authority to keep the project attractive for the international/local private players as well to avoid wasting time by the unneedful step-back of the project.

Table 1-2 Standard Timeline for the Development of Waste to Energy Facility

Year		1	2	3	4	5	6	7	8	9	10	11	Remarks
New Facility	MSW Treatment Master Plan (MP) (10 year SWM Plan - Chapter 2)												Reviewed once every 5 yrs
	Facility Conceptual Plan												Decision on renewal & site
	F/S (Facility Basic Plan - Chapter 3)												Decision on processing method
	Business Scheme Study (PFI/PPP Applicability Study - Chapter 3)												Decision on business scheme
	Topographic Survey												Reflected in facility basic plan
	Geological Survey												Reflected in facility basic plan
	Environmental Impact Assessment												1.5-4 yrs
	Bid/ Selection of Winning Bidder												standard 2 yrs
	Construction Work (Chapter 5)							Construction					standard 3-4 yrs
	Operation (Chapter 5)											Start	

Source: JICA Expert Team

Table 1-3 Purposes of each activity and documents

Item	Purpose	Phase / Document
Selection of candidate construction sites	To select a candidate construction site of WTF, typical process includes shortlisting from all candidate sites and ultimately selecting one after evaluation.	Planning Phase: At Facility Conceptual Plan
Study on Business Scheme	To select the construction and operation methods of the WTF. Often, the business methods are selected out of several schemes such as public-build & public-operation scheme, PFI scheme, DBO schemes, etc.	Formulation Phase: At F/S
Selection of the treatment/processing system	To exclude the treatment system that does not conform to the WTF development policy of the LG.	Basic waste treatment system is planned in Master Plan/ Planning Phase, and process technology is selected in FS/ Formulation Phase.
Feasibility Study	To set facility specifications, preconditions, performance requirements, operations and maintenance conditions, that is necessary to order construction, operation, and maintenance and management work.	Formulation Phase

Source: JICA Expert Team based on Planning and Design Guidelines for WTF Development (2017, JWMA)

1.3 Consignment of Professional Engineer

To develop a WTF/WTE, it is necessary to smoothly and reliably fulfill various surveys, devise some plans, and follow certain procedures. However, because projects like WTF/WTE take place once every 20-30 years for each LGU, it is not realistic to place engineering experts in the LGU for these projects.

Therefore, most of LGs in Japan employ waste treatment specialists who are well-versed in procedures to develop a facility as well as being familiar with laws and technologies in the field of waste treatment (hereinafter, called as “Waste Treatment Consultants”). These Waste Treatment Consultants in reality are involved with LGU throughout all the life cycle of a projects, from support to formulate waste treatment master plan, to support in planning the development of the facility, to conducting a variety of surveys, environmental impact assessment, to supervising the designing, construction, maintenance, operation and management of the WTFs, etc.

APPENDIX A: CONSIGNMENT OF PROFESSIONAL ENGINEER explains the items to consign with Waste Treatment Consultants, Selection methods, and the contract procedures cases in Japan. Selection methods regulated under RA9184 are also discussed in this Appendix A.

1.4 Access to the Project Development Finances

For the formulation of a WTE project, there are several financial support opportunities for LGUs to utilize, for example, Project Development and Monitoring Facility (PDMF) of PPP Center[3], Asia Pacific Project Preparation Facility (AP3F[4]) and Transaction Advisory Service (TAS[5]) of Asian Development Bank (ADB), Project Feasibility Study Support Facility of MOEJ[6], etc. which provides institutional, financial and technical support for the project formulation timeline, i.e. feasibility study, transaction advisory, performance monitoring, etc. All of these facilities requires LGUs to prepare an appropriate MSW management master plan, a minimum project idea as a project conceptual plan, and a certain level of decision to implement the PPP project.

[3] https://ppp.gov.ph/pdmf/overview/
[4] https://ap3f.adb.org/
[5] https://www.adb.org/business/how-to/what-are-adb-s-transaction-advisory-services
[6] https://www.env.go.jp/recycle/circul/venous_industry/index_en.html

1.5 Definitions

Appropriately Controlled Combustion (ACC)	Appropriately Controlled Combustion (ACC) shall refer to a Waste-to-Energy technology converting WtE feedstock to energy by combustion technology in accordance with the following order of objectives: 1. Waste treatment and sanitation 2. Waste reduction 3. Energy recovery
Evaluation	Involves the assessment of project proposals from proponents against a pre-established set of evaluation criteria and metrics.
Formulation	Involves the formulation of facility design and operational specifications to ensure compliance with technical requirements as specified in the law
Monitoring	Involves the supervision of the LGU of the operational activities of the WTE facility to ensure compliance with government regulations. Scope and depth of monitoring activities shall rely on the business scheme observed for the project, e.g. BOT, BOO, DBO, etc.
Planning	Involves the development of a reference document on the development plan for the LGU, that shall serve as guide in approving or otherwise of solicited and unsolicited proposals to ensure alignment to the overall plan of the LGU
Residual Waste	WTE technical standards that was developed in the TCP in fulfillment of Activity 1-4 defined as; Remaining waste after the implementation of 3Rs (Reduce, Reuse, Recycle) by LGUs at maximum extent, in economical and institutional terms, regardless of its disposal mode such as being utilized in a WtE facility or disposed in Sanitary Landfill.
Supervision	(Should be come earlier than monitoring) defined as LGU to monitor the designing and construction activity of WTE to be carried out by private partner.
Target waste quality	The quality of the waste to be delivered to the WTF for the planned years and is determined based on records of the quality of the waste in past years, in seasons, and the plan for collection and recycling of waste in the future.
Waste to Energy	(DAO 2019-21 definition) The structure/appurtenant facility where the Waste-to-Energy facilities on appropriately controlled combustion operations are housed.

1.6 Acronyms

ACC	Appropriately Controlled Combustion
ADB	Asian Development Bank
AP^3F	Asia Pacific Project Preparation Facility
BAC	Bids and Awards Committee
BLT	Build- Lease- and- Transfer
BOO	Build- Own- and- Operate
BOT	Build-Operate-Transfer
BTO	Build- Transfer- and- Operate
CAO	Contract- Add- and- Operate
CDP	Comprehensive Development Plan
CLUP	Comprehensive Land Use Plan
CP	Counterpart
CSWMB	City Solid Waste Management Board
DA	Department of Agriculture
DAO	Department Administrative Order
DBO	Design-Build and Operate
DENR	Department of Environment and Natural Resources
DILG	Department of the Interior and Local Government
DOE	Department of Energy
DOH	Department of Health
DOST	Department of Science and Technology
DOT	Develop- Operate- and- Transfer

DPWH	Department of Public Works and Highways
DRR	Disaster Risk Reduction
DTI	Department of Trade and Industry
EMB	Environmental Management Bureau
ETV	Environment Technology Verification
FBP	Facility Basic Plan (Same with Feasibility Study)
FCP	Facility Conceptual Plan
F/S	Feasibility Study (Same with Facility Basic Plan)
GPPB	Government Procurement Policy Board
GPRA	Government Procurement Reform Act
HRB	Highest Rated Bid
HRRB	Highest Rated Responsive Bid
IEC	Information, Education, and Communication
IRR	Implementing Rules and Regulations
JET	JICA Expert Team
JICA	Japan International Cooperation Agency
JWMA	Japan Waste Management Association
LCA	Life Cycle Assessment
LCC	Life Cycle Cost
LG	Local Government
LGU	Local Government Unit
MGB	Mines and Geosciences Bureau
MMDA	Metro Manila Development Authority
MOEJ	Ministry of Environment Japan
MRF	Material Recovery Facility
MSW	Municipal Solid Waste
MSWMB	Municipal Solid Waste Management Board
NEDA	National Economic and Development Authority
NEDA ICC	NEDA Investment Coordination Committee
NG	National Government
NGO	Non-Government Organizations
NSWM	National Solid Waste Management
NSWMC	National Solid Waste Management Commission
PDMF	Project Development and Monitoring Facility
PEZA	Philippine Economic Zone Authority
PFI	Private Finance Initiative
PhilGEPS	Philippine Government Electronic Procurement System
PIA	Philippine Information Agency
PPP	Public-Private Partnership
PPPC	Public-Private Partnership Center
PRA	Philippine Reclamation Authority
PSWMB	Provincial Solid Waste Management Board
QBE	Quality Based Evaluation
QCBE	Quality and Cost Based Evaluation
QCBS	Quality and Cost Based Selection
RA	Republic Act
R/D	Record of Discussion
RDF	Refuse Derived Fuel
RED	Regional Executive Director
ROT	Rehabilitate- Operate- and- Transfer
ROO	Rehabilitate- Own- and- Operate
SLF	Sanitary Landfill
S/V	Supervision
SWM	Solid Waste Management
SWMP	Solid Waste Management Plan
T/A	Transaction Advisory
TAS	Transaction Advisory Service

TCP	Technical Cooperation Project
TESDA	Technical Education and Skills Development Authority
T/F	Tipping Fee
WACS	Waste Quality Analysis
WTE	Waste-to-Energy
WTF	Waste Treatment Facility

Chapter 2 Planning Phase

2.1 Components of the Planning Phase

The diversification of waste treatment systems in recent years, along with the introduction of business schemes that involve private sectors has spread more widely as an option for facility development in waste treatment operations at LG levels. On the other hand, demands for the accountability and sustainability of such choices have strongly increased, and technology for the development of WTFs with objectivity, transparency, and reasonability is also strongly sought after.

The blue box in Figure 2-1 MSW shows the position of the Planning Phase in the procedure of WtE-ACC project.

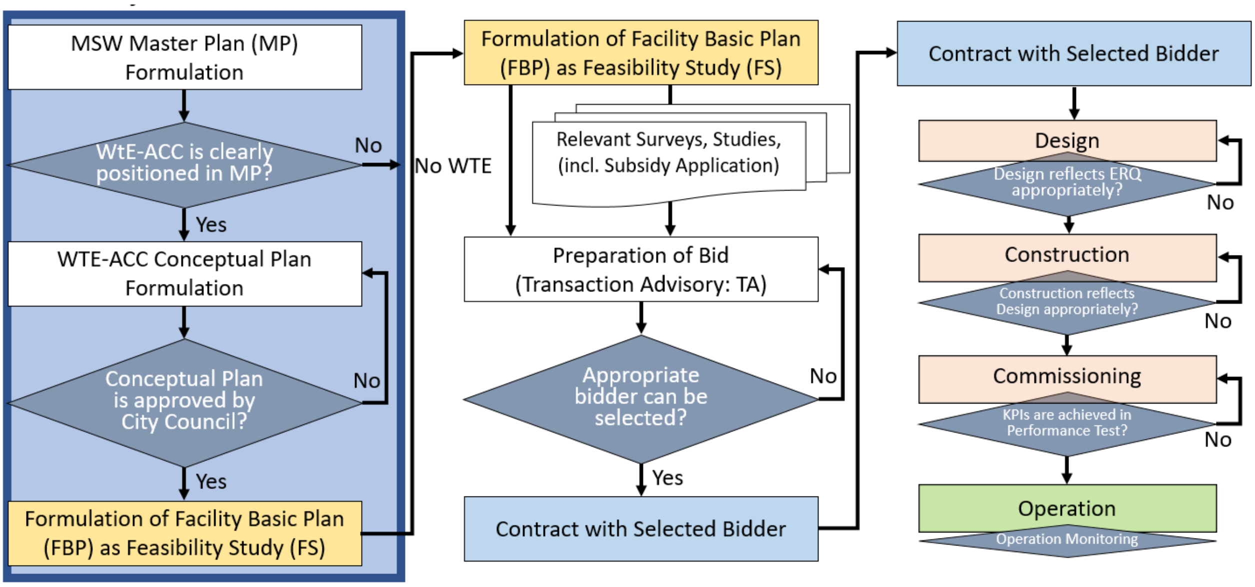
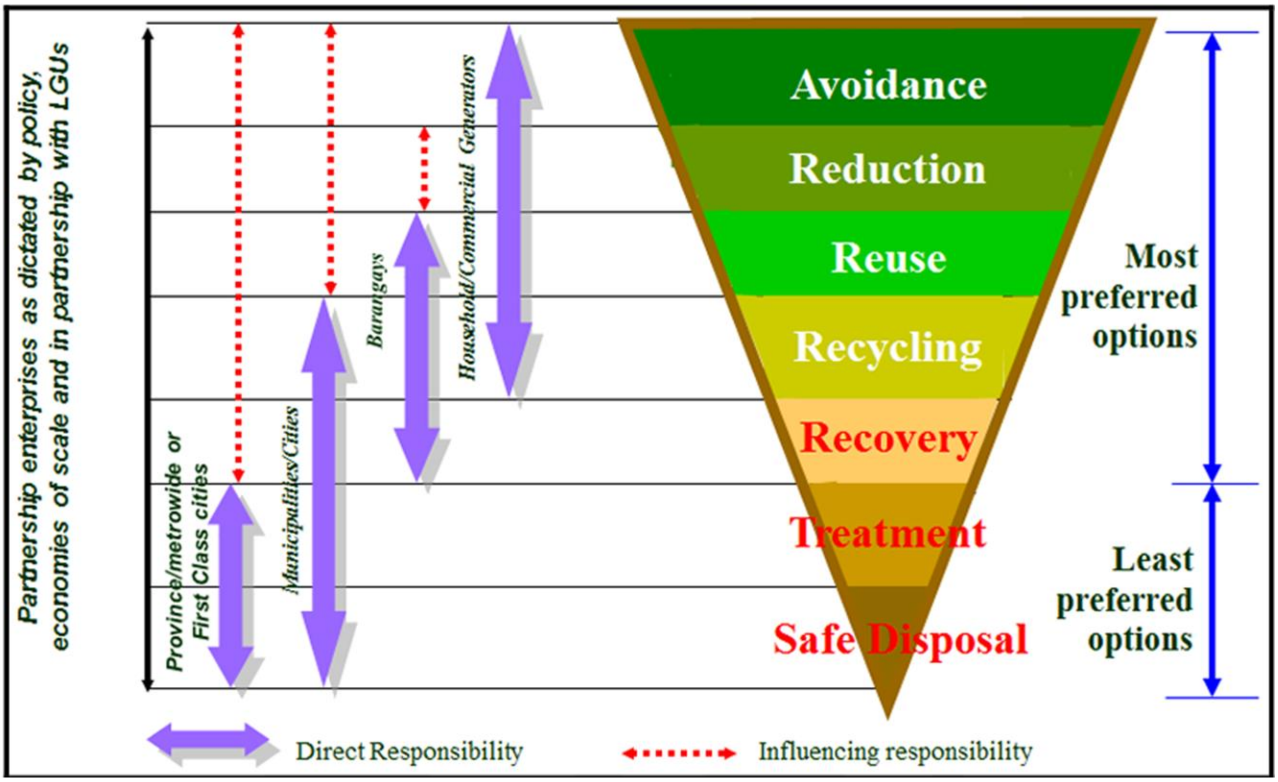


Figure 2-1 WtE Project Procedure and position of Planning Phase

2.2 Legal requirement to LGUs in MSWM

1) Role of National Gov., Province, Cities/Municipalities and Barangays in RA 9003

Chapter II of the Ecological Solid Waste Management Act of 2000 or RA 9003 discusses the Institutional Mechanism of the Act. The key stakeholders in the implementing structure of the law include the National Solid Waste Management Commission (NSWMC), Department of Environment and Natural Resources (DENR), the Local Government Units (LGUs), and the Waste Generators including the citizens.



Source: National Solid Waste Management Status Report (2008-2018), DENR-EMB, https://emb.gov.ph/wp-content/uploads/2019/08/National-Solid-Waste-Management-Status-Report-2008-2018.pdf

Figure 2-2 Overall Policy of RA 9003 based on Waste Management Hierarchy

(About NSWMC)

The NSWMC, which shall be referred to as the Commission, should oversee the implementation of solid waste management plans and shall serve as the key policy-making body to achieve the objectives of RA 9003. The Commission shall be composed of fourteen (14) members of the government sector, together with three (3) members from the private sector. The heads of the following agencies should be part of the commission in their ex officio capacity: Department of Environment and Natural Resources (DENR), Department of the Interior and Local Government (DILG), Department of Science and Technology (DOST), Department of Public Works and Highways (DPWH), Department of Health (DOH), Department of Trade and Industry (DTI), Department of Agriculture (DA), Metro Manila Development Authority (MMDA), League of Provincial Governors, League of City Mayors, League of Municipal Mayors, Association of Barangay Councils, Technical Education and Skills Development Authority (TESDA), and the Philippine Information Agency (PIA). On the other hand, the private sector shall be represented by a representative from non-government organizations (NGOs) whose principal purpose is to promote recycling and the protection of air and water quality, a representative from the recycling industry, and a representative from the manufacturing or packaging industry. The roles of the Department of Environment and Natural Resources (DENR) are as defined in Section 8 of the law. DENR is the lead government agency responsible for the implementation and enforcement of RA 9003 through the DENR Secretary who chairs the NSWMC. Currently, DENR-EMB-SWD serves as the Secretariat of the Commission.

(About Municipalities/Cities, Provinces, and Barangays)

The LGUs are the key implementing and enforcing arm of the law within its respective political jurisdictions: Provincial, Municipal, and Barangay Level, as stated in Section 10 of the Act. The law also mandates the establishment of Provincial Solid Waste Management Board (PSWMB, Sec. 11) and City or Municipal Solid Waste Management Board (CSWMB / MSWMB, Sec. 12). The establishment of these respective boards are reiterated in the Implementing Rules and Regulations of the Act, DAO 2001-34, in its Rule VI Section 1 and 4. The IRR also included the creation of the Barangay Solid Waste Management Committee as stated in Rule VI Section 6. Lastly, all waste generators have the responsibility to comply with the law. Segregation of waste is primarily at-source as stated in Section 21 of the Act. Figure 2-2 shows the Overall Policy of RA 9003 based on Waste Management Hierarchy.

(About DENR and NSWMC)
Section 14 mandates DENR for the preparation of the National Solid Waste Management (NSWM) Status Report and its contents. In turn, the Commission must use the Status Report to develop the NSWM Framework which is among the powers and functions of the NSWMC, listed in Section 5. The contents of the Framework are detailed in Section 15 of the Act. The Act promotes solid waste management following a hierarchy of options as discussed in Rule 8, Section 1 of the IRR. These options cover the entirety of solid waste management: from volume reduction to final and safe disposal. Guided by this hierarchy, the NSWM Framework introduced the inverted triangle with corresponding levels of governance that have direct responsibilities in different options, starting from households up to the province or metro wide level of political organizations. The NSWM Framework also identified and summarized the different actors and their respective scope of interest in the implementation of Solid Waste Management in the country, shown in Table 2-1

Table 2-1 Scope of interest of identified actors for SWM (NSWM Framework 2004)

Actors	Scope of Interest and Agenda
Households and community service users including commercial, institutional, and industrial establishments.	These segments of actors are primarily interested in an effective and dependable waste collection service at a reasonably low price. Where the waste these actors generate end up is not their priority concern for as long as the quality of their own living environment is not affected by dump sites. However, when their awareness is raised on the health implications and the broader objective of an environmentally sound waste disposal, these groups can be mobilized to become influential forces for its effective implementation. Commercial and industrial establishments have different motivations for carrying out ecologically acceptable practices for waste disposal. Most of the time it is dictated by reliability, economics (does waste disposal cut significantly into their operating costs) and sensitivity of their products to public and market perception.
Barangays	The barangay is the basic level of governance in a community. These units have the mandate to upgrade their respective local environmental conditions, improve delivery of basic services and petition municipal/city and even provincial governments for service improvements. The barangay is the most valuable partner of an LGU for local solid waste management. When sufficiently organized, the barangay can be tapped to manage and operate local collection services and waste recovery and composting activities. As solid waste management deals directly with protection of health and maintaining the integrity of the environment, it is an important agenda item that can be used by communities in selecting the next barangay head.
Municipal/City Executives (Mayors, Vice Mayors and other LG Officials)	As mentioned in earlier discussions, LGUs specifically municipal /city executives are primarily responsible for the provision of solid waste collection and disposal services. Their responsibilities and authorities have been mandated under the act and its IRR as also reinforced by RA 7160. More than the authority however is the political motivation for providing these services. User satisfaction of the provided service, greater allocation from the national government, and national recognition are enough incentives for local executives to seriously attend to solid waste management matters. Local executives also acknowledge that effective SWM programs depend largely on their constituency's active participation and support and therefore recognize the value of enhancing public awareness.
Provincial Executives (Governors and Vice	While municipal/city executives assume significant responsibilities, provincial executives and region wide authorities are also mandated to ensure the effective

Actors	Scope of Interest and Agenda
Governors) including the MMDA	implementation of the Act. Its key functions, through a Provincial SWM Board, is to provide support to municipal executives under their jurisdiction, carry out their responsibilities and coordinate the planning, implementation, and operation of SWM facilities. If the economics of operating a single or common SWM facility has been agreed, the Provincial Executives are given responsibility to oversee and supervise the said facility. Similar to municipal executives, the political motivation serves as the key driving force for provincial executives to provide these services to their constituencies.
Private Sector	Private sector participation is deemed critical for SWM. Considering that LGUs may not necessarily have sufficient resources and funds to support the operation of an environmentally acceptable SWM collection, transfer, treatment and disposal facility, the private sector is a source of potential service providers that can fill in the gap. Operating under various partnership arrangements with LGU, the private sector can provide more effective and better service at even lower costs. The different partnership modality the private sector offers to LGUs can cover capital infusion, management and organizational arrangements, labor and technical support. Another part of the Private Sector is the informal private sector which is comprised by unregistered or least regulated activities of solid waste management which are carried out by individuals, families, groups or small enterprises. Their basic motivation is self –organized revenue generation such as the informal garbage pickers, junkyard dealers, and scavengers. Usually, the motivation for this group is simply survival in the absence of regular employment. The informal private sector generally works under substandard and unhealthy conditions exposing them to the hazards of health, no social and economic security, and lack of access to basic services such as health care, sanitation, and education. As this sector has no other alternative means for livelihood, they welcome any opportunity that will improve their lot.
Non-Governmental Organizations (NGOs)	NGOs operate between the private and government functions. The motivations for their involvement in SWM vary from humanitarian reasons to providing support for development through service improvement. Some NGOs are even involved in generating sustainable employment targeting their assistance program to the informal private sector. Given their strength in social mobilization, NGOs can significantly contribute to increasing awareness on SWM, organization of grass root SWM activities, catalyzing access to credit for the informal private sector, and consolidating voice and position in the planning of SWM plans at local and provincial level.
National Government Agencies	The National Government Agencies are responsible for establishing the institutional and legal frameworks for SWM and ensuring that the LGUs have the capacity to implement them. As part of their support mandate, the national government agencies are to provide guidelines, standards, capacity building programs in the areas of administration, financial management, technical capacity and public awareness programs. The National Government is also supposed to provide the venue for cross jurisdictional conflict resolution. They also serve to catalyze greater Public-Private partnership for SWM.

Source: National Solid Waste Management Framework (2004), NSWMC, http://nswmc.emb.gov.ph/wp-content/uploads/2017/11/NSWMC-FRAMEWORK-PDF.pdf

2) Responsibilities of RSWMB and CSWMB/MSWMB

The specific responsibilities mandated by the act on Provincial and Municipal/City level through the PSWMB and the MSWMB/CSWMB are discussed in the succeeding paragraphs.

The PSWMB must be chaired by the Provincial Governor and has twelve (12) responsibilities which primarily support the preparation, implementation and updating of the Provincial Solid Waste Management Plans based on the submitted Municipal/City level SWM Plans from component LGUs. The PSWMB must verify the harmony among the contents of the different plans and provide clustering of LGUs with common SWM issues. The itemized responsibilities of the PSWMB are as follows:

Table 2-2 Responsibilities of PSWMB (DAO 2001-34 Rule VI, Section 2)

1. **Develop a provincial solid waste management plan** from the submitted solid waste management plans of the respective city and municipal solid management boards and municipal solid waste management boards herein created. It shall review and integrate the submitted plans of all its component cities and municipalities and ensure that the various plans complement each other and have the requisite components. The Provincial Solid Waste Management Plan shall be submitted to the Commission for approval. The Provincial Plan shall reflect the general program of action and initiatives of the provincial government in implementing a solid waste management program that would support the various initiatives of its component cities and municipalities.
2. **Provide the necessary logistical and operational support** to its component cities and municipalities in consonance with subsection (f) of Section 17 of the Local Government Code.
3. **Recommend measures and safeguards against pollution and for the preservation of the natural ecosystem**.
4. **Recommend measures to generate resources, funding and implementation of projects** and activities as specified in the duly approved solid waste management plans.
5. **Identify areas within its jurisdiction, which have common solid waste management problems** and are appropriate units for planning local solid waste management services in accordance with Section 41 hereof.
6. **Coordinate the efforts of the component cities and municipalities** in the implementation of the Provincial Solid Waste Management Plan.
7. **Development of an appropriate incentive scheme** as an integral component of the Provincial Solid Waste Management Plan.
8. **Convene joint meetings of the provincial, city and municipal solid waste management boards** at least every quarter for purposes of integrating, synchronizing, monitoring and evaluating the development and implementation of its provincial solid waste management plan.
9. **Represent any of its component cities or municipalities** in coordinating its resource and operational requirements with agencies of the national government.
10. **Oversee the implementation of the Provincial Solid Waste Management Plan**.
11. **Review every two (2) years or as the need arises, the Provincial Solid Waste Management Plan** for purposes of ensuring its sustainability, viability, effectiveness and relevance in relation to local and international developments in the field of solid waste management.
12. **Allow for the clustering of LGUs** for the solution of common solid waste management problems.

Source: DENR Administrative Order 2001-34 – IRR of RA 9003 (2001), DENR-EMB, https://emb.gov.ph/wp-content/uploads/2015/12/DAO-2001-34.pdf

On the other hand, the City or Municipal Waste Management Board (CSWMB / MSWMB) must be headed by the Municipal/City Mayor. The Board also has twelve (12) responsibilities, which are very similar to those of PSWMB's, but are at the city/municipal level. The list below are the responsibilities of the CSWMB / MSWMB as lifted from Section 4 of the law's IRR:

Table 2-3 Responsibilities of CSWMB/MSWMB (DAO 2001-34 Rule VI, Section 4)

1. **Develop the City or Municipal Solid Waste Management Plan that shall ensure the long-term**

management of solid waste, as well as integrate the various solid waste management plans and strategies of the barangays in its area of jurisdiction. In the development of the Solid Waste Management Plan, it shall conduct consultations with the various sectors of the community.

2. **Adopt measures to promote and ensure the viability and effective implementation of solid waste management programs in its component barangays**.
3. **Monitor the implementation of the City or Municipal Solid Waste Management Plan** through its various political subdivisions and in cooperation with the private sector and the NGOs.
4. **Adopt specific revenue-generating measures** to promote the viability of its Solid Waste Management Plan.
5. **Convene regular meetings** for purposes of planning and coordinating the implementation of the solid waste management plans of the respective component barangays.
6. **Oversee the implementation of the City or Municipal Solid Waste Management Plan.**
7. **Review every two (2) years or as the need arises the City or Municipal Solid Waste Management Plan** for purposes of ensuring its sustainability, viability, effectiveness and relevance in relation to local and international developments in the field of solid waste management.
8. **Develop the specific mechanics and guidelines for the implementation of the City or Municipal Solid Waste Management Plan.**
9. **Recommend to appropriate local government authorities specific measures or proposals for franchise or build operate-transfer agreements** with duly recognized institutions, pursuant to RA 6967, to provide either exclusive or non-exclusive authority for the collection, transfer, storage, processing, recycling or disposal of municipal solid waste. The proposals shall take into consideration appropriate government rules and regulations on contracts, franchises and build-operate-transfer agreements.
10. **Provide the necessary logistical and operational support to its component cities and municipalities** in consonance with subsection (f) of Section 17 of the Local Government Code.
11. **Recommend measures and safeguards against pollution and for the preservation of the natural ecosystem**; and
12. **Coordinate the efforts of its component barangays in the implementation of the city or municipal Solid Waste Management Plan**.

Source: DENR Administrative Order 2001-34 – IRR of RA 9003 (2001), DENR-EMB, https://emb.gov.ph/wp-content/uploads/2015/12/DAO-2001-34.pdf

The PSWMB and CSWMB / MSWMB must be composed of representatives from both the private and public sectors. Instatement of an Environment and Natural Resources Officer is compulsory on Provincial Level but are optional on City/Municipal level. On the other hand, administrative charges on all Government Officials who failed to level officials are also explicitly stated on the law's IRR.

2.3 Positioning of 10-year Solid Waste Management Plans

As stipulated in Section 16 of RA 9003, 10-year Solid Waste Management Plans must be prepared both on Provincial and Municipal/City level. The plans must be consistent with the National Solid Waste Management Framework and are subject to the approval of the Commission Palawan Council for Sustainable Development for the Province of Palawan, and by the NSWMC for the rest of the country. The components of the plans are as detailed in Section 17 of the law.

Table 2-4 The Minimum Components of the LGUs' SWMP (According to Section 17 of RA 9003)

Component	Description
City or Municipal Profile	Contains the background information on the city or municipality and its component barangays, covering important highlights of the distinct geographic and other conditions.
Waste characterization	Contains the waste characterization to identify the constituent materials which comprise the solid waste generated and disposed within the jurisdiction of the LGU. The constituent materials shall be identified by volume, percentage in weight or its volumetric equivalent, material type, and source of generation which includes residential, commercial, industrial, governmental, or other sources.
Collection and Transfer	Describes the geographic subdivisions to define the coverage of the solid waste collection area in every barangay. Toward this end, the plan shall define and identify the specific strategies and activities to be undertaken by its component barangays to ensure 100% collection efficiency from residential, commercial, industrial and agricultural sources, where necessary within its area of coverage.
Processing	Defines the methods and the facilities required to process the solid waste, including the use of intermediate treatment facilities for composting, recycling, conversion and other waste processing systems. Other appropriate waste processing technologies may also be considered provided that such technologies conform to internationally acceptable and other standards set in other laws and regulations.
Source reduction	Shall include a program and implementation schedule showing the methods the LGU will use, in combination with the recycling and composting components, to reduce a sufficient amount of solid waste disposed of in accordance with the diversion requirements of Sec. 20.
Recycling	This component shall include a program and implementation schedule which shows the methods by which the LGU shall use, in combination with the source reduction and composting components, to reduce a sufficient amount of solid waste disposed of in accordance with the diversion requirements set in Sec. 20.
Composting	The composting component shall include a program and implementation schedule which shows the methods by which the LGU shall use, in combination with the source reduction and recycling components, to reduce a sufficient amount of solid waste disposed of within its jurisdiction to comply with the diversion requirements of Sec. 20 hereof.
Solid waste facility capacity and final disposal	This shall include, but shall not be limited to, a projection of the amount of disposal capacity needed to accommodate the solid waste generated.
Education and public information	This component shall describe how the LGU will educate and inform its citizens about the source reduction, recycling, and composting programs.
Special waste	This component shall include existing waste handling and disposal practices for special wastes or household hazardous wastes, and the identification of current and proposed programs to ensure the proper handling, re-use, and long-term disposal of special wastes
Resource requirement and funding	The component includes identification and description of project costs, revenues, and revenue sources the LGU will use to implement all components of the LGU solid waste management plan.
Privatization of	The plans shall indicate specific measures to promote the participation of the private sector in

Component	Description
solid waste management projects	the management of solid wastes, particularly in the generation and development of the essential technologies for solid waste management. Specific projects or component activities of the plan which may be offered as private sector investment activity shall be identified and promoted. Appropriate incentives for private sector involvement in solid waste management shall likewise be established and provided for in the plan, in consonance with Sec. 45 of the act and other existing laws, policies and regulations.
Incentive programs	This component shall detail programs providing for incentives, cash or otherwise, to encourage the participation of concerned sectors.

Source: The Ecological Solid Waste Management Act – RA 9003 (2000), https://emb.gov.ph/wp-content/uploads/2015/09/RA-9003.pdf

In accordance with its mandate, the NSWMC has published an annotated outline prescribing the contents of the 10-year SWMPs both on Provincial and Municipal/City level. The annotated outline contains the detailed descriptions of not only the required sections, but also highly recommended/prescribed information. Both plans have the same twelve (12) key sections. However, subsections were included or removed on either Provincial or Municipal/City SWMP. In essence, the Provincial SWMPs are a summary and integration of submitted Municipal/City SWMPs, including the planned financial, institutional, and technical support/assistance to be provided by the Provincial LGU to ensure and augment the compliance of its component Municipalities and/or Cities. These plans also ensure the holistic approach to SWM on the Provincial Level and avoid conflicts of different Municipal/City SWM Plans. In retrospect, Municipal/City SWMP are the main bases of Provincial SWMP, hence must contain more details for synthesis.

Table 2-5 The Components of the Provincial/Municipal/City SWMP Based on the Annotated Outline of NSWMC

Outline	Description (Provincial Level)	Description (Municipal/City Level)
EXECUTIVE SUMMARY	Overview of the plan including current situation, vision, and objectives.	
1. Introduction	Introduction of the SWM Plan to the reader including purpose and approach. Must include Province's vision related to Solid Waste Management, and key issues faced by the province and its cities/municipalities.	Introduction of the SWM Plan to the reader including purpose and approach. Must include Municipal/City's vision related to Solid Waste Management, and key issues faced by the community. ● Detailed WACS for HUC, 1st and 2nd Class City; ● Simpler WACS for Municipalities 3rd Class and below. ● Secure list of income and population.
2. Provincial/ Municipal/City Profile	Key information about the Province/Municipality/City including Location, History, Population, Economic Profile/Land Use, and Physical Characteristics.	
3. Current Solid Waste Management Conditions	Description of solid waste management practices in existence including the current Institutional Arrangements, Inventory of Equipment and Staff, Source Reduction Efforts, Collection, Transfer, Processing Facilities, Final Disposal, Special Wastes (Health Care Wastes, Toxic and Hazardous Wastes), Markets for Recyclables (Number per Municipality), Information, Education and Communication (IEC), Costs and Revenues, and the identified Key Issues on Provincial Level. Information on these subsections are summarized information of component Municipalities and Cities.	Description of solid waste management practices in existence including the current Institutional Arrangements, Inventory of Equipment and Staff, Source Reduction Efforts, Collection, Transfer, Processing Facilities, Final Disposal, Special Wastes (Health Care Wastes, Toxic and Hazardous Wastes), Markets for Recyclables, Information, Education and Communication (IEC), Costs and Revenues, and the identified Key Issues on Municipal Level. Detailed information of different facilities such as location, ownership must be specified on Municipal Level Plans.
4. Waste Characteristics	Summarizes the information gathered through WACS such as quantity of wastes disposed and generated per type per sector, and quantity of waste diverted through different efforts such as	Summarizes the information gathered through WACS such as quantity of wastes disposed and generated per type per sector (stratified), and quantity of waste diverted through different

Outline	Description (Provincial Level)	Description (Municipal/City Level)
	recycling.	efforts such as recycling and composting. Includes projection of quantity of waste generated based on population projections. Note: Simpler WACS for low-class municipalities.
5. Legal/Institutional Framework	Overview of existing institutional arrangements in undertaking the relevant aspects of the plan. This section includes Local Laws and Regulations, Roles and Membership of PSWMB and CSWMBs/MSWMBs, and activities to involve identified Stakeholders.	Overview of existing institutional arrangements in order to identify parties responsible for undertaking the relevant aspects of the plan. This section includes Local Laws and Regulations, Roles and Membership CSWMBs/MSWMBs, List of BSWM Committees, and activities to involve identified Stakeholders.
6. Plan Strategy	Delineation of the desired outcome of the solid waste management plan, including Visions, Targets, and Strategies particularly in achieving required diversion rates among others.	Delineation of the desired outcome of the solid waste management plan, including Visions, Targets, and Strategies particularly in achieving required diversion and disposal rates among others. Description of Collection, Plans for Disposal, and Operation of MRF and Composting Facilities must be included.
7. SWM System	Detailed description of each program that will be implemented to reach the objectives and targets defined in Section 6 including Source Reduction, Collection, Segregation, Recycling, and Composting, Transfer, Alternative Technologies for Residual Wastes, Final Disposal, Special Wastes (Health Care Wastes, Toxic and Hazardous Wastes), Information, Education and Communication (IEC), and Markets for Recyclables on Provincial Level.	Detailed description of each program that will be implemented to reach the objectives and targets defined in Section 6 including Source Reduction, Collection, Segregation, Recycling, and Composting, Transfer, Alternative Technologies for Residual Wastes, Final Disposal, Special Wastes (Health Care Wastes, Toxic and Hazardous Wastes), and Information, Education and Communication (IEC)on Municipal Levels. Subsections for Collection include the route, Private Collection Services, Storage and Set-out, Segregated Recyclables, Segregated Compostable, Mixed Solid-Waste/Residuals. Segregation, Recycling, and Composting has its own subsections with a dedicated segment for Marketing and Market Development for recovered materials. Details on the Capacity of Existing and New Disposal Facilities must be provided on dedicated subsections, as well as the design of Categorized Disposal Facilities (Sanitary Landfill). IEC programs must be introduced in detail, including the core messages for target audiences, and the approach/method.
8. Implementation Strategy	Discussion of the logistics of how the solid waste management system will be implemented including the details of the Framework, Diversion Projections, Monitoring Program, and Incentive Programs on Provincial/Municipal/City Level.	
9. Institutional Aspects	Details the planned structure of implementation including the future roles of the Provincial SWMB, and Summary of Ordinances and Legal Requirements among component Municipalities and Cities within the Province.	Details the planned structure of implementation including the future roles of the City/Municipal SWMB, Barangays, Private Entities, NGOs, Citizens, Waste, Generators and Recycling Companies. It shall also include a summary of recommended changes to

Outline	Description (Provincial Level)	Description (Municipal/City Level)
		City/Municipal Structures, Zoning and Building Code Changes among other Legal Requirements within the Municipality/City.
10. Social and Environmental Aspects	Discussion of Social and Environmental issues (positive and negative impacts) related to planned development of full-scale infrastructures.	
11. Cost Estimates /Financial Aspects	Financial plan for implementation of solid waste management system, including Investment Cost, Annual Costs and Funding Options.	Financial plan for implementation of solid waste management system, including Investment Cost, Annual Costs, Funding Options, and Cost Evaluation and Comparison.
12. Plan Implementation	Details the Implementation Phases of Development, Milestones, and Implementation Schedule.	
References	List of References	

Sources: Annotated Outline for LGUs (2018), NSWMC,
http://nswmc.emb.gov.ph/wp-content/uploads/2018/08/annotated-outline1.doc
Annotated Outline for Provinces (2018), NSWMC,
http://nswmc.emb.gov.ph/wp-content/uploads/2018/08/Provincial-Annotated-outline1.doc

In 2010, NSWMC and JICA published a Guidebook for the Formulation of Solid Waste Management Plan[7]. The guidebook was published primarily as a guidance document that provides practical advice on how the solid waste management plan can be formulated and implemented at the city/municipal level by introduction of the concept of strategic planning for MSW management. It also contains sample strategies, formulas, and other detailed methods for determining target parameters crucial for the formulation of 10-year SWMPs, such as calculation of collection coverage, and waste diversion ratio. The guidebook also provides a General Guidelines/Procedures in Conducting Waste Analysis and Characterization Survey/Study (WACS) and Sample forms for Detailed Cost and Revenue Estimates.

Further, under the activity of JICA TCP, JET is in evaluation of existing evaluation criteria of EMB for 10-year MSW management plan of LGUs by study of “Guidebook for Formulation of Solid Waste Management Plan” and “Annotated Outline (10-Year SWMP)” as reference documents and checklists for preparation of the 10-year SWM plans. These guidebook and checklist are formulated based on RA9003 which was enacted on the premise that WTE-ACC technology shall not be applied. Therefore, evaluation the criteria for 10-year SWM plan will be requested to be revised by including criteria concerning the WTE-ACC projects. JET is discussing with NSWMC to develop the evaluation criteria based on the draft criteria shown in the table below.

Table 2-6 Proposed Evaluation Criteria for 10-year SWM plan

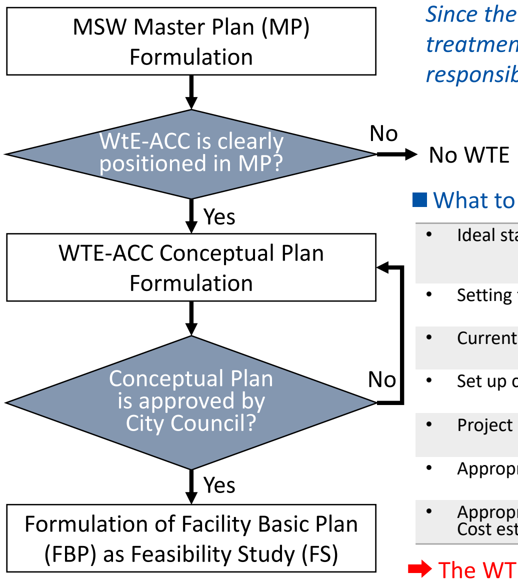
Item	Proposed Evaluation Criteria
Role of WTE facility in waste treatment flow	Amount of waste reduction by WTE project is quantified. Amount of disposed waste reduction is quantified. WTE-ACC facility is identified in future waste treatment flow, and throughput including residue is shown.
WTE Project	Total cost incurred by LGU during project period is calculated. Legal basis for promoting WTE project is clarified. Mayor has made decision on promotion of WTE project.

Source: JICA Expert Team

[7] Guidebook for Formulation of Solid Waste Management Plan (2010), NSWMC and JICA, https://nswmc.emb.gov.ph/wp-content/uploads/2017/09/FSWMP-Proof-Layout.pdf

2.4 Facility Conceptual Plan

Figure 2-3 shows the procedure and items to be decided by LGU in planning phase.



Since the Law clearly stipulates that "Local government is responsible for Waste treatment", even if LGUs contract out some parts to private, LGUs are still primarily responsible for waste. Therefore, WtE Project shall be led by local governments.

■ What to be decided by LG in Planning Phase

• Ideal state of waste management	⇒ Set Political Priority for Zero Waste (100% material recovery) or Heat Recovery (WtE-ACC) considering recyclable market, land
• Setting the service provision area	⇒ Single municipality or wide-area union (clustering)
• Current and future waste volumes	⇒ Target volume for WtE, how to handle plastics,
• Set up capacity of a WTE-ACC (t/day)	⇒ Annual Target waste volume for WtE ÷ Operating days
• Project Formulation Timeline	⇒ For EIA ( ) yrs, Bidding ( ) yrs, Construction ( ) yrs, *Should be set in practical manner.
• Appropriate Site Selection	⇒ Urban or Suburb, next to landfill, etc. *Recommend not to rely on private land.
• Appropriate Capital and Operational Cost estimation	⇒ Market cost based on precedent studies

➡ The WTE-ACC Conceptual Plan must be approved by City Mayor/Council.

Source: JICA Expert Team

Figure 2-3 Procedure and Items to be decided by LGU in planning phase

As discussed in the previous sub-chapter, when LGU plans to develop WTE-ACC, necessity of such project shall be clearly stipulated/positioned in the 10 year SWM Plan of LGU in terms of LGU's direction how to achieve RA9003 target, waste mass balance flow, from generation to final disposal, in which how to reduce waste by 3Rs, intermediate treatment, and dispose the remaining waste into the Sanitary Landfill, and timeframe.

Then, LGU has to prepare a **Facility Conceptual Plan** which summarizes the project idea such as its objective, applicable technology(ies), capacity of facility (as t/day), candidate sites and timeframe (target COD year) in line with 10 year SWM Plan so that the LGU can proceed to further deliberation in the formulation phase. LGUs can outsource to develop this Facility Conceptual Plan to Waste Treatment Consultants or do it themselves. The deliberation level can be lighter touch than the description in "Chapter 3 Formulation Phase" of this document, however, the commitment of LGU's council for the concept is crucial.

Since LGUs are obliged to treat and dispose the generated/collected MSW by RA9003, even if such WTE-ACC or WTF projects will be outsourced to private entities, LGUs are still primarily responsible for the appropriate treatment/disposal of MSW, therefore, selection of WTE-ACC/WTF must originate and be carefully managed by LGUs. In the world, there are a lot of failure cases which the project is suspended in the contract phase, construction phase and in early operation phase. Many private proponents have exited and left the project/asset based on the contract, however, LGU shall be there to reactivate the project/asset by themselves or find a successor. Because of the complexity and patents in WTE-ACC facility, it is usually difficult to find a successor and in some cases the project starts from the concept building phase.

Because of such circumstances, reputable private investors, national/international financing institutes, and international donors always expect the LGU's strong interest and continuous policy commitment for the project, it is important that Facility Conceptual Plan to be authorized and approved by the LGU's council.

2.5 The selection of candidate construction sites

1) Background

Although WTFs are indispensable for a comfortable lifestyle, there are still concerns that they cause pollution as the NIMBYism; some residents even think of them as troublesome, and there have been many cases where it was difficult to determine a candidate construction site.

However, in recent years, awareness of environmental and resource conservation has increased globally, and with separation and collection of waste for recycling being thoroughly done by residents, and with development of new waste treatment technology that allows for better recycling efficiency being promoted, residents' awareness is changing, too. Furthermore, the establishment of technology to effectively remove acid gases and dioxins has made WTE-ACCs safer and more reliable. In addition, recently, due to the expansion of heat utilization method, facilities used for welfare purpose, and facilities used for environmental education purpose, and evacuation purpose are also on the rise. It is therefore necessary to consider holistically before selecting a candidate construction site instead of prioritizing places with few residents.

Based on the above, for the procedure to select a candidate construction site, it is important to select a site based on clear and well-grounded reasoning, satisfying all conditions mandated in regulations for land use and welfare, as well as safety, economy, and ease of land acquisition. In addition, the selection procedure itself should be considered as a means to achieve consensus among local residents regarding the candidate construction site; and apart from the selection procedure carried out by local officials in charge, attempts to, for example, form a council to ensure fairness and transparency, and active disclosure of public information should also be observed.

2) Laws for regulation of the potential construction site

(1) Laws and Regulations on Environmental Preservation and Pollution Control

Depending on their scale and activities, WTFs will be subject to the application of environmental protection laws and others, and these laws will constitute the construction conditions of the intended facilities.

In Philippines, several environmental protection laws define the statutory limits, requirements, and responsibilities of different developments and its proponents as tabled in Table 2-7 While some laws do not have specific provisions for waste to energy facilities, umbrella/blanket statements or provisions for industries of the same nature are present. These laws will dictate some of the most crucial technical requirements of the facility

Table 2-7 Laws and Regulations on Environmental Preservation and Pollution Control in the Philippines

Name of Law	Scope of application	Legislative Requirements
Code on Sanitation of the Philippines (PD 856)[1975]	All Industrial Estates	Mandates sanitary requirements and necessary environmental provisions for all Industrial Estates.
Pollution Control Decree (PD 984) [1976]	All Pollution Sources	National policy to prevent, abate and control pollution of water, air and land.
Philippine Environment Code (PD 1152) [1977]	All Public and Private Proponents	Mandates the specific environment management policies and environment quality standards to be created and complied with. Specifically, Air Quality Management, Water Quality Management, Natural Resources Management Conservation, and Waste Management.
Environmental Impact Statement System and its Implementing Rules and Regulations (PD 1586, DAO 2003-30, EMB MC 2014-005) [1978, 2003, 2014]	All Projects or Undertakings that is Projected to have Adverse Environmental Impact	The EIS system categorizes different projects based on its possible environmental impacts. The guideline defines the statutory requirements for different categories.
National Pollution Control Commission (NPCC) MC 1980-002 [1980]	Noise Emitting Industries, Equipment, and Activities.	This law sets the statutory requirements on Noise Levels on general areas. This also limits Exhaust Noise from steam engines, turbines and equipment.
Toxic Substances and Hazardous and Nuclear Wastes Act and its Implementing Rules and	Hazardous Waste Generating Facilities	All potentially hazardous waste generating facilities are covered by this law and its IRR. All generators must be registered online, hire a full-time Pollution Control Officer, and submit regular Self-Monitoring Reports. This law also

Name of Law	Scope of application	Legislative Requirements
Regulations (RA 6969, DAO 2013-22) [1990, 2013]		details the other responsibilities of generators in handling and management of hazardous wastes.
Appointment/Designation of Pollution Control Officers (DAO 1992-26) [1992]	Industries requiring services from PCO (Annex A)	This law specifies the need to hire services from an accredited Pollution Control Officer (PCO) for certain industries including similar Industries of similar nature to WTE Facilities such as the Electricity Generation and Distribution Industry.
	Firms requiring full-time PCOs (Annex B)	This law specifies the need to hire accredited Pollution Control Officer (PCO) on a full-time basis for firms with certain operational capacities: ● Other Fuel-Burning Installations ○ Grate Surface Area 3.5m2 ○ Solid Fuels 473 kg/hr ● Incinerators ○ Grate Surface Area 3.5m2 ○ Capacity 475 kg/hr
Clean Air Act and its Implementing Rules and Regulations (RA 8749, DAO 2000-81) [1999, 2000]	Facilities with Stationary Air Pollution Sources	Section 19 of the Act details the statutory requirements of Stationary Air Pollution sources. Rule XIX of the IRR requires all air pollution sources to have a valid Permit to Operate.
Ecological Waste Management Act and its Implementing Rules and Regulations (RA 9003, DAO 2001-34) [2000, 2001]	All Waste Management Stakeholders	This Act requires the formation of Solid Waste Management Boards on Provincial and Municipal/City levels. These boards shall be responsible for the formulation of Solid Waste Management Plans.
Self-Monitoring Report (SMR) System (DAO 2003-27) [2003]	Industries Covered in Annex A and Annex B or DAO 1992-26	This guideline details the format, required contents, and ideal frequencies of reporting for environmental compliance monitoring of facilities. Self-Monitoring Reports (SMR) have dedicated modules for RA 6969, RA 8749, RA 9275, and PD 1586.
Clean Water Act and its Implementing Rules and Regulations (RA 9275, DAO 2005-10, DAO 2016-08, DAO 2021-19) [2004, 2005, 2016, 2021]	Facilities that Discharge Industrial Effluent	The latest effluent quality guidelines must be adhered to at all times. Discharge from industrial sources must comply with the statutory limits set based on its Philippine Standard Industrial Classification (PSIC) codes and classification of the receiving body of water. Section XIV of the IRR requires all sources of effluent to secure a Discharge Permit.
Guidelines Governing the Establishment and Operation of Waste-to-Energy Technologies (NSWMC Res 669, EMB MC 2019-008) [2016, 2019]	Waste-to-Energy Facilities	These guidelines set the registration, and permitting requirements, standards and procedures on the establishment and operation of Commercial Scale Waste-to-Energy Facilities. Commercial scale facilities are defined as facilities with rated capacity of at least one (1) Megawatt (MW). Waste-to-Energy facilities utilizing thermal processes must adhere to the standards set defined in Section 19 of RA 8749 as Fuel Burning Equipment. Effluent from Waste-to-Energy facilities must conform to Rules 6.3, 8.3, 12.1 and 19.6 of the IRR of RA 9275 (DAO 2005-10). Host LGUs of WTE Facilities must be implementing an approved SWM Plan as stated in Sections 11 and 12 of RA 9003. The law also explicitly requires the submission of self-

Name of Law	Scope of application	Legislative Requirements
		monitoring reports in accordance with DAO 2003-27.
Guidelines Governing Waste to Energy Facilities (DAO 2019-21, EMB MC 2020-23) [2019, 2020]	Waste-to-Energy Facilities	These guidelines cover the requirements, and procedures on the establishment and operation of all Waste-to-Energy facilities utilizing municipal solid wastes. All Waste-to-Energy facilities, regardless of power generation capacity, are covered by the Environmental Impact System. ● Category A: ECP (EIS) -≥ 30MW power output or ≥ 1,140 TPD feedstock. ● Category B: Non ECP (EIS)- 10-30MW power output or 380-1,140 TPD feedstock. ● Category B: Non ECP (IEE Checklist)- 1-10MW power output or 38-380 TPD feedstock. The law also defines the dioxin limits.
Electric Power Industry Reform Act (RA 9136) [2001]	All Energy Generators	Section 65 of the law mandates all Energy Sub-Sectors to adhere to all relevant Environmental laws.
Renewable Energy Act (RA 9513) [2008]	All Renewable Energy Generation Facilities	Section 14 of the law states that all Renewable Energy explorations, development, utilization, and Renewable Energy systems operations shall be conducted in accordance with existing environmental regulations.
Prescribing Policies and Program to Promote and Enhance the Development of Biomass Waste to Energy Facility (DOE DC. 2022-02-002)	Biomass WTE Facilities	This draft law details the regulatory eligibility requirements for Biomass WTEs for the RA 9513, also known as Renewable Energy Act.

Source: JICA Expert Team

Table 2-8 shows the Japanese reference for the Environmental Protection Laws. Since the *underlined/Italic* laws are not in place in the Philippines, these requirements can be the criteria for the selection of the siting in addition to the requirements in Table 2-7

Table 2-8 Environmental protection laws and regulations in Japan

Name of Law	Scope of application
Waste Management (Treatment) Law	Facilities with capacity of 5 tons or more a day (or in the case of incinerating facilities: 200 kg or more an hour, or having grates area of $2m^2$ or above) will be subject to this law.
Air Pollution Control Law	Facilities with a grate area of $2m^2$ or above, or incinerators with a burning capacity of 200kg or more per hour will be treated as smoke- and soot-emitting facilities under this law.
Water Pollution Control Law	Incinerators with processing capacity of 200kg or above per hour, or having a grate area of $2m^2$ or above, that discharge effluent into public water areas such as river, lakes, or marshes, will be treated as designated facilities under this law.
Noise Regulation Law	Facilities with air compressors and blowers (motor's rated capacity of 7.5kW or above) is treated as designated facilities under this law, and will be subject to regulation in areas specified by provincial governors.
Vibration Control Act	*Facilities with air compressors (motor's rated capacity of 7.5kW or above) are treated as designated facilities under this law, and will be subject to regulation in areas specified by provincial governors.*
Offensive Odor Control Law	*This law does not provide any designation, but facilities will be subject to regulation in areas specified by provincial governors.*
Sewage Law	Incinerators with processing capacity of 200kg or above per hour, or having a grate area of

Name of Law	Scope of application
	$2m^2$ or above, that discharge wastewater into public sewers, will be treated as designated facilities under this law.
Law on Special Measures to counter against Dioxins	*Incinerator installed at construction sites, business establishments, or other facilities, with processing capacity of 50kg or above per hour, or having a grate area of 0.5m2 or above, that discharge dioxins into the atmosphere, or discharge waste water or contaminated water is treated as designated facilities under this law.*
Soil Pollution Control Law	*When there is fear of health hazard, or when designated facilities that deal with hazardous substances are demolished, or when there is a change of facilities' characters (for facilities with area above 3000m2), this law is applied. Waste incineration facility that deals with hazardous substances does not fall under this law. However, there are cases when provincial ordinance is applied if the wastewater treatment facility is thought to be handling harmful substances.*

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

(2) Laws on facility establishment, land use regulation, and construction

In selecting candidate construction site, it is necessary to narrow down the candidate sites holistically by national and local land use restrictions, etc. shown in Table 2-9 Apart from all the national laws, LG levels have also been actively reviewed and enacted, so it is necessary to update their statuses regularly.

Table 2-9 Laws on facility establishment, land use regulation, and construction

Name	Ranges to be applied
Local Government Code (RA 7160) [1991] and **Local Zoning Ordinances**	The location of a Waste to Energy Facility must be within the appropriate zones of the approved **Comprehensive Land Use Plan** of a political jurisdiction. Local Government Units (LGUs) by the virtue of RA 7160 were given the authority to appropriate zoning and land use. No Build Zone Ordinances shall also be considered as an exclusion criterion for siting.
Water Code of the Philippines (PD 1067, DAO 2021-07) [1976, 2021]	All lands adjoining bodies of waters such as creeks, lakes, rivers and ocean are subject to legal easement requirements set by the law and related issuances. The same law also requires application of water permit, both surface and ground for various nature of usage including industrial use.
Urban Development and Housing Act (RA 7279) [1992]	The law covers land appropriation on Urban Areas. This law describes different modes of land acquisition urban lands for socialized housing for the urban poor.
National Integrated Protected Areas System Act (RA 7586, RA 11038) [1992, 2018]	This is the national policy for the protection of environmentally important areas defined as Protected Areas. The law mandates the control of developments within and around identified/legislated Protected Areas, including national parks, forest reserves, protected landscape and seascapes among other categories defined in the law. Special Use Agreement must be secured should a development encroach on Protected Areas.
Indigenous Peoples Rights Act (RA 8371, NCIP AO 98-01, NCIP AO 12-03) [1997, 1998, 2012]	This act, its IRR and all related issuances shall be complied to for developments/construction projects that may affect Indigenous People and their Ancestral Domains in the Philippines. All developmental activities must have prior informed consent.
National Heritage Act (RA 10066) [2009]	This is the national policy for the preservation of cultural heritage, its property and histories, and the ethnicity of local communities. The act prohibits and limits projects and developments in and around identified important cultural properties, and archaeological and anthropological sites.
National Building Code (PD 1096) [1977]	This code covers all public and private structures for its design, location, siting, construction, alteration, repair, conversion, use, occupancy, maintenance, moving, demolition of, and addition. The law mandates issuance of Building Permits issued by Building Officials prior construction. Clearance from relevant agencies serve as an attachment to the application of the permit.
Comprehensive Agrarian Reform Law (RA 6657, AO 2017-07) [1988, 2017]	Land Use Conversion must be secured from the Department of Agrarian Reform (DAR) for agricultural land of more than 5 hectares. A permit from the local

Name	Ranges to be applied
Civil Aviation Authority Act (RA 9497) [2008]	Permanent and temporary structures to be constructed in the vicinity of airports should secure Height Clearance Certificates from the Civil Aviation Authority of the Philippines.
Forestry Reform Code of the Philippine (PD 705, DAO 2004-59) [1975, 2004]	Special Permits must be obtained for potential WTF sites that are located on areas identified as forest or timber land or one that is not yet classified Alienable and Disposable Land.
Laguna Lake Development Authority Act (RA 4850, LLDA BR 2011-408) [1966, 2011]	Developmental activities within the Laguna de Bay Region must seek clearance from the Laguna Lake Development Authority (LLDA).
Strategic Environmental Plan (SEP) for Palawan Act (RA 7611) [1992]	Projects within the Province of Palawan must seek Strategic Environmental Plan Clearance from the Palawan Council for Sustainable Development (PCSD).
The Special Economic Zone Act (RA 7916) [1995]	Sites within ECOZONE or any other areas under the management and administration of Philippine Economic Zone Authority (PEZA) must obtain clearance from
Wildlife Resources Conservation and Protection Act (RA 9147) [2001]	Prohibits and limits developments and activities within the identified critical habitats of wildlife resources in the Philippines.
Fire Code of the Philippines (RA 9514) [2008]	This law mandates the requisite of the issuance of Fire Safety Inspection Certificate (FSIC) as part of several local permit requirements. The same law also stipulates the need for Fire Safety Clearance for the storage, handling, installation and transportation of hazardous materials, operations and processes described in the law. The law also has specific fire safety provisions for hazardous areas, such as rooms containing high pressure boilers.
Revised Charter of the Philippine Ports Authority (PPA) (PD 857) [1975]	The Philippines Port Authority is vested with the authority to plan, develop, and manage Port Districts. Any developmental project
Charter of the Public Estates Authority (PD 1084, EO 14 -2009, AO 2019-04) [1977, 2009, 2019]	Defines the requirements for securing clearance for reclamation projects from Philippine Reclamation Authority (PRA) formerly known as Public Estates Authority (PEA). Applicable for WTE projects that include reclamation components, regardless of size/magnitude.
Guidelines Governing Occupational Safety and Health in the Construction Industry (DOLE DO 98-13) [1998]	Guidelines in the interest of ensuring the protection and welfare of workers in the construction industry. Must be compiled for all construction projects in the Philippines.
Occupational Health and Safety Act (RA 11058) [2008]	This act details the responsibilities of employers and rights of employees in relation to Occupational Health and Safety in establishments, projects, sites, including Philippine Economic Zone Authority (PEZA) establishments, and all other places where work is being undertaken.
Right of Way Act (RA 10752) [2016]	This law applies for government infrastructure projects. The provisions of the act ensure proper compensation for involuntary resettlement, structure demolition, and land acquisition.
Philippine Disaster Risk Reduction and Management Act (RA 10121 and IRR) [2010]	This Act provides for the development of policies and plans and the implementation of actions and measures pertaining to all aspects of disaster risk reduction and management. While hazard and risk mapping are among the main tools of the National Council and its Local Offices, there are no direct provisions regarding the establishment of no-build zones; Disaster Risk Reduction (DRR) Measures should nonetheless be integrated to Comprehensive Development Plans (CDP) and Comprehensive Land Use Plan (CLUP).

Source: JICA Expert Team

While there are plenty of laws in place that could legally restrain and regulate construction in view of safety and environmental protection, there are still areas for improvements that need to be addressed, particularly in the aspect of implementation. Following the onslaught of TS Haiyan in 2013, DENR called for the institution of 40-m Coastal Buffer Zones through the Local Zoning Ordinances. There are also several recommendatory no-build zones by other agencies such as PHILVOLC's 10-m clearance along traces of active faults. This illustrates the heavy reliance on LGU's Zoning Ordinances of each locality in formalizing/legislating no-build zones for areas identified as critical or hazardous.

Table 2-10 shows the laws on facility establishment, land use and construction in Japan for the reference. Same as the Environmental Protection Laws, the *underlined/Italic* laws can be the criteria for the selection of the siting in addition to the requirements in Table 2-9 because these are not in place in the Philippines yet.

Table 2-10 Laws on facility establishment, land use regulation, and construction in Japan

Name	Ranges to be applied
City Planning Law	When a WTF is to be established within the city planning area under the jurisdiction of this law, a planning decision is needed.
River Law	When there are new construction, reconstruction or removal of a facility in the river area, permission from the river administrator is needed.
Law on Disaster Prevention for Steep-Slope Failure	*Except for collapse-prevention facilities, construction or remodeling of facilities in hazard areas of steep-slope shall be limited.*
Law on Regulation of Residential Land Development	*Applicable to cases where a WTF is to be constructed within the regulated area for residential land development.*
Coastal Law	Applicable to cases where a facility not for coastal preservation purpose, is to be developed.
Road Law	*Applicable to cases where the road is continuously used, such as for electric poles, electric wire, gas pipe, water pipe, etc.*
Law on Conservation of Urban Green Space	*Applicable to cases where there is to be new construction, remodeling, or expansion of a facility within the conservation area for green space.*
Law on Conservation of Green Space in the Greater Tokyo Area	*Applicable to cases where there is to be new construction, remodeling, or expansion of a facility within the conservation area (except for the conservation area for green space mentioned above).*
Natural Parks Law	Applicable to cases where there is to be new construction, remodeling, or expansion of a facility within the special area of a national park or a semi-national park; or cases where there is to be new construction, remodeling, or expansion of a facility within the common area of the national park or a semi-national park, but exceeds a certain standard.
Law on Hunting and Wildlife Protection	Applicable to cases where a construction is to be set up in a special protection area.
Agricultural Land Law	Applicable to cases where farmland is to be converted for construction of a factory.
Ports and Harbors Law	Applicable to cases where there is to be construction, or remodeling of a structure that exceeds the designated mass within, or near the vicinity of, a port area. Applicable to cases where there is to be establishment, or restructuring, of WTF within the waterfront area.
Urban Redevelopment Law	Applicable to cases where there is to be new construction, reconstruction of facility and other structures within the enforcement area for urban redevelopment projects of the city.
Land Readjustment Law	*Applicable to cases where there is to be new construction, reconstruction of facility and other structures within the enforcement area for land readjustment project of the city.*
Cultural Asset Protection Law	Applicable to cases where 'important buried cultural property ground' is excavated for civil engineering work.
Industrial Water Law	Applicable to cases where underground water is extracted through wells (that have a cross-sectional area of its mouth exceeding $6cm^2$) in the designated areas for industrial use.
Law on Regulation of Groundwater extraction for Buildings	Applicable to cases where there is to be placement of pumping equipment (that has a cross-sectional area of its mouth exceeding $6cm^2$) to collect groundwater for use of heating and cooling equipment, flush toilets, and car wash equipment within the designated areas.

Name	Ranges to be applied
Building Standard Law	Article 51 under this law stipulated that a construction cannot start without a city planning decision. However, the provision of the same article also stipulated that that will not be the case if the location of the construction site does not interfere with the general city planning, and is approved for construction or extension. When a building is to be constructed, approval from the city's chief architect must be obtained. In addition, there is also regulation for building according to different land uses.
Fire Protection Law	Regarding fire protection in buildings, if the chief architect cannot get an approval from the fire chief, or head of the fire station, construction approval for the building cannot be obtained. Heavy oil tanks and similar dangerous storage areas are subject to regulation under this law.
Aviation Law	Air obstruction light is required for (1) buildings with height that exceeds the designated approach surface, transitional surface, or flat surface, or (2) buildings exceeding 60m in height above sea level or above around, or buildings specified by ministerial order. Daytime obstruction sign is required for chimneys or steel towers with height over 60m from the ground or above sea level, deemed potentially blocking the views from aircraft
Radio Wave Law	*Applicable to cases where new construction or expanded construction with height over 31m from the ground is to be carried out within the radio wave propagation obstruction prevention area.*
Wired Telecommunications Law	*Applicable to cases where wired telecommunications facilities are installed.*
Cable Television Broadcast Law	*Applicable to cases where there is construction of a cable TV broadcasting facility, and the facility is set to perform cable TV broadcasting services.*
High Pressure Gas Safety Law	*Applicable when the facility produces or stores high pressure gas.*
Electricity Utility Law	*Applicable to cases where (1) the facility receives power at extra-high voltage (7,000V or above); (2) capacity for received power at high voltage power reception is 50KW or more; (3) there is installation of private power generation equipment or there is installation of emergency backup power generator.*
Industrial Safety and Health Law	Some descriptions in the documents for operation of WTF in terms of operation organization and management for safety and health system.
Natural Environment Conservation Law	Applicable to cases where there are to be new construction or renovation of buildings and other structures in wildlife conservation area,
Forest Law	Applicable to cases where a WTF is to be built in forest reserves.
Land Disaster Prevention Law	*Applicable to cases where a WTF is to be built in a disaster caution zone.*
Erosion Control Act	*A prefectural permission is required when restricted activities are performed within the designated erosion control areas.*
Landslide Prevention Act	*Applicable to cases where a WTF is to be built in a designated landslide prevention area.*
Law for the Agricultural Development Area	Applicable to cases where there are to be new construction, or renovation of buildings or other structures in the land for agricultural use.
Landscape Act	*In case new constructions take place in a landscape planning area, there might be a need to file reports and place limitations of the design and form of the structure.*
Compulsory Purchase of Land Law	*Governing law for the tax exemption/reduction system for the land owners in case of compulsory purchase of land.*

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

3) Candidate site selection procedure

The candidate site selection procedure is illustrated below. The selection procedure should be conducted in consideration of transparency and fairness.

(1) Extraction of a candidate sites

A. Narrowing down the available options

By methods such as setting exclusive conditions, options for a candidate site are gradually narrowed down. Field investigations are then carried out with the narrowed down options. Conditions and criteria to be considered for narrowing down are detailed in "2.5 4) Conditions and criteria related to candidate site selection".

B. Recommendations from LGs

Candidate site can also be proposed based on recommendations of LGs.

C. Public announcement/invitation

Certain conditions, such as the required area, are set, and a public announcement to recruit a candidate site can be considered. It is desirable that terms and conditions are made clear, and that the period for this public offering should be sufficient.

D. Combination of A., B., and C.

Usually, combination of methods above A., B., and C. takes place.

(2) Selecting a candidate site

A. Selection by person in charge of LG

This is a procedure where selection is decided by authority such as LGs.

B. Selection by an investigation panel consisting of stakeholders of LG

This is a procedure where an investigation panel (comprised of LG authority) is formed, and then exclusion conditions and selection criteria are set up. Selection is then decided by this panel based on the set up conditions and criteria.

C. Selection by an investigation panel consisting of experts and solicited representatives from local residents

This is a procedure where an investigation panel (comprised of experts and local residents) is formed, and then exclusion conditions and selection criteria are set up. Selection is then decided by this panel based on the set up conditions and criteria.

D. Combination of A., B., and C.

This procedure combines all three procedures above mention above.

4) Conditions and criteria related to candidate site selection

Table 2-11 shows examples of conditions and items for evaluation related to candidate site selection in Japan. The table is, for the sake of convenience, clustered into several categories. However, at the point of selection, it is desirable that these categories are ignored, and set the conditions based on the locality. Also, it is not necessary to employ all the conditions and criteria listed in the table. It is ideal that these conditions and criteria are set based on the situations of the area where the facility will be based.

Table 2-11 Examples of conditions and criteria for site selection (Modified by JET from Japanese example)

No	Categories	Conditions and criteria for site selection
1	Land use	1) Land Use Regulations 2) Urban Planning 3) Conservation/Protected Area, etc. 4) Current State of Land Use 5) Future Development Plans (incl. land use)
2	Natural environment	1) Natural Environment Conservation 2) Water Sources, Discharge Point 3) Inventory of Flora and Fauna 4) Carbon Dioxide Emissions 5) Mineral Deposits 5)Presence or absence of necessary impact mitigation measures on environment
3	Topography, geology, land history	1) Terrain/Topography 2) Geology 3) Land history
4	Disaster	1) Areas warned for land-related disasters, landslides, or erosion.

	prevention	2) Active Faults and Assumed Seismic Intensity 3) Assumed inundation and Inundation Damage Record 4) Possibility of Liquefaction 5) Presence or Absence of Other Dangerous Points
5	Living environment	1) Distance from Social Infrastructures (schools, daycare centers, nursing homes, medical and health facilities) 2) Distance from Private Houses and Communities 3) Sunlight Inhibition 4) Population Density
6	Surrounding conditions	1) Measures against noise, vibration, and odor 2) Utility Infrastructure Status (road network, water supply, drainage, electricity, communication, etc.)
7	Collection and transportation	1) Waste Collection and Transportation Costs 2) Waste Transportation Distance and Unit Price by LGUs (When clustering, processing of wastes from multiple LGs is performed) 3) Vehicle Traffic
8	Related Facilities	1) Motor pool for Waste Collection Vehicles 2) Related MSW Management Facilities (MRFs (bulky waste, inert waste, plastic packaging waste, etc.) Landfills, Sewage Treatment Facilities, etc.) 3) Residual Heat Utilization Facility
9	Consensus	1) Number of Landowners 2) Number of Relocations Required 3) Understanding Level of Local Communities 4) Understanding Level of Landowners 5) Distance from other LGs
10	Economics (Financial Viability)	1) Capital Costs (for construction of the facility, and auxiliary infrastructures such as Transfer Stations etc.) 2) Non-Construction cost (land acquisition costs, utility development costs, land preparation costs, land improvement costs (if necessary), and other costs) 3) Operation and Maintenance Costs
12	Others	1) Impact on Landscape 2) Impact on Tourist Areas 3) Connection to Historical Sites and Cultural Assets 4) Impact to Indigenous Community and Domain

Source: JICA Expert Team

As of now, there is no siting requirement about WTFs as well as WTEs in the Philippines. However, there are similar conditions for the siting of SLF in Section 40 of RA 9003. Likewise, Rule XIV Section 1 of its IRR, DAO 2001-34, also defined Minimum Considerations for Siting and Designing Sanitary Landfills. DENR also released an Administrative Order (DAO 1998-50) entitled "Adopting the Land Fill Site Identification and Screening Criteria for Municipal Solid Waste Disposal Facilities" which details **Absolute and Conditional Criteria, Considerations, and Methodology of Screening potential sites for SLFs for LGUs**. Apart from SLFs, Treatment, Storage, and Disposal (TSD) Facilities are also akin to WTE facilities. **Minimum Considerations for Siting TSDs were defined in Section 5.2.2 of DAO 2013-22**.

A more detailed procedure for site screening for Sanitary Landfills was published by the **NSWMC through a resolution in 2013 entitled the "Adaptation of Modified Guidelines on Site Identification and Suitability Assessment Procedure for Sanitary Landfill (NSWMC Resolution 64 S. 2013)"**. The resolution is essentially consistent with prior releases including Section 40 and 48 of RA 9003 and the DAO 1998-50 incorporated with additional considerations from sectoral consultations. The guideline has identified thirteen (13) factors to be considered including:

1 Proximity to Groundwater Resources,
2 Proximity to Perennial Surface Waters,
3 Local Geological Conditions (Underlying Rock Formation),
4 Seismic Conditions (Proximity of Faults),
5 Soil Properties and Availability of Cover Material,
6 Topography (Terrain and Slope),
7 Vulnerability to Flooding,
8 Proximity to Residential Areas and Other Sensitive Land Users,

9 Proximity to Ecologically Sensitive or Environmentally Critical Area,
10 Consistency with Current or Proposed Land Use Classification,
11 Proximity to Airport,
12 Landfill Area and Lifespan,
13 Haul Distance, Accessibility and Road Conditions.

The specific Absolute and Conditional Criteria are in Table 2-12 , which is directly lifted from the Resolution.

In comparison with the factors identified by the Japanese Guidebook for siting WTE Facilities, parameters such as Proximity to Airport, Availability of Cover Material, and Landfill Area and Lifespan were not considered. The factor Proximity to Airport is only critical for SLFs due to birds and possible bird strike incidents to aircrafts. Provided that the stockpiling area for the MSW that serves as the feed to the WTE facility is enclosed, issues regarding this may be minimized. Landfill Area and Lifespan should be considered should onsite disposal for residue management be integrated in a WTE Facility. For off-site disposal, this factor is not applicable. Nonetheless, proper disposal of treatment by-products should be secured. Lastly, consideration regarding the availability of cover material may be disregarded since cover materials are not essential to WTE Facility operation for both facilities with onsite and off-site residue disposal. While there are numerous additional factors considered in the Japanese Guidebook, the consideration for Indigenous People and their Ancestral Domain is not included, hence must be integrated in the local version.

Table 2-12 Landfill Site Identification Criteria and Screening Guidelines from NSWMC Resolution 64 Series of 2013

Site Selection Parameters		Exclusion (Absolute) Criteria	Conditional (Remediable) Criteria	
			Criteria	**Considerations**
1	Proximity to Groundwater Resources	The site shall not be located on shallow unconfined aquifers. Areas in or within 500 m upgradient of groundwater reservoir or neater supply intakes (water supply cells, jetmatic pumps or open dug wells) used for private or public drinking, irrigation or livestock shall also be excluded.	Avoid sites within 1 km of confined aquifers (deep wells) used as drinking water sources. Also avoid major recharge areas for future potable water sources. Minimum distance of 2 meters shall be maintained between the base of the landfill liner and the highest water table (during the rainy season) at the site.	If groundwater has a yield of more than five (5) liters per second, the aquifer is of major environmental and economic importance. Verify with National Water Regulatory Board (NWRB) groundwater recharge areas for existing, pending or future water sources or aquifers used for drinking water supply. Proper engineering measures are required to avoid risk of groundwater contamination. Locations of active public drinking water supply wells «within one (1) kilometer (km) from the facility shall be shown on the facility map.
2	Proximity to Perennial Surface Waters	The site shall not be located within 300 meters of watershed areas or upgradient (point of intake) of any surface waters used for public or private drinking water supply, irrigation or livestock.	Avoid areas within 1 km upgradient of a perennial stream, river or lake. Observe the classification and actual use of water bodies near the site.	The conditional clause for non-potable water sources may be adjusted if it is feasible to protect surface waters and catchment basins from contamination through engineering measures Locations of public water supply intakes within 1 km from the facility shall be shown on the facility map.

Site Selection Parameters		Exclusion (Absolute) Criteria	Conditional (Remediable) Criteria	
			Criteria	Considerations
3	Local Geological Conditions (Underlying Rock Formation)	The site shall not be located on areas with underlying rocks characterized as jointed, fractured or fissured: carbonate (limestone or dolomite); karst, and other porous rock formations; or in areas with sinkholes or caverns.	Avoid areas within 300 meters of jointed, fissured, fractured or porous rock formations. Avoid areas classified as geological hazards.	Stringent engineering design will be required for facilities to be located near jointed, fissured, fractured or porous rock formations to avoid groundwater contamination and reduce vulnerability to geologic hazards. Verify with DENR-MGB and DOST- PHIVOLCS the site's geo-hazard risks.
4	Seismic Conditions (Proximity to Faults)	No facility shall be constricted at a site within 75 meters from a Holocene fault (faults from 60 million years old to present) or a known recent active fault.	Avoid areas within 500 meters of active faults or in areas with an average return period between 50 to I 00 years for an earthquake of magnitude 6 and above.	Disability shall be able to sustain the effects of a ground acceleration generated by an earthquake of 50 to 100 years or more recurrence interval with magnitude of 6 and above consult with references or Seismic simulation tools from DENR-MGB, DOST-PHIVOLCS and other authorities
5	Soil Properties and Availability of Cover Material	The site shall not be located in unstable, very soft and settling soil (sand, coarse sand or fine sand) with high potential for liquid function, slumping or erosion.	Avoid areas with highly permeable soils (loamy fine sand, loamy sand, Sandy loam, find sandy loam or very fine sandy loam). Avoid areas with soil permeability values faster than 10-6 cm/s. The site needs to have an adequate quantity of earth cover material that is easily handed and compacted.	NSWMC Resolution No. 06 DENR Administrative Order 2006-10 both refers to minimum soil permeability requirements for categories 1, 2 and 3 sanitary landfills (SLF). For ease in compliance, clayey soil has to be available at selected sites. Otherwise, an outside guaranteed clay source shall be identified. The ideal daily soil cover is sandy loam, which has good water and air permeability characteristics that allow easy leveling and compaction of waste. if inert material is not available, an oxide guaranteed source of cover materials should be identified.
6	Topography (Terrain and Slope)	The site shall not be located on a landslide-prone area with ground slope nominally greater than 50% or 2:1 horizontal to vertical ratio as determined by authorities. No site shall be situated in old queries or abandoned mine pits.	Avoid mountainous or hilly areas with ground slope nominally greater than 20% or 5:1 horizontal to vertical ratio. Ideally, the site has a great slope topography.	Landfilling in hilly areas is feasible but steep slopes increase the costs associated with engineering and access arrangement to minimize disaster risk. Complex topography also demands highly detailed hydrogeological investigation. Natural or man-made

Site Selection Parameters		Exclusion (Absolute) Criteria	Conditional (Remediable) Criteria	
			Criteria	Considerations
				depressions or bowls do not allow for free flow and collection of leachates. Its aquifer is usually very exposed and highly vulnerable to any type of contamination.
7	Vulnerability to Flooding	The site shall not be located in areas prone to seasonal flooding such as swamplands, marshes, and wetlands. This also includes areas that are deemed very highly susceptible to meteorologically influenced and related natural hazards (flood prone areas) declared by DENR-MGB or other appropriate authorities.	Avoid locating sites and areas that may be subject to wash out or inundation during a major flood i.e. 100-year floodplain. Avoid areas with high rainfall and strong winds, such as those vulnerable to extreme weather events (i.e. more than 300 mm/day) with increasing frequency is determined by DOST-PAGASA.	The nearing master shall be required to protect the facility against 100-year flood including: a. The area of the residual catchment basin shall not be less than three times the area of the landfill site. b. Area shall have a free draining capability (drainage pattern) both during construction and operation of the facility. c. Local drainage systems will be in place and functional to facilitate conveyance of discharged water from landfills. Consult with the DOST-PAGASA and other authorities regarding metallurgical data and projections needed for landfill design, construction, operation and disaster risk reduction.
8	Proximity to Residential Areas and Other Sensitive Land Users	The site shall not be located in or within 250 m of existing or proposed residential, commercial or urban development areas and areas of historical, archaeological, cultural, geological or scientific interest. which are more than 100 years old and declared by national commission for culture and the arts, national historical institute or national museum	Avoid locating the facility within 1 km of residential, commercial, industrial or urban development areas, memorial sites, churches, schools, historical sites, and other public places. Avoid areas that reproach the boundaries of any non-participating city or municipality e.g. not part of the cluster or shared facility.	The site will be chosen with regard to sensitivities of community residents. Distance limitations of the remediable criteria may be mitigated if the side is isolated to protect sensitive receivers. Proper engineering and management measures, including visual barriers, shall be applied as the site gets near to sensitive land users. Measures also depend on the photography of surrounding land as well as prevailing wind direction.

Site Selection Parameters		Exclusion (Absolute) Criteria	Conditional (Remediable) Criteria	
			Criteria	Considerations
				The suitability of sight encroaching political boundaries will depend of the proximity, density of nearest household and acceptability of other political entities
9	Proximity to an Ecologically Sensitive or Environmentally Critical Area.	The site shall not be located within 500 meters of the boundaries of ecologically sensitive areas proclaimed as protected areas under the national integrated protected areas system(NIPAS) act , or by any related issue once or national parks(areas of national significance), conservation parks(areas with valuable or interesting natural features) recreation parks (Areas manage primarily for public recreation with some native vegetation), forest reserves, sites of flora and fauna of national or regional significance, wildlife sanctuary, mangrove areas, coral reefs or wetlands of important biodiversity.	Avoid areas within 500 meters of boundary to potentially ecologically sensitive areas that have been proposed or pending declaration as national parks, conventional parks, recreation parks, and forest reserves, sites of flora and fauna of national or international significance, wildlife sanctuary, mangrove areas, coral reefs or wetlands of important biodiversity.	Consideration for sites near ecologically sensitive areas will depend on the local condition and accompanying engineering measures. The exact extent of an ecologically sensitive area should be verified with DENR-NAMRIA, DENR-PAMB, DA-BFAR and other competent authorities. If the site is a habitat of listed endangered species, mitigating measures for protection of the species as required by applicable law shall be included in the project proposal.
10	Consistency with Current or Proposed Land Use Classification.	The location of the facility shall be consistent with the existing or proposed land use classification or comprehensive land use plan (CLUP) of the host LG unit (LGU).	Avoid areas with valuable minerals and energy resources, tourist destinations or across major transportation routes, water, gas, electrical power or communication transmission infrastructure. Also avoid areas classified as prime agricultural land or inconsistent with the strategic agricultural zone BSWM of DA.	The site may be located where there are existing infrastructure routes as long as their presence will not affect the landfill operations or if rerouting and economically feasible. land purchase cost for prime agricultural land will be relatively high and a change of land use will require a permit from the Department of Agriculture (DA) and the Department Agrarian Reform (DAR)/ Stricter landfill operation will be required to avoid damage on crops on adjacent lands
11	Proximity to Airport	The site shall not be located within three (3) kilometers of an airport servicing turbojet aircraft, or 1.6 kilometers of an airport servicing piston driven or turboprop (propeller) aircraft.	Avoid areas within 13 km of the nearest airport.	Permission shall be sought from the civil aviation authority of the Philippines (CAAP), formerly known as ATO, if the site is located within 30 km of the nearest airport. In addition, the owner or operator of the

Site Selection Parameters		Exclusion (Absolute) Criteria	Conditional (Remediable) Criteria	
			Criteria	Considerations
				landfills shall institute a bird control program to prevent hazard to aircraft if bird population becomes significant due to landfill operations.
12	Landfill Area and Lifespan	The site shall be large enough to accommodate waste for a period of five (5) years, with provision for expansion, during which people must internalize the value of environmentally sound and sustainable waste disposal.	Avoid sites when the area is insufficient for landfill design to have a total lifespan of at least ten (10) years	Small areas do not normally allow for face wise expansion or acceptable economies of scale. the minimum land area depends on the total service population, waste analysis and characterization study and expected landfill service life (e.g., 2.6ha/100,000 population, 0.5kg/person/day, 0.7 tons/m3 bulk density and 0 m fill height) Consideration for land ownership also has to be taking into account giving priority to publicly owned land.
13	Haul Distance, Accessibility and Road Conditions	The site shall be accessible from major roads and thoroughfares, provided that if it is not accessible, the project design shall include means of access.	Areas more than 30 km away or 30 minutes travel time from primary waste generation centers have to be avoided as much as possible.	If the distance or travel time is more than indicated limits, investment in either larger capacity transfer vehicles or transfer station may be necessary. Road and traffic conditions, including load capacity of bridges, also have to be active and considered. The area must be easily accessible to collect waste collection vehicles and all landfill machinery at all times. The access road must be all-weathered and have adequate width and load capacity to cater two-way heavy vehicle flow.

Source: Adaptation of Modified Guidelines on Site Identification and Suitability Assessment Procedure for Sanitary Landfill - NSWMC Resolution 64 S. 2013, NSWMC, http://nswmc.emb.gov.ph/wp-content/uploads/2016/07/nswmc-reso-64-adoption-of-modified-guideline-on-site-identifcation-criteria-SLF.pdf

Sample procedural flow for selection of candidate site

This section provides four (4) examples on how to select a candidate site for WTF both in Japanese and local contexts. In the Philippines where WTE-ACC is yet to exist, an example for a site screening/selection for a related facility (SLF) is presented.

The first 2 examples are process flows which are exactly applied for the site selection of WTE in Japan. The 3rd process is a local example showing the procedures for the site selection of SLF in Philippines as introduced in a

NSWMC Resolution. The last is an integration of all prior examples as the suggested process flow for WTF site selection in Philippines.

(2) [Example 01] Selection utilizing the geographical information (Japan case)
Figure 2-4 shows the sample flow and procedure for the selection of WTF site using the geographical information. LG shall consider and apply how many steps to be taken, or how many candidate sites should be selected at the first stage, etc. based on the available data set as well as the required transparency level.

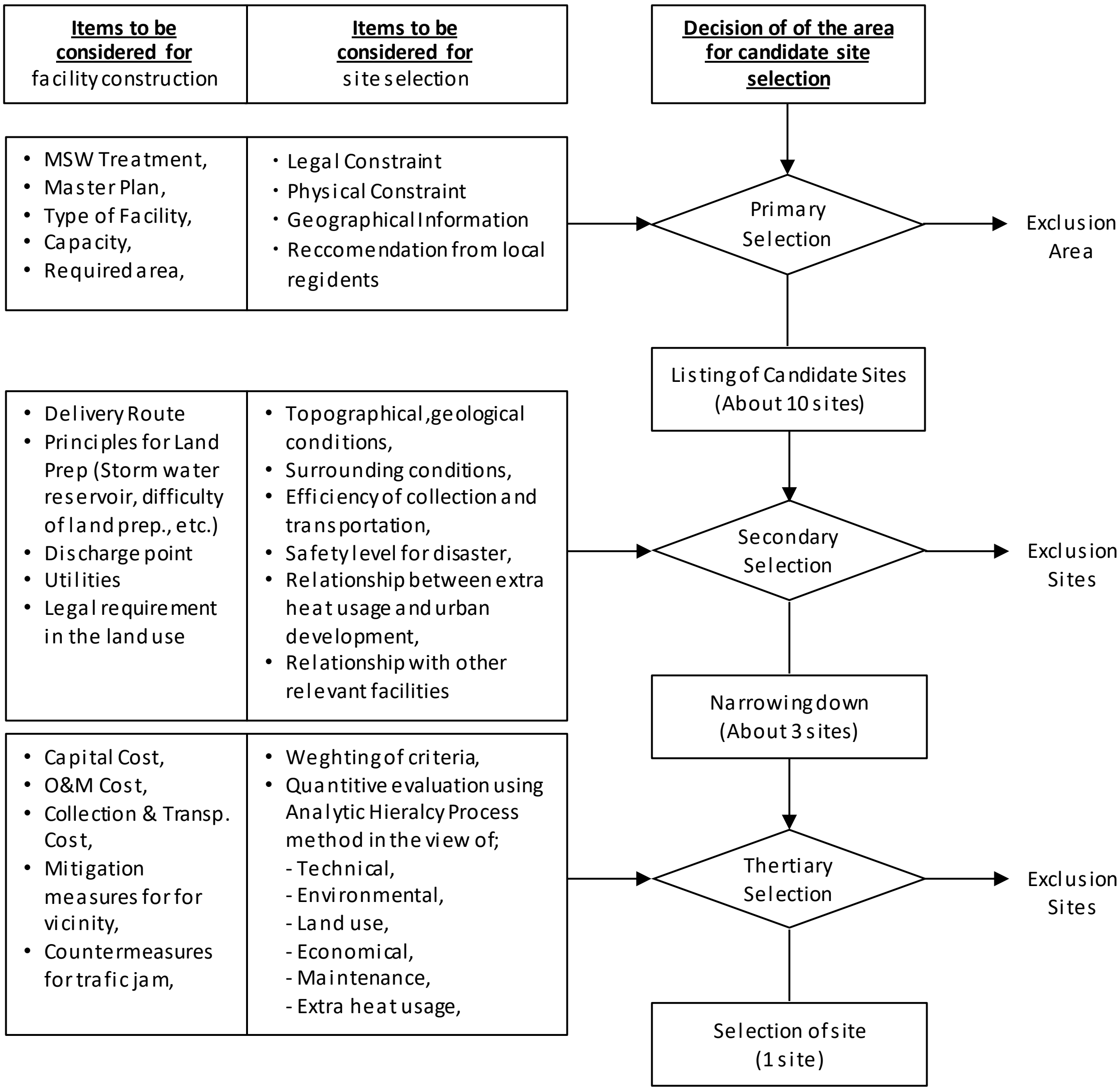
A. Primary selection (narrowing down of zones / setting up exclusion zones and listing of about 10 candidate sites)
a) Based on the Waste Treatment Master Plan and Regional Plan, plan an outline of the facility, and set up a required area for it.
b) From all legal and physical constraints, set areas (as construction sites) that are not suitable for the planned facility and mark them as exclusion areas. For example, construction of planned facility is almost impossible in areas with the following physical constraints:
(i) Steep terrains
(ii) Active faults and its adjacent areas
(iii) Vicinity of water source
(iv) Sites where it is difficult to secure the required area for the planned facility
In addition, areas that cannot secure approval for construction due to the constraints shown in Table 2-10 are set as exclusion areas.

c) As shown in "2) Laws for regulation of the potential construction site", areas deemed undesirable to set up a facility should be made exclusion areas.
d) In case a candidate site is too large, simulation for waste collection and transportation should be carried out to narrow down the appropriate areas.
e) Candidate sites should be limited to around 10, coming from mapping (narrowing using maps), public announcement, and/or recommendations from LGs.

B. Secondary selection (narrowing down to about 3 candidate sites)
Set up further detailed items for evaluation for matters that cannot be grasped from the primary selection alone, and further narrow down options from them.
a) Considering matters such as transport route to the candidate site, matters regarding land preparation, drainage, utilities, and legal requirements for land use.
b) Once the number of candidate sites has been narrowed down to 3, necessary items from "3) Candidate site selection procedure" of this chapter will be extracted and applied relatively for each site, and set corresponding criteria for each site.

At this stage of the selection procedure, it is necessary to disclose information about the selection of a new construction sites for a WTF as accountability for the project as well as to promote consensus building with residents near the candidate sites.
When a candidate site is selected by a public committee, it is necessary to sufficiently explain the selection process in a manner that maintains fairness, transparency and clarity. Furthermore, there is also a need to consider and carefully examine different methods such as disclosure of information, protection of opinions of the minority, reflection of local residents' opinions, to promote consensus building with local residents.
Also, despite not being subject to the *survey of impacts on living environments* (or *environmental impact assessment*), if the construction of a WTF at the candidate site is deemed imposing impacts on the ecosystem of animals and plants surrounding the candidate site, it is desirable for there to be field investigations, hearings and research on existing materials to grasp the characteristics of the candidate site.

C. Tertiary selection (deciding on a candidate site)
a) In deciding a candidate site, the differences in terms of total costs caused by the characteristics of the construction at each site, i.e. capital cost, operational cost, collection and transportation costs, traffic jams, or impacts on local residents, as well as differences in terms of countermeasures to mitigate such problems should be organized carefully and compared for selection.
b) When listing candidate sites in above, decision should be made after considering each item in greater details, and obtaining the understanding of local residents.



Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Figure 2-4 Sample procedural flow for the selection of candidate site utilizing the geographical information

(3) [Example 02] Selection by recommendations of LG, or through public offering

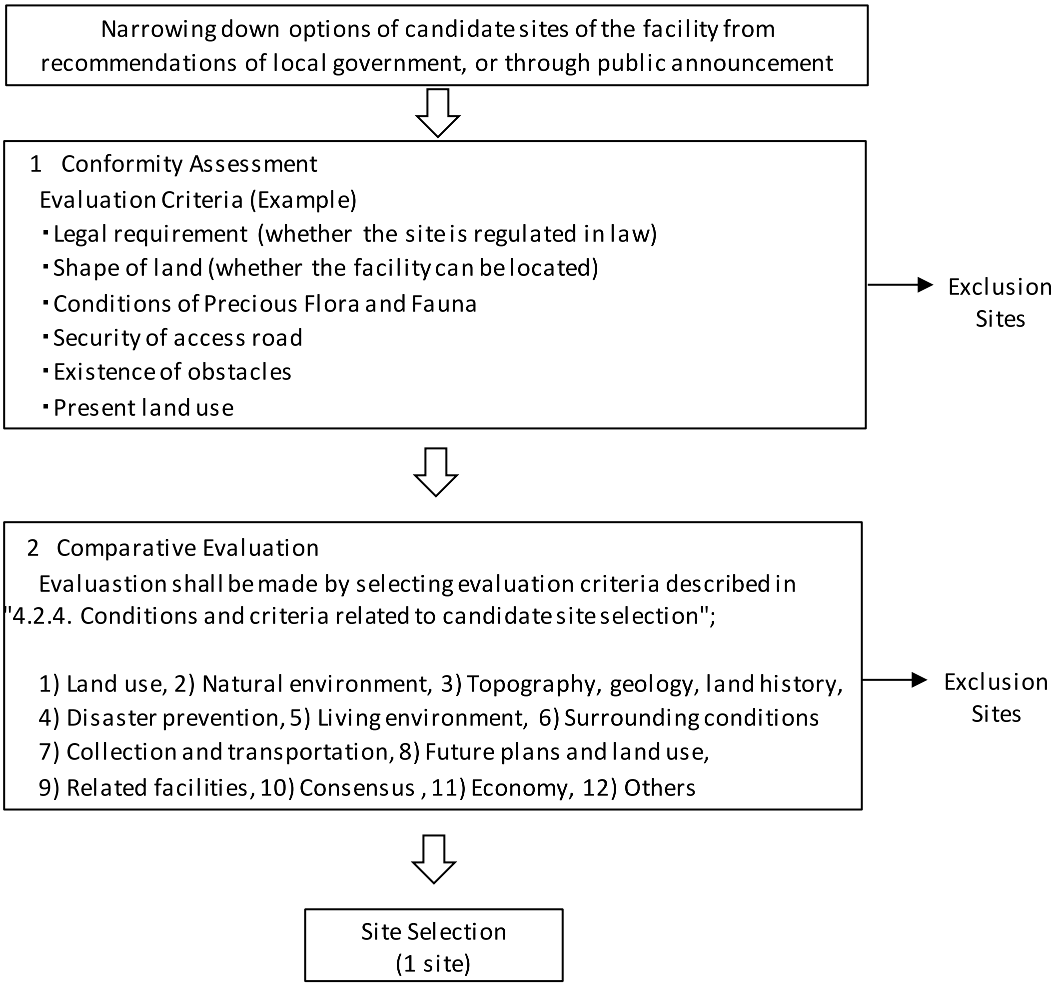
Figure 2-5 shows the sample flow and procedure for the selection of WTF site through recommendation from LGs, or through public offering.

A. Conformity Assessment

For candidate sites narrowed down through recommendations from LG or through public offering, it is first necessary to evaluate whether these places match with the conditions stated. The evaluation criteria can be considered such as; “Legal requirement (if undesirable restriction is imposed or not)”, “Shape of land (WTF can be mounted or not)”, “Conditions of precious fauna and flora”, “Securing the entering route”, “Existence of obstacles”, and “Present land use”, etc.

B. Comparative Evaluation

Comparative evaluation of candidate sites will be conducted based on the items shown in “2.54) Conditions and criteria related to candidate site selection.” In many cases, each candidate site is given a score, and the site with the highest score is selected. Table 2-13 shows the scoring matrix that can be used in selecting the candidate site.



Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Figure 2-5 Sample procedural flow for selection of a candidate site thru recommendation of LG or public offering

Table 2-13 An example of scoring matrix in selecting the candidate site

■Comparative Evaluation

	Items		Importance	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	Average points
				Candidate Areas												
Comparative Evaluation	Natural Environment Conservation (out of 6 points)	1 Designation of water sources, springs, etc.	2	○ 4	◎ 6	△ 2	△ 2	○ 4	○ 4	○ 4	△ 2	△ 2	△ 2	△ 2	△ 2	3.0
		Scores		4	6	2	2	4	4	4	2	2	2	2	2	3.0
	Harmony with surrounding environment (out of 48 points)	2 School facilities	2	◎ 6	△ 2	△ 2	△ 2	○ 4	◎ 6	◎ 6	△ 2	△ 2	△ 2	△ 2	△ 2	3.2
		3 Social and welfare facilities	2	◎ 6	○ 4	△ 2	△ 2	△ 2	○ 4	○ 4	△ 2	△ 2	△ 2	△ 2	○ 4	3.0
		4 Health and medical facilities	2	○ 4	△ 2	△ 2	△ 2	◎ 6	◎ 6	◎ 6	△ 2	△ 2	△ 2	△ 2	△ 2	3.2
		5 Cultural and tourist facilities	2	◎ 6	○ 4	△ 2	△ 2	△ 2	△ 2	○ 4	△ 2	△ 2	○ 4	△ 2	○ 4	3.0
		6 Waste related facilities	2	△ 2	△ 2	○ 4	○ 4	◎ 6	◎ 6	◎ 6	△ 2	△ 2	△ 2	△ 2	△ 2	3.3
		7 Administrative facilities	2	◎ 6	○ 4	◎ 6	◎ 6	△ 2	○ 4	○ 4	△ 2	○ 4	△ 2	○ 4	◎ 6	4.2
		8 Housing	2	○ 4	△ 2	△ 2	△ 2	◎ 6	○ 4	◎ 6	△ 2	△ 2	△ 2	△ 2	△ 2	3.0
		9 Measurement survey observation points	2	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	6.0
		Scores		40	26	26	26	34	38	42	20	22	22	22	28	28.8
	Disaster Prevention Considerations (out of 30 points)	10 Designated shelter	2	◎ 6	△ 2	△ 2	△ 2	△ 2	○ 4	○ 4	△ 2	△ 2	△ 2	△ 2	△ 2	2.7
		11 Emergency shelter	2	◎ 6	△ 2	○ 4	△ 2	○ 4	△ 2	△ 2	○ 4	◎ 6	◎ 6	◎ 6	◎ 6	4.2
		12 Prefectural flood assumption zone	2	△ 2	◎ 6	○ 4	○ 4	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	5.3
		13 Assumed maximum seismic intensity	2	○ 4	◎ 6	○ 4	○ 4	△ 2	△ 2	△ 2	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	4.5
		14 Active fault	2	△ 2	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	◎ 6	5.7
		Scores		20	22	20	18	20	20	20	24	26	26	26	26	22.3
	Efficiency considerations (during construction) (out of 12 points)	15 Main roads	1	△ 1	△ 1	◎ 3	◎ 3	△ 1	○ 2	△ 1	○ 2	△ 1	△ 1	◎ 3	◎ 3	1.8
		16 Special high-voltage transmission lines	1	△ 1	◎ 3	△ 1	△ 1	○ 2	◎ 3	◎ 3	○ 2	◎ 3	○ 2	◎ 3	◎ 3	2.3
		17 Water supply system	1	○ 2	△ 1	△ 1	○ 2	○ 2	○ 2	△ 1	◎ 3	◎ 3	◎ 3	◎ 3	◎ 3	2.2
		18 Drainage system	1	△ 1	◎ 3	◎ 3	◎ 3	○ 2	△ 1	△ 1	◎ 3	◎ 3	◎ 3	◎ 3	◎ 3	2.4
		Scores		5	8	8	9	7	8	6	10	10	9	12	12	8.7
	Consideration for efficiency (during operation) (out of 6 points)	19 Collection and transportation costs	1	○ 2	△ 1	◎ 3	◎ 3	△ 1	△ 1	△ 1	○ 2	○ 2	○ 2	○ 2	△ 1	1.8
		20 Incineration residue removal costs	1	◎ 3	○ 2	○ 2	○ 2	△ 1	△ 1	△ 1	△ 1	△ 1	△ 1	△ 1	△ 1	1.4
		Scores		5	3	5	5	2	2	2	3	3	3	3	2	3.2
	Other (out of 9 points)	21 Land use	2	◎ 6	△ 2	◎ 6	△ 2	◎ 6	◎ 6	◎ 6	△ 2	△ 2	△ 2	△ 2	△ 2	3.7
		22 Height difference within the site	1	◎ 3	◎ 3	◎ 3	◎ 3	△ 1	△ 1	△ 1	◎ 3	◎ 3	◎ 3	◎ 3	◎ 3	2.5
		Scores		9	5	9	5	7	7	7	5	5	5	5	5	6.2
	Comparative Evaluation Total Score (out of 111)			83	70	70	65	74	79	81	64	68	67	70	75	72.2

◎：3points, ○：2points, △：1point

	Items	Importance	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	Average points
Comprehensive evaluation	Feasibility of land acquisition (out of 6 points)	2	◎ 6	△ 2	△ 2	△ 2	△ 2	△ 2	△ 2	△ 2	△ 2	△ 2	△ 2	△ 2	2.3
	Possibility of consensus building (out of 6 points)	2	△ 2	△ 2	△ 2	△ 2	△ 2	△ 2	△ 2	△ 2	△ 2	△ 2	△ 2	△ 2	2.0
	Overall Evaluation Total Score (out of 12)		8	4	4	4	4	4	4	4	4	4	4	4	4.3

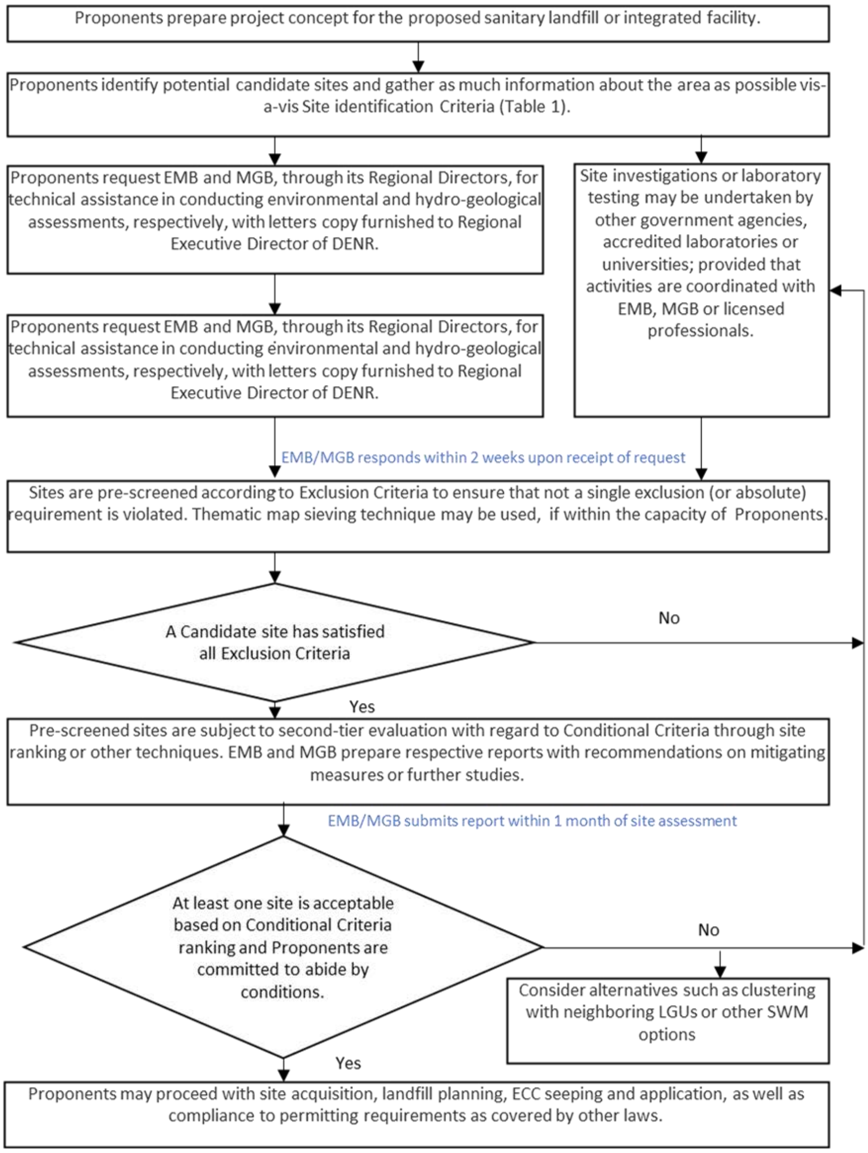
◎：3points、△：1point

	Items	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	Average points
		Candidate Areas												
Final evaluation	Comparative Evaluation Total Score (out of 111)	83	70	70	65	74	79	81	64	68	67	70	75	72.2
	Overall Evaluation Total Score (out of 12 points)	8	4	4	4	4	4	4	4	4	4	4	4	4.3
	Total Score (out of 123)	91	74	74	69	78	83	85	68	72	71	74	79	76.5

(4) [Example 03] SLF Site Suitability Assessment Flow and Selection Procedure of NSWMC2013-64

The NSWMC Resolution No. 64 Series of 2013 provided a procedural flow on site screening and suitability assessment for SLFs. The procedure is a combination of field and desktop investigation considering defined absolute and conditional criteria on different iterations of screening.

In this guideline, the procedure is initiated by the conceptualization of the disposal facility followed by baseline data collection. The proponent LGU may tap MGB (Mines and Geosciences Bureau) and EMB Regional Offices through the DENR Regional Executive Director for technical assistance for site pre-screening and evaluation particularly in environmental and hydro-geological assessments. Using the primary and secondary collected information, two levels of screening follow: Initial Screening for Exclusion Criteria and the Second/Final Screening in the consideration of Remediable Criteria. The specifics of these criteria are detailed in Figure 2-6 Figure 2-6 . After the second level of screening, it triggers the process of land acquisition as necessary, as well as the initiation of application for necessary permits, including ECC.



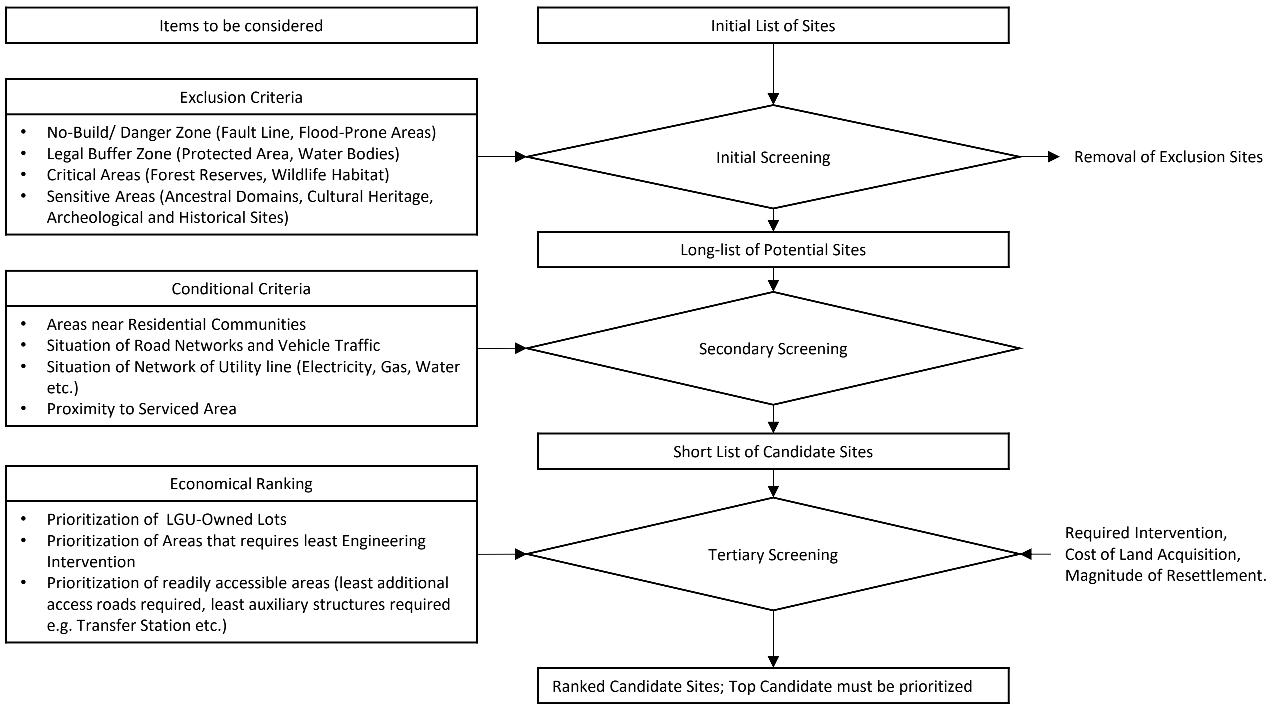
Source: Adaptation of Modified Guidelines on Site Identification and Suitability Assessment Procedure for Sanitary Landfill - NSWMC Resolution 64 S. 2013, NSWMC, http://nswmc.emb.gov.ph/wp-content/uploads/2016/07/nswmc-reso-64-adoption-of-modified-guideline-on-site-identifcation-criteria-SLF.pdf

Figure 2-6 Process Flow on Site Suitability Assessment and Selection Procedure (NSWMC Res. No. 64 S. 2013)

(5) Recommended Integration

Figure 2-7 is patterned to [Example 01] Selection utilizing the geographical information (Japan case), with additional elements adapted from examples 2 and 3. The initial list of candidate sites, to be subjected to initial screening, could be extracted in many ways as described in Section 3) , including through GIS as illustrated in [Example 01] Selection utilizing the geographical information (Japan case), and by public announcement shown in [Example 02] Selection by recommendations of LG, or through public offering. The existing process of request for technical assessment from EMB and MGB through DENR Regional Executive Director (RED) in [Example 03] SLF Site Suitability Assessment Flow and Selection Procedure of NSWMC2013-64 could be adopted to the screening procedure for WTE Facilities.

Just like the first example, three level of screenings is advised. But similar to [Example 03] SLF Site Suitability Assessment Flow and Selection Procedure of NSWMC2013-64, the first two screenings are for Exclusion, and Remediable Criteria, respectively. After which, the evaluation of cost attached to the shortlisted sites not only for land acquisition, but also possible resettlement and compensation, as well as necessary engineering interventions. An additional iteration of screening considering cost/financial prior to final site ranking is recommended. The parameters to be considered after the initial iteration may be changed depending on the local conditions and prioritization. Nevertheless, absolute/exclusion criteria should be adhered to at any time as specified in Table 2-12 .



SOURCE: JICA Expert Team

Figure 2-7 Sample integrated flow for the selection of candidate site

5) Considerations in the selection of candidate sites

The points for consideration in the selection of candidate sites are;

(1) There will be many cases where conditions and criteria will diverge into different direction; for example, disaster resistance and economic efficiency often get into a trade-off relationship. Also, economic efficiency tends to be in trade-off relationships with any other conditions in many cases, so it is desirable that it be adjusted by weighing the evaluation items if necessary.
(2) When weighing each evaluation item, it is desirable to set them appropriately so that there would be as little bias as possible.
(3) In the selection process, when narrowed down candidates are to be announced to the public (as the level of specific address), it is desirable to pay certain considerations such as visiting local authorities and/or land owners to explain the progress of selection for the purpose to have general understanding of the area if needed before the public announcement.

6) Actions after the selection of candidate site

After the completion of the candidate site selection process, it is advisable that the following measures be taken.

(1) To conduct an explanatory meeting on the process of the candidate site selection. Meetings are to be conducted for each level of landowners, local district, schools, and LG; it is necessary to determine how to conduct the meetings at the LG level. Furthermore, there might be a need to give explanations to neighboring administrative areas as well.

(2) The explanatory meetings are to be carried out until understanding and cooperation of as many residents as possible is obtained.

(3) Once construction is set to be carried out, there have been cases where stricter standards than actual laws and ordinances were set, and agreement on pollution prevention were formed with local residents. It is necessary to consider whether or not to form such agreements too.

Chapter 3 Formulation Phase

3.1 Formulation of Feasibility Study (F/S)

1) Overview of the F/S and Formulation Phase

The Feasibility Study (F/S), in Japan, called as Facility Basic Plan (FBP)), shall be formulated at the end of formulation phase for the preparation of the bidding document and construction order, and its main purpose is to determine the conditions of the order for the company performing the facility construction and operation. The development of the F/S must be in consistency with higher plans, such as the LG's development master plan, MSWM Master Plan, and must be based on selection processes of construction site, treatment method, business scheme, etc. as well as survey results of geology, topography of the construction site.

In addition, procurement of a WTF/WTE system usually employs "Performance based ordering system (in other word, Design-Build Contract)" because a WTF/WTE system is an aggregate of wide-ranged technologies, complex and huge sized controlling system, and its unique structure, patents, know-hows which are usually belonging to the plant manufactures. Therefore, it is necessary to keep in mind that the F/S should also follow the performance based ordering system, and set appropriate ordering conditions (input specifications, output performance requirements) to make sure no shortage will occur.

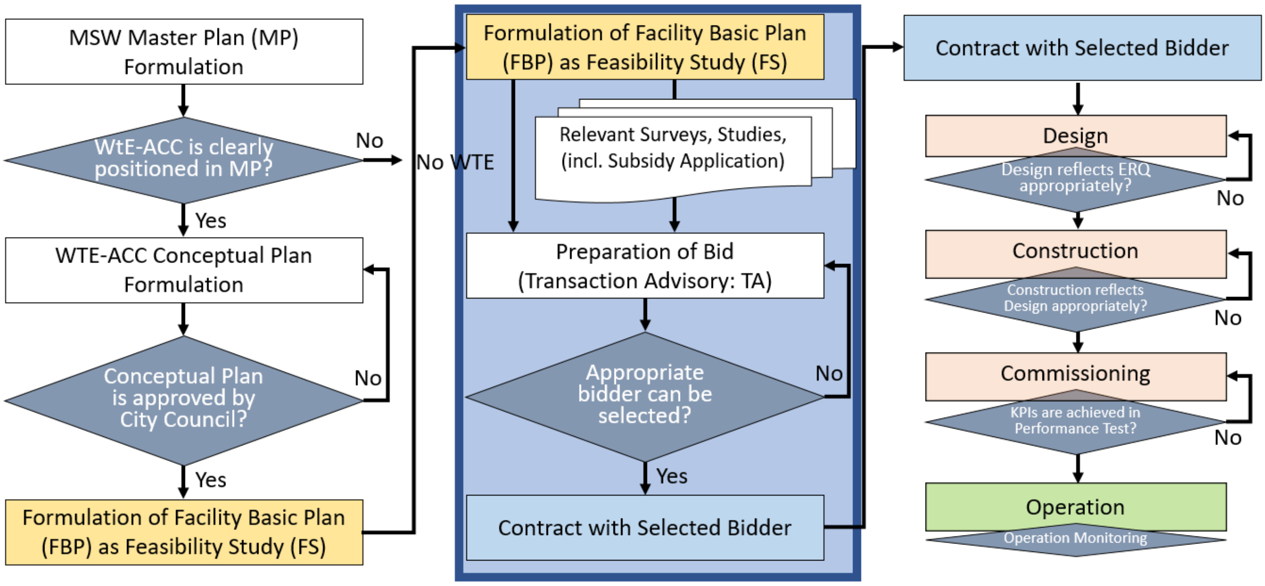
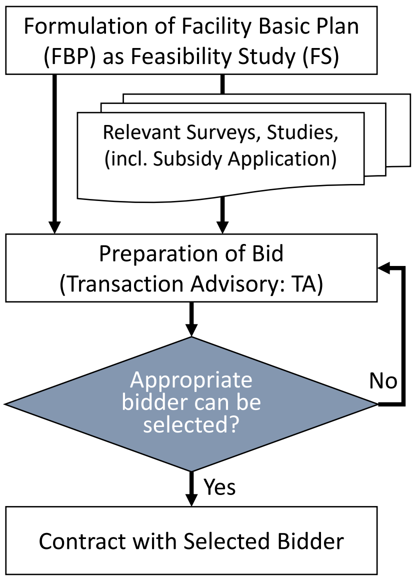


Figure 3-1 WtE Project procedure: Formulation Phase



■ What to be decided by LG in the FS Phase

Technical	• Treatment Technology Selection	⇒ Thermal (Stoker, fluidized bed or gasification, etc.), or Non-thermal (Biomethanation, etc.)
	• Quantity / Quality of WTE Feedstock	⇒ How much MSW can be "continuously" supplied to WTE? ⇒ How much LCV can be guaranteed? (This is out of control of private proposer)
	• Pollution Control Standards (Exhaust gas, Wastewater, Residues, etc.)	⇒ Under Clean Air Act (National Standards), International Standards, and/or Stricter Voluntary Standards? ⇒ Monitoring frequency shall also be identified.
Financial	• Business Scheme	⇒ Study on applicability of PPP modality (BOT, BOO or DBO, Concession, JV, etc.)
	• Project cost estimation (Capex/Opex), Financial Model, Financing Plan	⇒ Total cost, amount of funds to be procured …
Project Boundary	• Role demarcation (Scope of Work)	⇒ Basic concept of task demarcation shall be identified at this phase so that **gov. budget can be forecasted**.
	• Value Chain Analysis (Treatment Process flow for upstream/ downstream)	⇒ Upstream arrangement (Segregation classification, pretreatment, how to deliver segregated waste, etc.), ⇒ Downstream arrangement (Handling of bottom ash and fly ash, disposed at TSD? Monofill?)

➡ Since there are NO "Zero T/F" WTE projects in the World, LGU shall concept out what LGU can provide and what LGU expects to Private Operator, in such aspect, security of annual expenditure for T/F through project period must be the most important point.

Figure 3-2 What to be decided by LGU in the Formulation Phase

2) Structure of the F/S

Table 3-1 shows a sample table of contents of F/S and following sections explain each component.

Table 3-1 Sample Table of Contents of F/S

1) Executive Summary 2) Relevant Laws and Regulation 3) Site Conditions 4) Design Conditions 5) Operational Conditions 6) Project Cost and Financial Plan 7) Work Schedule 8) Construction Plan

(1) Executive Summary

Executive Summary of FBP shall contains;

A. Purpose of the Facility
B. Principles of the Facility Development
C. Construction site
D. Site area
E. Target Waste to be treated
F. Capacity of the Facility
G. Treatment Technology
H. Related Projects; In the connection with the planning project, if there are any relative project plan such as; construction of access road, construction of a compensatory community welfare facility (swimming pool, recreation facility, etc.), District Heat & Cooling Facility, Power Plant, etc., describe the contents of those relevant plans.
I. Construction preparatory work; Describe the required preparatory work before the contract. Such work includes geological survey, topographic survey, EIA (Environmental Impact Assessment), City Planning Decision (for land use), and other necessary permits and approvals.
J. Completion Date of Construction
K. Others; Other relevant points to note in executing the Project (Collaboration with local residents, Consensus Building, etc.).

(2) Relevant laws and regulations (Examples in Japan, for Philippines laws and regulation, please refer “2.2 Legal requirement to LGUs in MSWM”)

In formulating the FBP, the following relevant laws and regulations, technical standards, and rules must be complied. These relevant laws and regulations are frequently revised in conformity to strengthening environmental conservation, improvement of working environment, globalization and deregulation, etc. FBP must always reflect these changes and be developed under the latest laws and regulations.

A. Environmental protection laws and regulations (In case of Japan):
B. (a) Waste Management Act, (b) Special Measures Act against Dioxins, (c) Air Pollution Prevention Act, (d) Water Pollution Prevention Act, (e) Noise Control Act, (f) Vibration Control Act, (g) Basic Environment Protection Act, (h) Prefectural Environmental Impact Assessment Ordinance, (i) Recycling Acts (for Containers and packaging, for Home appliances, For construction, etc.), (j) Ordinance on Prefectural Protection and Restoration of Nature, (k) Prefectural Pollution Prevention Ordinance, (l) Prefectural Fire Prevention Ordinance, (m) Public Waters Reclamation Act, (n) Soil Contamination Countermeasures Act, etc.
C. Laws and Ordinances on Water:
D. (a) Water Supply Act, (b) Prefectural Water Supply Ordinance, (c) Prefectural Industrial Water Supply Ordinance, etc.
E. Laws and Ordinances on Sewerage:
F. (a) Sewerage Act, (b) Prefectures Sewerage Ordinance, (c) River Act, (d) Septic Tank Law
G. Laws and Ordinances on Occupational Safety:
H. (a) the Labor Standards Law, (b) Industrial Safety and Health Act, (c) Industrial Safety and Health Regulations, (d) Ordinance of Health Standards in the Office, (e) Ordinance on the Prevention of Anoxia, (f) Special Ordinance on the Prevention of Chemical Hazard, (g) Ordinance on the Prevention of Organic

Solvent Poisoning, (h) Ordinance on the Prevention of Asbestos-induced Health Impairment

I. Laws and Ordinances on Cranes:
J. (a) Crane Structure Standard, (b) Crane Safety Rules, (c) Crane Structure Standard for the Overload Prevention, (d) Machine Inspection Rules
K. Laws and Ordinances on Electricity:
L. (a) Electricity Business Act, (b) Electrical Supplies Safety Act, (c) Electrical and Mechanical Equipment Explosion Proof Structural Standard, (d) Electrical Standard Committee (JEC), (e) Japanese Electric Industry Association Standards (JEM), (f) Technical standards for Thermal Power Plants for Power Generation, (g) Technical Standards for Electrical Equipment, (h) Technical Standards for Welding of Electric Works, (i) Electricity Supply Regulations, (j) Japan Wire Industry Association Standard Specification (JCS), (k) Indoor Wiring Regulation
M. Laws and Ordinances on Construction:
N. (a) Building Standards Act, (b) Law on Maintenance of Sanitation within Buildings, (c) Heartful Building Law[8]
O. Laws and Ordinances on Development:
P. (a) Urban Planning Act, (b) Act on the Regulations of Housing Land Development, (c) Development Permission and Technical Standards in Administrative Area
Q. Laws and Ordinances on Dangerous Articles:
R. (a) Fire Service Act, (b) Ordinance and Cabinet Order on the Regulations of Hazardous Substances, (c) General High-pressure Gas Safety Regulations, (d) Gas Supply Regulations
S. Laws and Ordinances on Weights: (a) Measurement Law
T. General Standards:
U. (a) Japanese Industrial Standards (JIS), (b) Construction Code for Pressure Vessels, (c) Ordinance on Safety Boilers and Pressure Vessels, (d) Boiler Structure Standards:
V. International Standard:
W. (a) Standards by the International Organization for Standardization (ISO), (b) Standards by the International Electrical Committee (IEC); other relevant laws, ordinances, regulations and guidelines
X. International Convention: Minamata Convention on Mercury, etc.

(3) Site Conditions

A. Geographical Conditions

Describe the site shape, surrounding conditions, planned ground height, radio wave propagation path, altitude restriction, regional development plan, geology, etc.

B. Urban Planning Items

Describe zoning, building coverage ratio, floor area ratio, fire zone designation, altitude limit, sun shadow regulations.

C. Utility Conditions

a) Detail the water supply capacity, the intake capacity of industrial water, and the draw-in position.
b) Detail the discharge destination of the sewerage and river discharge, the dischargeable amount of drainage (contaminated drainage, rainwater drainage), and the discharge position.
c) Categorize the types of city gas, the receivable amount, and the position of withdrawal.
d) Detail the received voltage of electricity, the power that can be received, the type of leased line of general line, the number of lines, and the lead-in position. In the case of special high voltage, it is necessary to discuss with the power company at an early stage.
e) Detail the number of telephone lines, and the pull-in positions.

D. Land Acquisition

Detail the land acquisition plan.

(4) Design Conditions

A. Design Principles and input conditions

a) Basic policy

Detail the basic concepts about harmonization with the surrounding environment, prevention of pollution, future plans, operation stability, labor savings (automation), service life prolongation, resilience improvement, environmental learning and sensitization, etc.

b) Incinerator system

Detail the number of furnaces, lines for exhaust gas, steam and condensed water.

[8] Heartful Building Law: "The law on the promotion of the construction of a particular building that disabled and elderly persons can comfortably use"

c) Target waste quality

Detail the items shown below. In case sludge and sewage dregs are to be treated together with MSW, then detail the pre-treatment method and calorific value as well. How to set the target waste quality range is set forth in section “3.4 Target waste quality “

- Type of waste: combustible waste (describe the types of waste collected separately), large-sized waste, crushed waste carried-in waste, etc.
- Waste calorific value: assume the future change in waste quality (for example 5-7 years after completion of the facility) and detail the calorific value as shown in Table 3-2 . Setting a planned calorific value when there are too many types of waste should be done with care.

Table 3-2 Target waste quality

Item \ Garbage quality		High quality waste	Standard waste	Low quality waste
Ternary Component (%)	Moisture content			
	Combustible content			
	Ash content			
Lower calorific value (kJ / kg)				
Unit volume weight (t / m3)				
Elemental composition (%)	Carbon (C)			
	Hydrogen (H)			
	Oxygen (O)			
	Sulfur (S)			
	Nitrogen (N)			
	Chlorine (Cl)			

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

B. Layout Plan

a) Building Layout Plan

(i) WTE-ACC building

Plan and detail the layout of the building to be used for WTE-ACC taking into consideration the site shape, connection with external roads, the traffic line within the premise, Sun shadow regulation, noise control, etc.

(ii) Administration Building

Plan and detail whether the administration building will be accommodate within the factory building, or to be built as a separate building taking into consideration connection with external roads, visitors, access to the factory, etc.

(iii) Building for Weighing Equipment

Plan and detail the layout in consideration of the traffic flow of transportation vehicles and space for waiting vehicles.

(iv) Chimney

Plan and detail the layout in consideration of the altitude restriction in observation of aviation laws, aviation hazard signs, radio wave paths and radio wave interference while keeping harmony with the surrounding environment.

(v) Other buildings

Plan and detail the layout of necessary auxiliary facilities such as storages of dangerous articles, car wash areas, parking lots, etc. in consideration of the traffic flow of transportation vehicles and their functions.

b) Vehicle flow plan

Plan and detail the location of roads within the premise in consideration of traffic flows of vehicles such as collection and transportation vehicles, ash removal vehicles, delivery vehicles for chemicals, truck with cranes for maintenance, and fire trucks.

c) External Structure Plan

(i) Roads within the facility

Plan and detail the circulatory route within the premise considering the total number of vehicles delivered to the plant, the number of vehicles at peak hours, the road width and the space for waiting vehicles.

(ii) Parking

Plan and detail the layout for parking lot for visitors near the administration building, and if necessary, the parking lot for collection and transportation vehicles.

(iii) Gate and Fence

Plan and detail the gates and fence at borders with roads and adjacent land taking into consideration the conditions of the site.

(iv) Plan for Greening the Facility

Detail the greening plan in accordance with the relevant regulations of LG.

d) Rainwater removal plan

Plan and detail the measures to control rainwater in accordance with the urban development rules, and the regulatory standards for development of forest land.

Take appropriate measures when releasing rain water directly into public waters.

C. Specifications of equipment

a) Equipment for intake and supply of waste

- Weighing machine: Detail the number, type, and capacity of weighing machines taking into consideration the maximum number of transportation vehicles per hour, vehicle maximum weight, vehicle size, etc.
- Waste pit volume: Detail the capacity in the number of days of the planned maximum daily volume of waste to be treated.
- Waste crushing machine: Describe method, capacity and the number when installing a crusher or breakage machine for facilitating incineration.

b) Combustion equipment

(i) Furnace types: Detail the types of furnace, such as stoker and fluidized bed type.

(ii) Combustion conditions: Detail the combustion chamber outlet temperature, combustion gas residence time, carbon monoxide concentration of combustion gas, etc.

(iii) Standards for incineration residue: Detail the standards with reference to heat loss reduction defined in the guideline for the performance of waste treatment facility. In addition, detail the regulatory standards to be complied with as stipulated in the Special Measures Act against Dioxins.

(iv) Fuel for auxiliary combustion: Detail the required conditions for keeping the necessary temperature at the furnace outlet and for the start and stop of the furnace, as well as the types of the auxiliary fuel devices.

c) Combustion Gas Cooling Equipment

(i) Detail whether the waste heat boiler system or the water injection system is used alone or in combination.

(ii) When planning for high efficiency power generation, detail the technology to be employed (high-temperature high-pressure boiler, low-temperature economizer, etc.) as a technical factor to improve power generation efficiency.

d) Equipment for exhaust gas treatment

(i) Detail the percolation type of dust collector for dust removal.

(ii) Detail the method of removing harmful gases in dirty smoke (sulfur oxides, hydrogen chloride, nitrogen oxides, etc.), dioxins, mercury and designated substances of “hazardous air pollutants.”

(iii) When planning for high efficiency power generation, consider technical factors and measures to improve power generation efficiency, and detail the technical method to apply to the equipment for exhaust gas treatment (high efficiency dry exhaust gas treatment, non-catalytic denigration, low temperature catalytic denigration etc.).

e) Water supply equipment

(i) Describe the type of water source (tap water, underground water, industrial water, etc.), water saving measures, water recycling system, etc.

(ii) When planning for the strengthening of the facility, detail the method to secure alternative water source (groundwater, etc.) if needs arise.

f) Wastewater treatment equipment

Detail the treatment system of the entire facility, not only wastewater discharge from the treatment process, but also wastewater from car wash, or other miscellaneous activities.

g) Equipment for residual heat utilization
(i) Detail the content of the equipment for heat and hot water supply and equipment for power generation along with external heat supply.
(ii) When planning for high efficiency power generation, detail the technology method (such as condensing extraction water turbine, etc.) to be applied as a technical factor and measures to improve power generation efficiency.

h) Chimney equipment
Detail the types of chimney equipment, such as reinforced concrete concentrated type, steel plate steel tower supported type, steel plate self-supporting collective type, reinforced concrete outer cylindrical steel plate inner cylindrical collective type, etc., and the height of the chimney from the ground.

i) Ash removal equipment
(i) Detail types of ash removal such as ash cooling water tank system, ash extruder system, etc.
(ii) Detail the method to treat collected dust.
(iii) If an ash pit is to be installed, detail the capacity in the number of days of maximum planned daily emissions.

j) Electrical equipment
(i) Detail the type of special high voltage or high voltage power receiving equipment. When supplying power to external facilities, describe the outline of such facilities.
(ii) Detail whether there exists an emergency power generation equipment. When planning for the strengthening of the equipment, detail the required functions and capacity.

k) Instrumentation equipment
Detail the structure of the control system.

l) Other equipment
(i) Detail whether there exists a deodorizing equipment as measures against malodor.
(ii) Detail whether there exists a pollution analysis equipment.
(iii) Detail whether there exist equipment for visitors to use to understand the treatment process.

D. Architectural Plan
a) Basic Policy
(i) Detail a plan that adheres to the functions and purpose of use of the plant, and in accordance with relevant laws and regulations.
(ii) Detail that the exterior of the factory to have a sense of unity and a design that is in harmony with the surrounding environment.
(iii) Detail the plan for elderly and disable persons in compliance with the Heartful Building Law as well as the conditions related to welfare of local public bodies.
(iv) Detail a plan that support female workers including plans for toilets, bathrooms, and changing rooms.
(v) Secure a visitor passage that makes explanations to visitors easy. Also, passage for visitors should also be paid attention to in case of emergency evacuation, such as fire.
(vi) Detail the countermeasures against dioxins such as installing an air shower room as well as the division of work area.
(vii) Detail a plan that takes into consideration future equipment renewal.
(viii) Detail a plan that takes into consideration the use of LED lighting, and heat insulating materials as energy-saving measures.

b) Factory Building (among Buildings within the facility)
(i) Structure plan
Detail the type of construction: steel-framed reinforced concrete, reinforced concrete, or steel-framed as well as consideration for sufficient strength and weight reduction. In addition, detail the anti-quake resistance required for structure, non-structure materials, and structure equipment.
(ii) Surface level plan
Detail a plan that takes into consideration the function of each room, the work environment, space for

maintenance, and future equipment renewal, as well as consideration for downsizing of the facility.

(iii) Height

Detail the height from the ground surface, as well as consideration for the sunlight in the surrounding areas affected by the height of the facility.

c) Administration Building (in case the administration building is designed as an attached building)

(i) Structural plan

Detail the type of construction: reinforced concrete or steel-frame as well as consideration for sufficient strength. In addition, detail the anti-quake resistance required for structural, non-structure materials, and structure equipment.

(ii) Surface level plan

Detail a plan with due consideration to the functions of each room as well as the working environment.

(5) Operational Conditions

A. Plant Operation Conditions

a) Plant Operating Conditions

Detail the plant operation conditions, its maintenance conditions, and the plant operation organization.

b) Conditions of waste transported into the plant

Detail the type of waste to be treated, the amount transported in, the method to transport the waste in, the route taken, the type and number of transporting vehicles, etc.

c) Handling conditions (such as residue of treated waste)

Detail the handling conditions, handling methods, transportation methods and the destination for incineration residue, sludge, and sewage etc.

B. Operation and Maintenance (O&M) Plan

Based on the results of Study on PFI/PPP Introduction (detailed in Chapter 3), detail an outline for the maintenance plan of the facility.

a) Organization and System for the O&M of the Facility

(i) Business Scheme

Detail the business scheme to be applied to the facilities such as direct management, consignment (operation service consignment, long-term comprehensive operation consignment, etc.), DBO method, etc.

(ii) Content and scope of the consignment

When the consignment method is employed, detail the division of work with directly-managed staff and the terms of outsourcing for each type of work. Depending on the content of work to be consigned, there might be cases where the conditions for consignment are already determined by relevant laws and regulations, so it is necessary to plan carefully not to violate the re-consignment restriction set forth in the Waste Disposal Act. Below is an example of work classification and work content.

Table 3-3 Breakdown of O&M Activities

Breakdown of O&M Service	Explanation of each work
i. Reception management work:	Measurement work, handling of treatment fees (including request for post-payment), etc. in the weighing building, guiding vehicles on the platform, and providing instruction for violating waste deliverer
ii. Operation management work:	Work concerning operation management of incinerators (and related equipment) so that waste carried into the facility is treated properly in compliance with the pollution prevention standard values, and relevant laws and regulations. Also, the following work may be included: planning of the operation plan according to the planned delivery volume and inspection and maintenance plan, management of incineration amount, management of productivity (management of each basic unit, operating cost, surplus heat supply, power generation, utility usage, etc.), management of properties of residues, maintain and update various manuals, etc.
iii. Maintenance work:	Work concerning the procurement and inventory management of utilities, spare parts, consumables, etc., daily inspection, legal inspection, periodical inspection, repair and renewal of plant equipment, and recording and drafting the plan for the above in order to properly maintain the function and performance of the facility and ensure safe and stable operation. Also, work may include planning, implementing, inspecting, and updating of maintenance plans based on the plan to lengthening life span of facility, and BCP (Business Continuity Plan).
iv. Environmental management work:	Work concerning the management of measurement of pollution prevention standard items such as exhaust gas, and work environment
v. Information	Work concerning recording of operation, inspection and testing, repair and renewal,

	management work:	environmental management, and recycling of various equipment such as incinerator as well as preparation and storage of reports
vi.	Disaster prevention management work:	Work concerning the investigation and identification of dangerous articles, places, and work, the composition of accident response manual, the organizing of disaster prevention group, and disaster prevention drill.
vii.	Recycling work:	Work related to the quality control, delivery, inventory control, etc. of resources such as incineration ash, fly ash, slags, metals, etc. if they are to be recycled.
viii.	Transportation work:	Work concerning the loading and transportation of incineration ash, fly ash, etc. to a final disposal site in accordance with the Waste Disposal Act.[9]
ix.	Environmental sensitization and learning work:	Work related to the learning of environment and environmental Sensitization using equipment from the facility, other than facility tour administered by schools and other groups.
x.	Other work:	Work concerning safety and health, work environment management, fire prevention management, cleaning of facility, greening the facility, maintenance of occupational health and safety standards, crime prevention and security, and other related work.

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

b) Placement of qualified personnel

In the maintenance system of waste treatment facilities, give detailed description of the qualified personnel for the facility because it is necessary to arrange legally qualified staff(s) based on relevant laws and regulations depending on the work content and the scale of the facility. Table 3-4 provides an example of qualified personnel. At facility planning for steam turbine power generation, it is necessary to appoint and arrange a boiler/turbine chief engineer and an electrical chief engineer during the construction work. When appointing an outsourcing company's employee as a chief engineer in a consignment method or DBO method, it is necessary to discuss with the public office that has jurisdiction over the pros and cons and the terms of consignment.

Table 3-4 Example of qualified personnel in Japan

Qualified personnel	Based Laws	Notes
Technical supervisor	Waste Disposal Act	For facility with processing capacity 5 ton or more/day. Who have certain qualifications or work experience specified by the Enforcement Rules
Safety and Health General Manager	Industrial Safety and Health Act	Workplaces that employs 100 or more workers. Elected from the personnel that runs the management work.
Safety Officer		Workplaces that employs 50 or more workers.
Health Officer		Workplaces that employs 50 or more workers.
Boiler handling operations chief		Special class boiler engineer license, for facility with boiler heat transfer area of 500 m^2 or more First class boiler engineer license, for facility with boiler heat transfer area from 25 m^2 to 500 m^2 Second class boiler engineer license, for facility with boiler heat transfer area of 25 m^2 or less
First class pressure vessel handling operations chief		Upper atmospheric pressure, volume of 5 m^2 or less, no employment of non-qualified personnel
Specific chemical substances operations chief		For the handling of ammonia, sulfuric acid, etc. selected from those who complete the special technical course Command and supervision of work
Chief for Dangerous work due to Anoxia		Selected from those who complete special technical course Command and supervision of work
Organic solvent operations chief		〃
Drying equipment operations chief		〃
Slinging work technician		Personnel who complete skill training course: for load of 1 ton or above The implementation of special education: for load less

9 The main restrictions on consignment transportation of bottom ash and fly ash are classified into 'technical requirements' and 're-consignment restriction.' 'Technical requirement' are defined in the Waste Treatment Act, and it is required that waste does not scatter or flow out from the transport vehicle, or container truck. For the "re-consignment of restriction", especially when consigning transportation operations to facility O&M in the PPP scheme, if the consignee of the operation consigns the transportation work to a third party of private contractors, care must be observed to avoid violation of the "prohibition of re-commissioned."

Qualified personnel	Based Laws	Notes
		than 1 ton
Forklift driver		Personnel who completes skill training course
Shovel loader driver		〃
Gondola operator		〃
Waste disposal facility workers		Personnel who completes special education
Work leader pertaining to dioxins		Selected from those who complete special education Command and supervision of work
Grinding wheel replacement special education participant		Personnel who completes skill training course
Electric operator (high pressure)		〃
Electric operator (low pressure)		〃
Arc welding technician		〃
Gas welding technician		〃
Personnel with special training on cranes		When using crane with loading capacity above 0.5 ton but less than 5 tons
Crane driver		When using crane with loading capacity above 5 tons
Safe driving manager	Road Traffic Law	If the headquarters have 5 or more cars.
Deputy Safe Driving Manager		If the headquarters have 20 or more cars One additional personnel is added for every 20 cars
Fire protection manager	Fire Service Act	For facilities with 50 or more workers Participants of training
Dangerous goods handler		When handling load exceeds the volume specified by the Fire Service Act, prohibition of work other than by qualified personnel or under their supervision
Hazardous Material Security Supervisor		When storing and handling dangerous materials that exceed 30 times the specified quantity by the Fire Service Law
Electrical chief engineer	Electricity Business Act	When generating electricity for household use with received power over 50 kW Type I: generation for all household Type II: generation for household with voltage less than 170,000V Type III: generation for household with voltage less than 50,000V
Boilers / Turbines Chief Engineer		For site with boiler and turbine Type I: All steam facilities Type II: Steaming equipment with pressure less than 5.88MPa
Special High Pressure Gas Handling Chief	High Pressure Gas Safety Law	When storing and consuming a certain amount of high pressure gas higher than the amount specified by the High Pressure Gas Safety Act

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

C. Pollution Prevention Standards

Based on the environmental protection plan, the following standards shall be summarized for pollution prevention. In planning for pollution prevention standards, apart from the regulatory standard values applied to the proposed construction site based on relevant laws and ordinances, determine the standard values sufficiently considering the site conditions and the impact of the construction to the environment, etc.

a) Exhaust Gas Emission Standards

Detail the regulatory standard values or self-regulatory standard values in accordance with the Air Pollution Control Act, the Special Measures Act against Dioxins, and the Prefectural Pollution Prevent Act in terms of the following listed items. When self-regulatory standard values are set as exhaust gas emission standard, then it is desirable to avoid the adoption of excessive strict self-regulatory standard values, taking into consideration the trade-off relationship between the efficient waste power generation and the improvement of waste gas treatment.

(i) Dust
(ii) Sulfur oxide
(iii) Nitrogen oxide

(iv) Hydrogen chloride
(v) Dioxins
(vi) Mercury
(vii) Amount of exhaust gas

b) Wastewater Discharge Standards
Detail the regulatory standard values for river discharge and sewer discharge respectively in accordance with the Water Pollution Prevention Act and the Sewerage Act, or set self-regulatory standard values.

c) Odor Prevention Standards
Detail the regulatory standard values in accordance with the Malodor Prevention Act and the Prefectural Pollution Control Regulations, or set self-regulatory standard values.

d) Noise Prevention Standards
Detail the regulatory standard values in accordance with the Noise Prevention Act and the Prefectural Pollution Prevention Regulations, or set self-regulatory standard values.

e) Vibration Prevention Standards
Detail the regulatory standard values in accordance with the Vibration Prevention Act and the Prefectural Pollution Prevention Regulations, or set self-regulatory standard values.

D. Environmental Protection Measures
Bear in mind that the environmental protection plan is closely related to the Environmental Impact Assessment for the development of the facility, detail the contents of the plan during the facility construction and during the facility operation respectively.

a) Measures during construction work
Regarding environmental protection measures during the time of the construction, pay attention not only from the viewpoint of pollution prevention, but also from the viewpoint of local environment preservation. Detail the summary of all measures that match the work contents and local situations. An example of items as measures is shown below.

(i) Use of exhaust-emission controlled machine, use of low-noise and low-vibration type of machine
(ii) Turbid water treatment method
(iii) Rules for construction vehicles (tire cleaning when leaving construction site, designation of vehicle route, avoidance of concentration of vehicle at particular time zones, dispersion of vehicle to various time zones, etc.)
(iv) Measures for native floras and faunas (for the plants and animals deemed to be protected by pre-construction surveys)
(v) Environmental monitoring methods

b) Measures during operation of facility
Detail the measures for environmental protection once the facility starts its operation.

(i) Exhaust gas control measures
Plan and detail the core measure items for the exhaust gas treatment technology to be introduced (dry treatment method, wet treatment method and catalyst method).

(ii) Measures against noise
Detail the measures to be taken to comply with the noise standards at the site boundary. There are also cases where a value is set separately for indoor noise apart from pollution prevention standard. When installing equipment that requires special consideration for noise reduction, detail the measures for noise reduction for such installation.

(iii) Measures against vibration
Detail the measures to be taken to comply with the vibration standards at the site boundary. When installing equipment that requires special consideration for vibration reduction, detail the measures for vibration reduction for such installation.

(iv) Measures against odor
Set the regulation for malodor substance concentration and a malodor index at the site boundary, discharge area etc., respectively, and detail the measures to be taken to comply with these regulations. For facilities that treat kitchen waste, special malodor control measures might be required.

(v) Measures against wastewater

Wastewater generated at WTE-ACCs are generally classified into domestic wastewater and plant wastewater. The standards concerning wastewater differ depending on whether there are a discharge destination, whether it is river discharge or sewer discharge, and on the closed system (zero wastewater discharge system); so plan and detail the measures according to the infrastructure conditions at the construction site. Regarding the treated water, even if a closed system is not adopted, reutilization within the plant will be considered taking into consideration the economics and other factors.

E. Residual Heat Utilization Plan

When considering a residual heat utilization plan, comprehensively examine the exhaust gas treatment technology, combustion technology, high-efficient power generation technology, etc. to be adopted, and consider the amount of heat that can be recovered and used effectively.

a) Detail how residual heat will be used, and the place where it will be used.
b) When the residual heat is to be supplied for outside parties, detail the supply method (steam supply, high temperature hydrothermal supply, warm water supply, etc.), and the required heat quantity for the supply destination.
c) When generating electricity with a steam turbine generator, consider all factors from the planned waste heat generation, to assumed frequency, incineration capacity, local power consumption, possibility of selling surplus electricity to a power company, external heat supply, etc., and determine and detail a target for power generation, generation efficiency, energy recovery rate. In addition, detail the matters to discuss with the power company.

(6) Project Cost Estimation and Financial Plan

A. Detail the estimated the cost for the entire project (including preparation for construction work) required for construction of facilities, and related work.
B. Detail how to obtain the necessary funds and the execution plan for each financial year depend on the Business Scheme.

(7) Work schedule

A. Before the contract signing, to detail out the timing and required period for each preparatory works.
B. Detail out the process and the required period from the preparation of bid to the conclusion of the contract.
C. Attach the works schedule (including related works) up to the completion of the construction work.

(8) Construction Plan

A. Pollution prevention during construction

Regarding pollution prevention during construction, summarize the legal requirements at the construction site, describe the measures taken against pollution, and describe the following items.

a) Noise and vibration: Detail about using construction machines with as low noise and vibration as possible for construction where noise and vibrations are likely to occur.
b) Drainage during construction: Among the on-site drainages during construction, set up the discharge destination for discharge from the temporary office and the construction site, provide temporary drainage pipe and sedimentation tank for rain water, and detail the method to prevent overflow of discharged water, and the discharge destination.
c) Prevention of dirt on the surrounding road from construction vehicles: In order to prevent contamination on the surrounding roads by construction vehicles, a car wash place for cleaning vehicles' tires shall be designated.
d) Prevention of the reduction of ground water: The excavation work for underground construction will be described so as not to cause the groundwater level to reduce.

B. Coordination with relevant works

If there are construction simultaneously taking place at the same time as the development of the facility, then describe a statement to sufficiently adjust coordination points, processes, etc.

C. Local Resident Response

Detail how to communicate/respond with local residents when the facility construction takes place.

3.2 Technology selection

1) Background

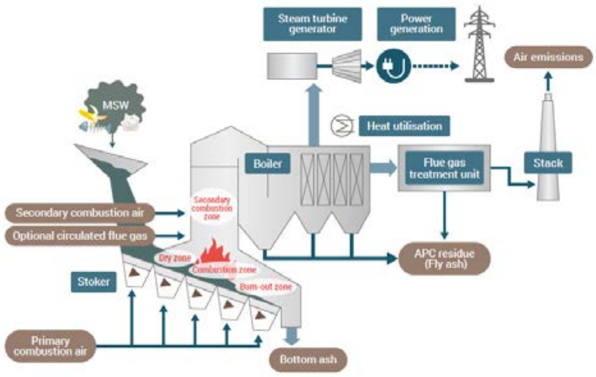
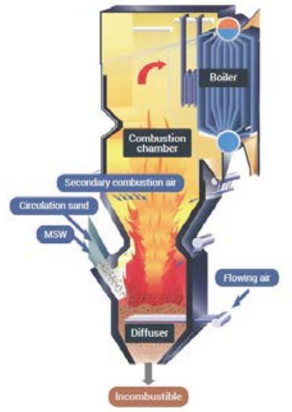
In recent decades, with regard to the heat decomposition technology for MSW, several furnace types with unique technological features have been developed due to high expectations for the reduction of environmental impact, boost economic viability, waste heat recovery, and improve processing performance, etc. Incinerators developed with any type of furnaces at all are considered to meet the performance requirement of LGs if they are built with due consideration for plan, design, and construction; however, the fact is that each type of furnace has each own features, and their compatibility might be a bit different in light of the development policy of the LG. Therefore, regarding the planning of the installation of waste incinerators, "technology model selection," a method that involves selecting furnace types (incineration, melting, etc.) that match the needs of the LGs, is widely practiced.
On the other hand, "waste treatment system selection," a method that does not stop at only selecting types of furnace but combines multiples channels, such as combined with biomass utilizing technologies, integrating with final disposal site and/or material recycling center, etc., and combination with recycling of incinerated ash, has also been sought after. The reasons behind such transition include, the difficulty in securing a final disposal site, the establishes of concepts such as LCA (Life Cycle Assessment) and LCC (Life Cycle Cost), and the way of thinking that recycling and final disposal should be carefully considered before selecting an intermediate waste treatment method. Therefore, when selecting the treatment technology, it is first necessary to sort out the coverage of the WTFs, and the options for recycling and final disposal methods for residues. Then, it is also necessary to decide whether the selection of treatment methods will be carried out within the range of 'technology model selection,' or 'waste treatment system selection.'

2) Procedure for the selection of treatment method

(1) Sort out the intermediate treatment technologies

The intermediate treatment technology for MSW includes not only combustion technology such as incineration, gasification and melting, but also biomass utilization technology such as methane gasification, carbonization and RDF. Among these technologies, some can treat the entire group of MSW, while others can be applied to only specific type of wastes among MSW. In addition, it may be necessary to restructure the waste segregation classification as a prerequisite condition for the introduction of new technology for the LGU. All things considered, it would be needed to sort out the applicable intermediate treatment technologies which have the proven track records in the world and the global trends in recent years.

Table 3-5 Thermal Treatment Technology (Stoker, Bubbling Fluidized Bed)

WTE-ACC Types	Stoker Type Grate Incinerator	Bubbling Fluidized Bed Incinerator
Structural Drawing (Example)	 Source: IGES[10]	 Source: IGES
Process	(1) A method in which the stoker is mechanically driven, and the input waste is sequentially transferred to the drying, combustion, and post-combustion processes (1 to 2 hours) for combustion. Garbage is agitated and inverted during transfer and burned efficiently from the surface. (2) The incineration ash (bottom ash) falls into the ash conveyor (submerged water-sealed) from the tail end of the stoker together with the incombustibles, and after cooling, it is discharged by a conveyor. (3) Dust (fly ash) contained in the combustion gas is collected in the gas cooling chamber and dust collecting equipment.	(1) A method in which crushed waste is fed into the fluidized bed of hot sand and dried, burned, and post-combusted almost at the same time. (2) Garbage is agitated in the fluidized bed and burned instantly (up to a dozen seconds). (3) The ash is discharged from the upper part of the furnace together with the combustion gas and collected as fly ash in the gas cooling chamber and dust collecting equipment. (4) The incombustibles are discharged and separated from the lower part of the furnace together with the fluidized sand, and the sand is returned to the lower part of the furnace again.
Commercial Capacity (Max)	-1,000t/day/line	-300t/day/line
Combustion Temp	850 ~ 950 dC	800 ~ 950 dC
Acceptable LCV	3,200 ~ 14,000 kJ/kg (requires supplemental fuel for waste below 3,200kJ/kg)	
Unsuitable waste	Bulky waste, Inert, Explosives, Hazardous Waste	
Stability	Long history and technically proven.	
Thermal Recovery	Stable heat recovery. Recovered heat can be used as residual heat and power generation.	
Material Recovery	Iron can be recovered by sorting from the incineration bottom ash, but the value is slightly reduced due to oxidization. Bottom ash can be used as cement aggregate or construction material with treatment cost.	
Residue Handling	Incineration bottom ash will be used as cement aggregates with cost or disposed in sanitary landfill (depends on LG's MSW strategy), Fly ash shall be stabilized by cement solidification or chelate treatment and disposed in sanitary landfill because it contains heavy metal.	

Source: Developed by JICA Expert Team with reference to "CCET guideline series on intermediate municipal solid waste treatment technologies (June2020)"

[10] CCET guideline series on intermediate municipal solid waste treatment technologies Waste-to-Energy Incineration (https://www.iges.or.jp/en/pub/ccet-guideline-wtei/en)

Table 3-6 Variation of Non-Thermal Waste Treatment System (Methanation, RDF, Compost)

	Methanation	RDF Production	Compost
Structural Drawing (Example)	 Source: Nagaoka City, Japan	 Source: Guun, Mandaue City[11]	 Source: JICA, Sri Lanka
Process (Example)	(1) A method in which the biodegradable waste is anaerobically fermented and obtain combustible biogas, (2) Segregated food waste will be crushed and separated to biodegradable fraction and non-bio fraction. (3) Biodegradable fraction will be fed to digester after pulping, (4) Fermented in the digester for 3 weeks then collect digested gas (biogas), (5) Captured biogas can be used for fuel and digested sludge can be utilized after drying.	Following explains about RDF fluff while there are several RDF category; (1) A method in which the combustible waste is shredded and wrapped to be the alternative fuel for cement kiln, waste incineration facility, (2) Segregated paper and plastic waste will be further separated manually in the conveyor and air separator, (3) light combustible fluff will be shredded and wrapped as a cube shaped fuel (RDF fluff), (4) RDF fluff can be used as fuel at cement kiln, or WTE facility.	(1) A method in which the biodegradable waste is aerobically fermented and converted to compost, (2) Segregated food waste will be manually separated, mechanically crushed (< 5cm) and piled up around 2.5m, add micro- organism for fermentation, (3) Pile will be mixed by wheel loader once in a couple of days and aged for 60 days. (4) Matured compost will be sieved by trommel to be the products,
Commercial Capacity (intake)	- 200t/day (depends on marketability of the products)	- 500t/day (depends on marketability of the products)	- 200t/day (depends on marketability of the products)
Acceptable waste	**Segregated** biodegradable waste	Segregated non-bio waste, combustible waste (Paper, Plastics, etc.)	Segregated biodegradable waste
Unsuitable waste	**Non-segregated waste**, Non-biodegradable waste, hazardous waste (paint, chemicals, explosive), etc.	Non-segregated waste, Biodegradable waste, inert, hazardous waste (chemicals, explosive), etc.	Non-segregated waste, Non-biodegradable waste, Inert, hazardous waste, etc.
Stability	Proven technology. Need to take care of long-term off-take of products as well as digestate (residue).	Proven technology. Need to take care of long-term off-take of products.	Proven technology. Need to take care of long-term off-take of products.
Thermal Recovery	Biogas can be used for heat and power generation.	RDF can be used as the fuel **only for cement kiln or WTE-ACC**. No compatibility to pulverized coal fired power plant.	No
Material Recovery	Digestate (residue) can be used as fertilizer but **its amount (same volume with input waste) and shape should be well considered. In urban area, it is usually minus profitability.**	Recyclables can be sorted and recovered through the manual/ mechanical separation.	Recyclables can be sorted and recovered through the manual/ mechanical separation.
Residue Handling	Problem in digestate.	Residue issue will be happened in subsequent facilities (cement kiln or WTE-ACC).	Leachate

Source: JICA Expert Team based on the websites of existing projects

[11] Recycling waste plastic as fuel and establishing circular economy (https://yport.city.yokohama.lg.jp/case_en/804)

(2) Extracting treatment methods for comparative evaluation

When the treatment method selection is carried out using 'model selection,' compatible furnace types will be selected from the relationship between the features of the waste to be treated, and the disposal destination.
On the other hand, when the treatment method selection is carried out using 'waste treatment system selection,' there is a need to sort out the following factors: intermediate treatment technology other than furnace type, change of collection and transportation system, final disposal destination, recycling of by-products, scope and its flexibility of the WTF, and to extract the treatment system that is compatible with LGU.

Figure 3-3 illustrates a waste treatment block flow which contains WTE-ACC as the major intermediate treatment system. In this case, at the discharge level, waste segregation of "combustible waste" shall be required so that the fleet for combustible waste can go WTE-ACC directly. Combustible fraction as by-products generated from MRFs for recyclables and bulky waste will also be fed to WTE-ACC. In this case, bottom ash from WTE-ACC is used as cement aggregate but if cement demand is full, it shall be disposed in Sanitary landfill together with Solidified fly ash, and incombustibles.

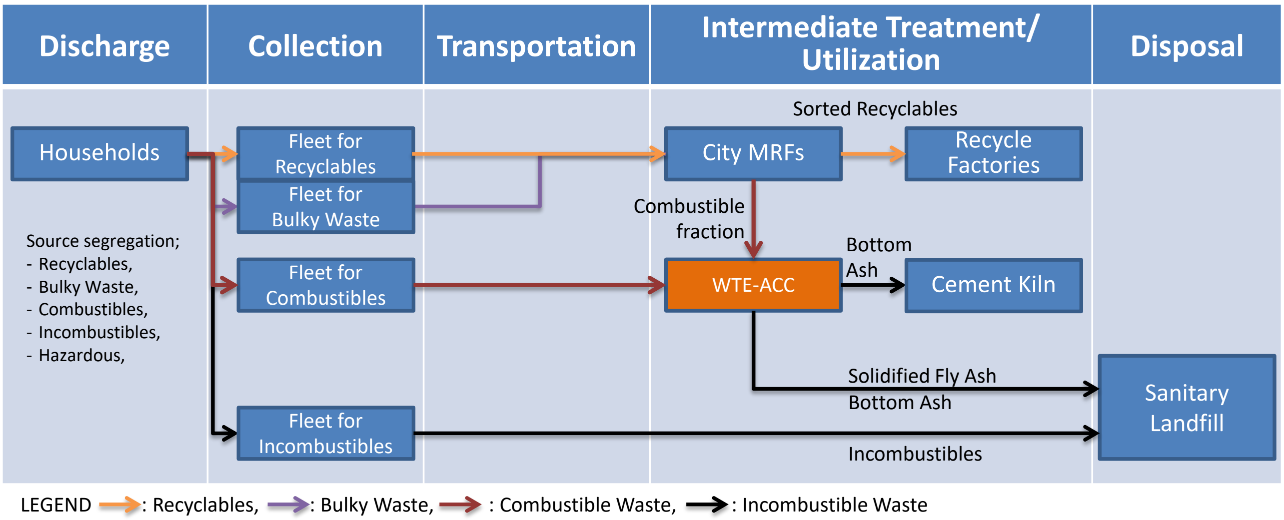


Figure 3-3 Waste Treatment Block Flow with WTE-ACC

Figure 3-4 Figure 3-5 illustrates waste treatment block flow with compost facility and/or biomethanation in addition to WTE-ACC. In this case, "biodegradable waste" segregation is required for household level. For biomethanation, purity of biodegradable is required so usually there is manual/mechanical waste segregation process before digester. The biggest challenge for compost and biomethanation is security of off-taking agreement for long-term. In the urbanized area, it is difficult to secure 200~500t/day of compost and digestrate demand for every day, in such case, stock shall be disposed in SLF appropriately.

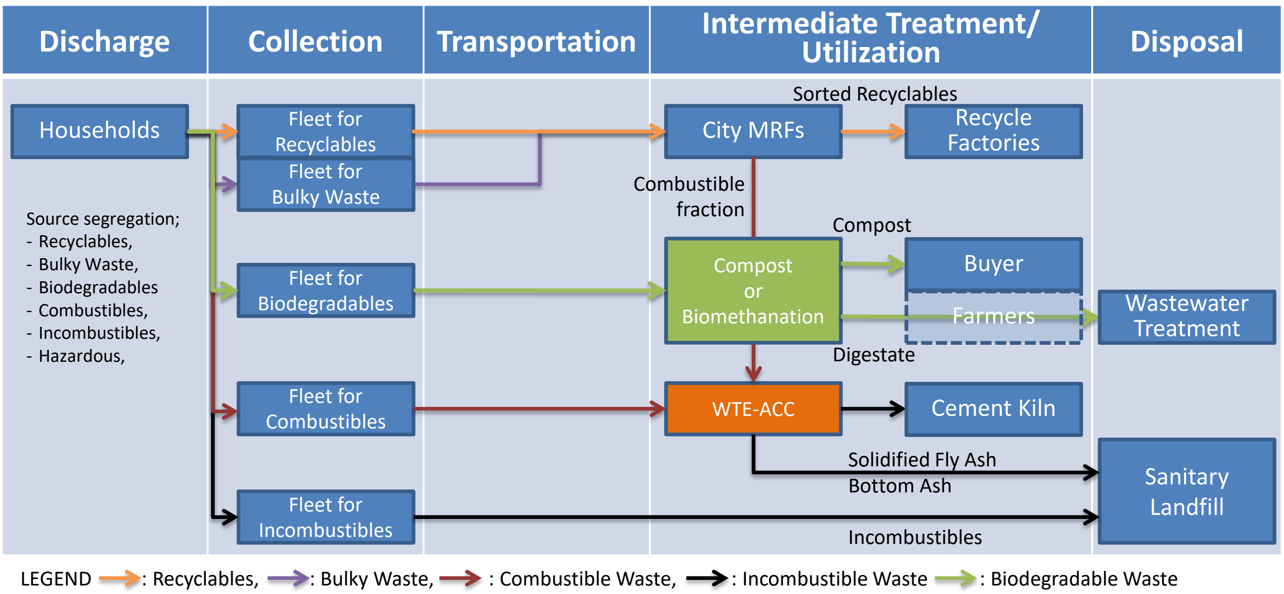


Figure 3-4 Waste Treatment Block Flow with Compost/Biomethanation

Figure 3-5 illustrates Waste Treatment Block Flow with RDF fluff production in addition to WTE-ACC. Segregation of Paper and Plastics which will be the material of RDF fluff at source is required. Same as compost/biomethanation, depending on the demand of off-taker (assuming cement industry), surplus of RDFs have to be disposed (utilized) in WTE-ACC.

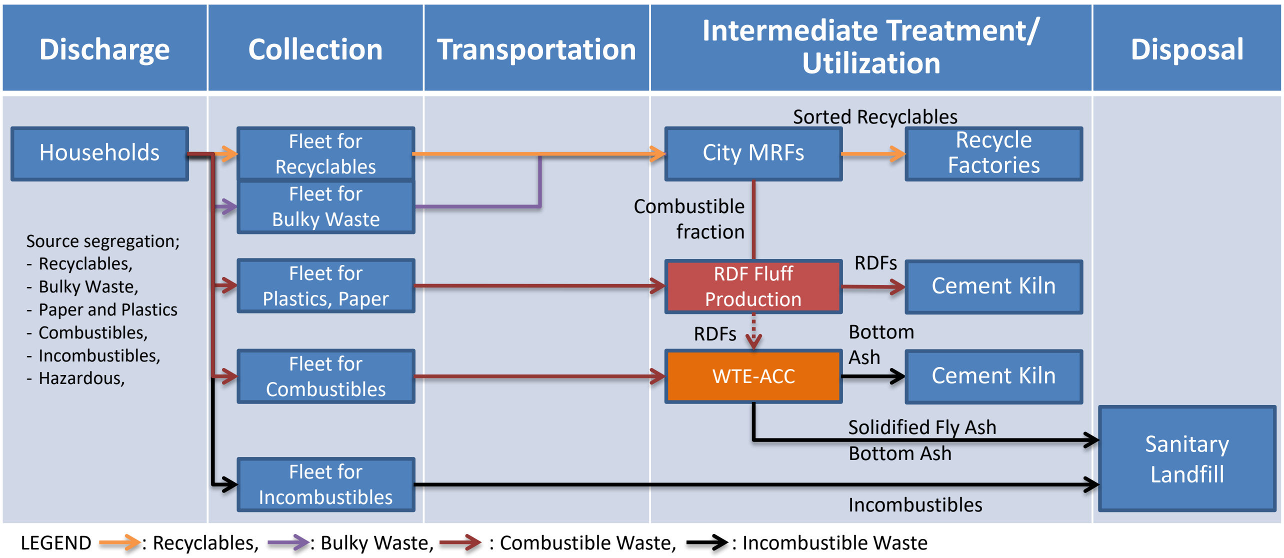


Figure 3-5 Waste Treatment Block Flow with RDF

(3) Setting of evaluation items and evaluation standard

To set up specific evaluation items and evaluation standard, it is necessary to sort out the functions and performance required for the treatment method, represented by the factors such as economy, safety, operational stability, maintenance manageability, durability, environmental friendliness, resource saving, and the conformity with facility development concept of LG.

Recently, since demands for the level of waste management quality are increased, and become diversified, it has become necessary to set evaluation items and standard based on various viewpoints, as well as to pay sufficient attention to securing appropriateness. Therefore, it is desirable to establish an evaluation committee for determination of the evaluation items and standard from a comprehensive and objective point of view.

(4) Data to be collected for the evaluation

It is desirable to use quantified data on the basis of the highest possible reliability for the evaluation of each treatment method. Therefore, when collecting evaluation data, it is desirable to prepare as much as possible **actual performance data in previous cases**, studies issued by public organizations, reports of academic associations, and specialized journals. In addition, when soliciting plant manufacturers for interviews and/or technical proposal, **in addition to select highly reliable and proven plant manufacturers, it is also necessary to confirm the technical adequacy of the proposed technology: whether the proposed technology has good operating records or not.**

(5) Comparative evaluation of treatment methods

As for the preparation of bid, it is very common to narrow down to one treatment method so that subsequent process e.g. EIA can be simpler. However, if LG wants to keep more than one treatment methods for bidding document, then it is not necessary to select only one technology at this phase; in fact, there are cases that start bidding process while still left more than one options for treatment methods (Called as **open technology selection**). However, if multiple treatment methods are left as options, Environmental Impact Survey (or Environmental Impact Assessment) shall also be carried out for multiple treatment methods, so attention should be paid to the setting of the pollution source conditions for environmental impact predictions, such as gas diffusion, noise calculation, etc. In addition, it is desirable to adopt the "Comprehensive evaluation type of bidding" that can select the successful bidder based on the score of technical bid and financial bid because the benefits associated with the selected treatment methods shall be different and it is difficult to evaluate only economy.

Furthermore, depending on the furnace type and processing system, there might be a difference in the number of technology holders, and in the number of companies who have willingness to participate. Therefore, regarding the selection of the treatment method, it is necessary to pay attention to make sure to maintain the competitiveness in the entire procedure.

Actual case studies for the technology selection for a city in Japan is shown in APPENDIX D: AN EXAMPLE OF WASTE TREATMENT TECHNOLOGY SELECTIONS IN JAPAN

3) Environment Technology Verification (ETV) under DENR-DOST Joint Administrative Order 2006-001

Section 5. e) Requirements of DAO2019-21, "e) The proponent shall submit an Environmental Technology Verification (ETV) Statement and Report following the DOST ETV Protocol as per DENR-DOST Joint Administrative Order 2006-001."

As written in Table 1-1 , ETV statement or report is the evaluation result of the claim that the applicant requested to validate, and ETV does not endorse, approve or authorize for use any product that it evaluates. Therefore, end user of WTE, which is normally LGU, shall understand such ETV policies and limitations, and is needed to analyze how the proposed technology is reliable by own discretion.

Although there are a lot of technologies to convert waste to usable heat, considering the MSW treatment is one of the public obligations, choosing proven technology with enough operational track record are essential because there are also many failure cases which employ unproven technology in the world.

3.3 Target Waste Amount

1) Target Waste Amount

The Target waste amount is the basis for setting the scale/size of the facility, and is important for the prediction of future amount, and must have high accuracy. In addition, when placing a combined order of both construction and operation work, such as PFI and DBO business schemes, because it is necessary to indicate in advance the target waste amount of each year for entire project period, it is also necessary to predict the target waste amount considering the target waste amount in the final year of the project.

2) Estimation of Target Waste Amount

The estimated amount of refuse generated and treated in the target year of the plan shall be determined for each type of refuse, considering the projected future population, the effect of waste reduction through emission control and collective collection, etc., the estimated amount of in-house treatment, etc., and the amount of refuse brought in (or carried out to other municipalities) from other municipalities.
In particular, consideration shall be given to the fact that the amount of refuse generated has generally been declining in recent years.

(1) Future projection of population and business activities, etc.

Since the amount of waste generated and disposed of varies depending on the population, social and economic conditions of the municipality, and local efforts to address the waste problem, these factors shall be forecasted, considering future trends. In this case, the impact of a declining population and an aging society with fewer children should be taken into account as much as possible. In addition, the tourist population and development plans for residential areas, etc. shall also be fully taken into consideration.

A. Population Projections

For future population projections, it is appropriate to use the trend method or the cohort factor method. It is also possible to use the projected future population indicated in the basic concept of the municipality.

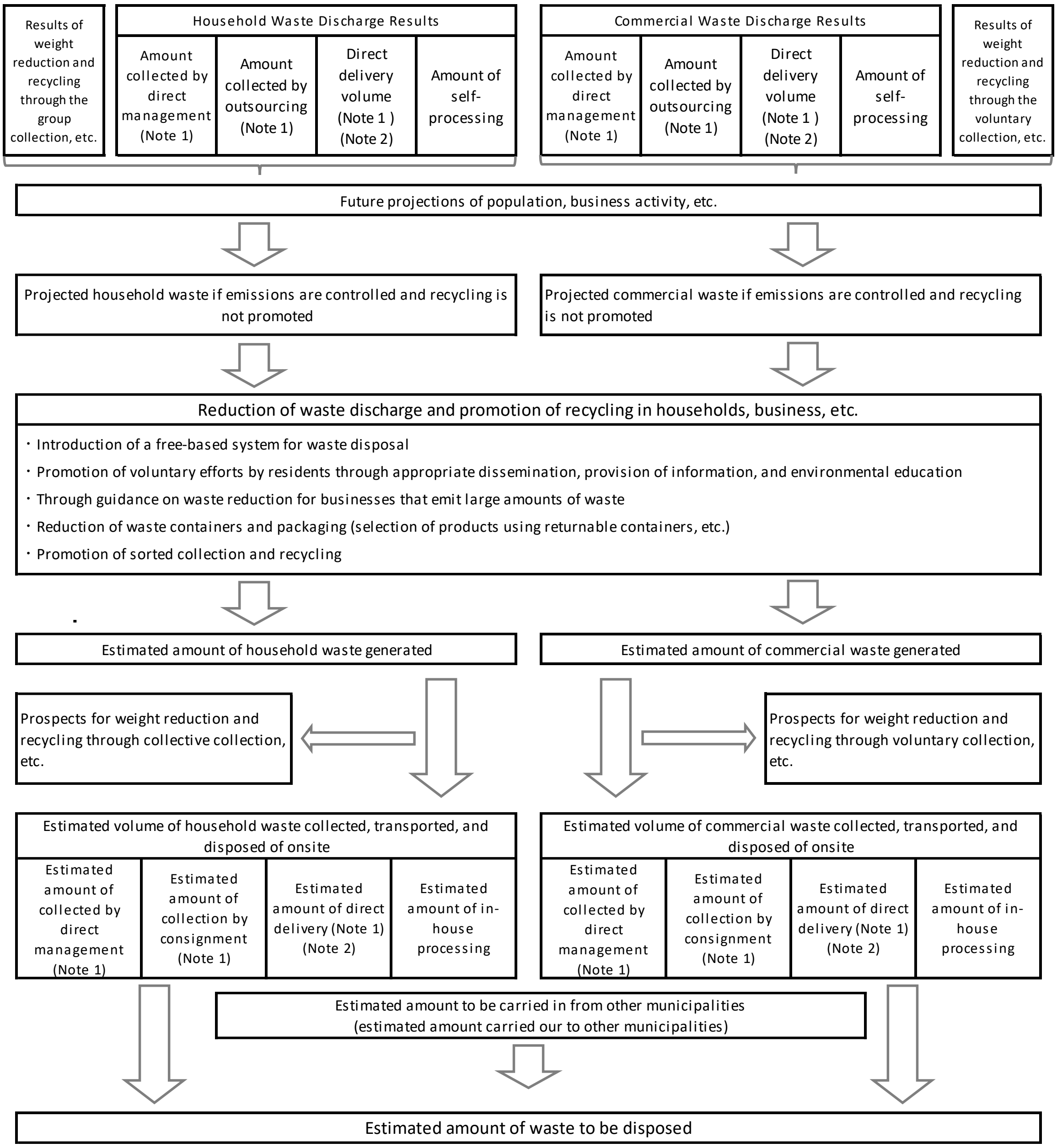
B. Future projections of business activities, etc.

As for commercial waste, it is desirable to make these projections depending on the situation, as they are affected by changes in the number of employees and business establishments, changes in economic conditions, and other factors.

(2) Estimation of future waste generation

First, an estimate is made of how the amount of waste generated will change in the future if waste emissions are not curbed, recycling is not promoted, and improvements are not made toward the formation of a recycling-oriented society. However, it should be noted that the amount of refuse generated has generally been declining in recent years. Possible forecasting methods include calculating the amount of waste generated per person per day (g/person/day) based on past results, estimating the future using the trend method, etc., and then multiplying the amount of waste generated by the projected future population.
Next, it is necessary to set targets based on policies implemented to curb the emission of waste from households, businesses, etc., and to promote recycling. Specifically, target values for the amount of waste generated should be set based on the effects of reducing waste emissions through the introduction of charging for waste disposal, implementation of public awareness programs, and other measures. Target values for recycling should be set based on changes in sorted collection categories, etc. Based on the above, the amount of waste generated by type (e.g., combustible waste, non-combustible waste, recyclable waste, bulky waste, especially controlled general waste, etc.) after achieving the targets should be forecasted after considering the effects of measures for collection (directly managed or outsourced), direct delivery, group collection, etc., respectively. In addition, in order to clarify the treatment system and volume to achieve the target values, it is desirable to show the volume from discharge to recycling and final disposal in the target year or interim target year in a flow diagram.
If a time-series graph is created that compares the predicted values and the target values to be achieved through various measures in the case where the current status remains unchanged without the previously predicted improvements toward the formation of a recycling-oriented society, the target values can be explained in an easy-to-understand manner for residents.

The estimation of projected waste amount shall be conducted as shown in Figure 3-6 .

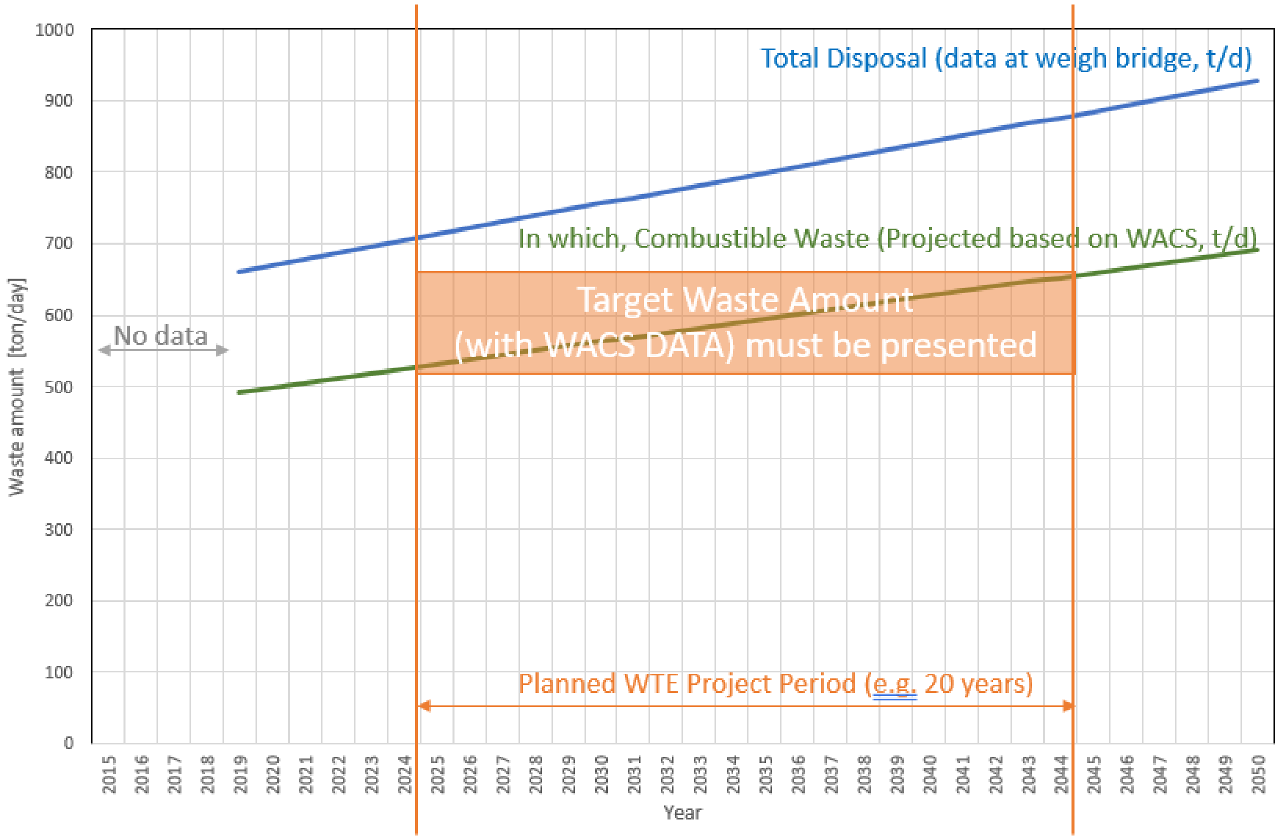


Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Figure 3-6　Examples of methods for predicting the amount of waste generated and treated

In the Philippines, 10-year plan is required while the life time of WTE-ACC is more than 10 years. In the planning of future waste quantity in F/S, the prediction period must be longer than 10-year plan.

On the other hand, since the expected amount of waste generated and treated/disposed in the facilities will be determined in 10-year SWM Plan or Waste Treatment Master Plan as higher level plan, it is necessary to use the target waste amount as specified in this plan. However, if it is decided that waste from recycling centers and other WTFs are to be incinerated together at the facility during the formulation of the target waste amount, it is necessary to review the target waste amount carefully and improve the facility plan's accuracy. In addition, for recycling centers, since it is necessary to set the capacity for each processing line, for example, of cans and glass bottles, it is also necessary to set the target waste amount of each classified category. For the combined project plan of WTE-ACC and Bio-methanation Facility, target waste amount for WTE-ACC shall consider the treatment method of Bio-methanation system.



Source: JICA Expert Team

Figure 3-7 Projected Target Waste Amount in the Planned WTE Project Period

3) Capacity of the facility

The capacity of the facility determines the processing capacity necessary to stably and economically treat the waste generated from the area during the period from the Commercial Operation Date until abolition of the facility. Regarding the capacity of the facility, the planner need to consider the factors and conditions of the local area such as target waste amount, number of operational/shutdown days of the facility, processing of extra waste generated during disasters, or high fluctuation of waste in tourist seasons., etc. On the other hand, the calculation method shown in Figure 3-8 has obtained certain reputation, and it has been widely used to set up the capacity of new facilities.

2. With regard to the Capacity of WTE-ACC

(1) Plant Capacity

Plant capacity (t/day) shall be calculated by following formula;

$$= \frac{Planned\ ave.waste\ gen.ratio\ (t/person - day)x\ planned\ collection\ pop.(person) + Planned\ direct\ delivery\ (t/d)}{plant\ availability\ (\%)x\ palnt\ adjustment\ availability(\%)}$$

a. Planned average daily waste generation rate per person (t/person-day),
Projected waste generation ratio based on the concept stipulated in "1 (3)" considering the Containers and Packaging Recycling Law as well as Food Recycling Law.

b. Plant availability ratio = (365 days – annual shutdown days) / 365days
Annual shutdown days shall be maximum 85 days, however, if special reasons not to comply with this, it is necessary to write reasons and discussion with relevant authorities.

(Note) Composition of 85 days are; Conditioning and maintenance: 30days, Check and repair 15days x 2times (30days), System shutdown 7 days, 3days for start-up x 3 times (9days), 3 days for shutdown x 3 times (9days)

c. Adjustable availability ratio = 96%
Adjustable availability ratio is the factor considering the capacity degradation in the case of unavoidable shutdown, urgent repair during the originally operation period.

(2) Number of furnace shall be basically 2 or 3, determined by the due deliberation of countermeasures during maintenance and economy,

(3) Capacity of waste receiving pit shall be determined considering the appropriate surplus of stable waste treatment,

(4) In case if there is existing WTF, and operation adjustment can be done with the facility, the capacity of new WTF shall be determined by the following formula;

$$= \frac{Planned\ ave.waste\ treatment\ amount\ (t/d) - Ave.daily\ treatment\ amount\ in\ existing\ facility\ (t/d)}{plant\ availability\ (\%)x\ palnt\ adjustment\ availability(\%)}$$

(Note) Average daily treatment amount in existing facility (t/d) = Annual treated amount (t/year) / 365 days

Source: Notification No. 031215002 of the director of waste management division, Waste Management and Recycling Dept, MOEJ

Figure 3-8 Example of calculation method of the capacity of WTE-ACC (15Dec, 2003)

3.4 Target waste quality

The Target waste quality in F/S is the quality of the waste to be delivered to the WTF/WTE for the planned years, and is determined based on records of the quality of the waste in past years, in seasons, and the plan for collection and recycling of waste in the future. Furthermore, it is important to set the target waste quality as the average value and the range of fluctuation.

<u>The waste quality is a generic term for the physical and chemical properties of the waste, i.e. “three component (water, combustibles and ash)”, “unit weight (apparent specific gravity)”, “physical composition (composition by type)”, “chemical composition (properties indicated by elemental composition)” and “lower calorific value (LCV)”</u>.

In planning a WTF/WTE, it is necessary to determine the waste quality in the target year along with facility type, the target waste treatment amount, however, waste quality is depending on the characteristics of the collection areas, applied waste separation system and many other factors. Therefore, to avoid any mismatch during the operation period, it is important to accurately predict and set the future waste quality based on the conditions such as waste separation and collection system, intermediate treatment and final disposal, etc. designed from long-term standpoint.

In planning a WTF, it is necessary to specify the waste quality according to the type of facility. For example, for the WTE-ACC, various properties such as “three components”, “unit weight”, and “colorific value” are needed to know the combustibility, and “elemental composition” of the combustibles are needed to know the composition of flue gas. For the Recycling Facility, factors such as composition of types of waste and unit weight are important for the selection of the type and capacity of equipment such as the crushing machine and sorting machine. For the bio-methanation system, water contents, pH and Carbon-to-Nitrogen (C/N) ratio which governs the fermentation process shall be important. Therefore, depending on the selected waste treatment system, survey items shall be different.

1) Type of waste

Types of waste are classified <u>based on either waste separation system</u>, or <u>kinds of materials and items</u>. ‘Types of waste’ by classifying materials and items is called “Composition of Waste in kind”. In each local area, when carrying out waste treatment, waste separation and collection system must be introduced with consideration to the actual conditions of the area.<u> The methods for separation shall differ depending on the situation of each area.</u> Table 3-7 shows an example of classification of waste based on Japanese *‘Waste Treatment Master Plan Formulation Guideline.’*

Also, recent years, as the background of increase the categories of waste separation items due to the promotion of 3R as well as regulations for plastic recycling towards the establishment of Circular Economy, LGUs who have implemented thorough waste separation/collection are increased. Table 3-8 shows the finest waste classification in kinds for the investigation of existing waste for the purpose to formulate practicable and detail future recycling plan and its implementation.

In other words, classification of waste is now possible to integrate or segmentalize according to the purpose of the waste usage/treatment, so ‘papers’ can be classified into ‘newspapers’ and ‘magazine’, and plastics can also be separated into several different sub-types, or conversely integrating them into the group. Therefore, ‘types of waste’ has a character that shall be changed with the area or with the time. As shown in Figure 3-8 number of the categories of waste separation at source is different in each LGUs across Japan and in FY2014 it is from 1 to more than 26 types.

Table 3-7 An Example of Waste Segregation Categories (A Case of a LGU in Japan)

Waste Segregation Categories	Combustible Waste	Non-Combustible Waste *2 (Unsuitable for combustion)	Bulky Waste*3	Recyclables	Hazardous Waste	Items difficult for appropriate treatment
Composition of Waste in kind	Paper, Kitchen Waste, Fibers, Woods, Plastics*1, Rubber*1, Leather*1, Etc.	Glass, Ceramics, Stones, Metals, etc.	Furniture, Electronics, Bicycles, etc.	Paper, Metal, Bottle, Glass, Cans, PET, etc.	Elec. parts which contains PCB, Dust from Waste Incineration Facility, Infectious Waste	Mattress, Rubber tire, TV,*4 Refrigerator,*4 etc.

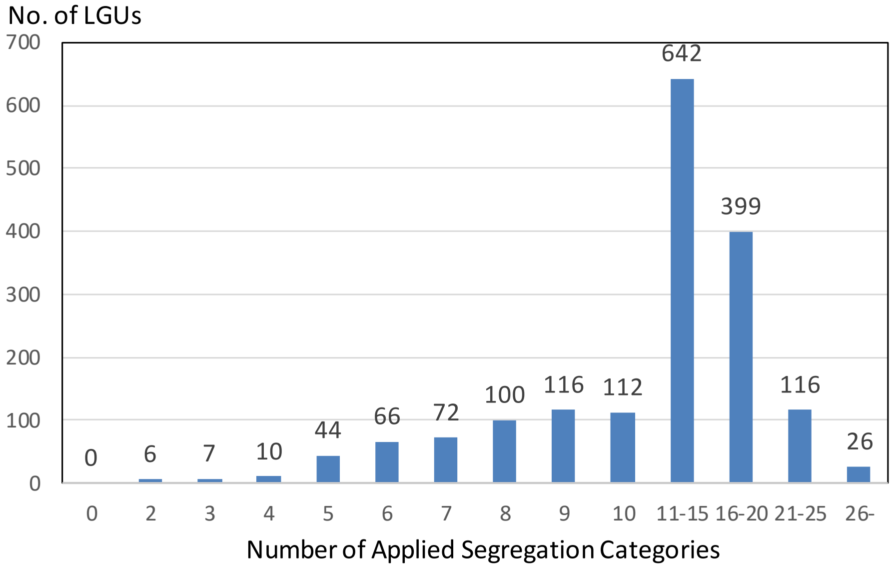
*1) Classification of plastics, rubbers and leathers are differed by LGUs (can be classified to Recyclables, etc.). According to Notice No. 43 of MOEJ in 2005, "for Plastics, LGUs shall take actions for Reduce, next Reuse/Recycle utilizing the rules of Packaging Law, the residues remaining form these 3R activities shall be used for heat recovery at the required level of efficiency, and no direct landfill considering the limitation of landfill site."
*2) Classification of Non-combustible Waste, sometimes include not only non-combustible waste but also unsuitable items for the combustion (burnable but not suitable).
*3) Classification of bulky waste sometimes divide into combustible-bulky and non-combustible bulky waste.
*4) TV and Refrigerator are classified in electric waste under Electric Appliance Recycling Law from 2001.
Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Table 3-8 An Example of Waste Composition Survey Categories (by Waste in kind)

					Sample NO				
Coll. Area		Coll. Date			Weather	Prev. day		Temp	dC
Location						Cur. Day		Temp	dC
						Specific Gravity			kg/L

NO	Major Classification	Minor Classification				Weight (Wet)	Ratio (Wet)	Apparent Volume	Apparent Specific Gravity
						g	%	L	kg/L
1	Plastic	Package	PET Bottle	Hard					
2				Soft					
3			Other Bottles	Hard					
4				Soft					
5			Tray	Formed Polystyrene	White				
6					Other				
7				Other					
8			Bag						
9			Other						
10		Non-Package							
	Sub-Total								
11	Paper	Package	For Beverage	Milk					
12				Other					
13			Other						
14		Non-Package	Newspaper						
15			Cardboard						
16			Magazines, etc.						
17			Mix Paper						
18			Other						
	Sub-Total								
19	Kitchen Waste	Waste Oil							
20		Other							
	Sub-Total								
21	Rubber and Leather								
22	Wood Waste	Clipped Branches							
23		Other							
	Sub-Total								
24	Textile	Usable as duster							
25		Other							
	Sub-Total								
26	Ferrous Metals	Package	For Beverage						
27			Taps and Caps						
28			Spray Can						
29			Other						
30		Non-Package							
	Sub-Total								
31	Alminium Metal	Package	For Beverage						
32			Taps and Caps						
33			Spray Can						
34			Other						
35		Non-Package							
	Sub-Total								
36	Other Metals								
37	Glass	Package	One-Way bottle	Colorless					
38				Brawn					
39				Other Colors					
40			Returnable Bottle						
41		Non-Package							
	Sub-Total								
42	Ceramics and Stones								
43	Hazordous Waste	fluorescent Tube							
44		Dry Cell Battery							
45		Mercurial Thermometer							
46		Other							
	Sub-Total								
47	Medical Waste	Specially-Controlled Municipal Waste							
48		Other							
	Sub-Total								
49	Other Combustibles								
50	Other Non-Comubustibles								
	Grand Total								

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)



Source: Japanese waste treatment in FY2014 (MOEJ, March2016)"
Figure 3-9 Situation of Waste Separation at Source in Japan

2) Items for Waste Quality Analysis (WACS in the Philippines)

Waste quality will be changed by separation system, type of business in the collection area, seasons, and socio-economic trends, etc. so waste quality surveys should be conducted as often as possible (at least four times a year) continuously and for more than 3 years.

The following items are generally used to investigate waste quality with defined testing method.

Table 3-9 Waste Quality Analysis Items

1	Physical Composition (%)	Depending on the waste separation classification applicable in each LGU. For example, if a LGU introduces waste classification of Table 3-7 physical composition shall be investigated/indicated in an accuracy of Table 3-8
2	3 Components (%)	Moisture, Combustibles, Ash
3	Calorific Value (kJ/kg)	High Calorific Value (HCV)[12], Low Calorific Value (LCV)[13]
4	Elemental Composition (%) of Combustible Matter	C, H, N, O, S and Cl
5	Specific Gravity (kg/m3)	Weight at sample waste of 1m3

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

There are many types of WTFs, such as incinerator (WTE-ACC), gasification & melting, crushing and sorting, RDF, high-speed composting, etc. Each of which has different treatment procedure, so it is necessary to select waste quality items to be analyzed based on the types of WTFs. A typical example of the waste analysis items corresponding to the type of facility is shown in Table 3-10

For the waste quality analysis method in Japan shall follow the "MOEJ Notification No.95 on 04Nov, 1977 (called as "Kansei 95") and "Waste analysis manual for WTFs[14]".

Table 3-10 Waste Quality Analysis Items for Each Type of WTFs (Example)

Variety of WTFs	Waste Quality Analyze Items
Incineration Facility, Gasification & Melting Facility	3 Components for Lower/Standard/Higher range of waste, Low Calorific Value, Specific Gravity, and Elemental Composition (C, H, O, N, S, Cl)
Crush and Sorting Facility	Composition in kind and specific Gravity (t/m3)
RDF Facility	Same with Incineration Facility + Composition in kind
Composting Facility	Composition in kind, Water Contents, pH, Specific Gravity, Elemental Composition (C, N, Heavy metals, etc.), Impurities Ratio

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

3) Items of Waste Quality Analysis and their Purposes

[12] HCV (in some cases called as Gross Heating Value, which is measured by the calorimeter,
[13] Net heating value which deducts vaporization heat of water contents inside of waste/combustibles from Gross Calorific Value.
[14] Japan Waste Management Association (Dec1983) Edited by Env. Dept. Ministry of Health (present MOEJ)

The Items of analysis/examinations on waste quality and each purpose are as follows;

(1) Physical Composition

By examining the composition of waste, it is possible to grasp the discharge situation by segregation types of waste, and from then to materialize the design plan for collection and transportation, treatment methods, final disposal sites, and recycling. Regarding the classification of survey items, it can refer Table 3-8 presented in the previous section.

Additionally, there are two display basis, which are WET and DRY basis. So, it is desirable to display the result of composition survey with their corresponding types (wet or dry) to avoid displaying error.

(2) 3 components / Proximate Analysis

For the planning of WTFs in particular WTE-ACC, obtaining 3 components composition of water, combustibles, and ash is fundamental understand the overall property and combustibility of the Target Waste.

Also, most of the ash components come from non-combustible waste, and it is an important factor to consider in planning for a final disposal site, and recycling plant of incineration ash.

(3) Specific Gravity

Specific Gravity is a factor used for the designing of; Garbage vehicle plan for the waste collection and transportation works, Volume of Sanitary Landfills, Volume of pit and crane in WTE-ACC as well as Volume of the capacity of conveyors, tanks and storages in each MRFs and/or WTFs, etc.

(4) Calorific value

Low Calorific Value (LCV) of waste is an important factor in designing WTFs that specializes in thermal processing, such as WTE-ACCs, and gasification melting facilities. Major parameters for firing grate, combustion chamber, the gas cooling system, the exhaust gas processing system, etc. will be determined by this LCV.

When the calorific value of the waste is low, and below the stable combustion temperature, an auxiliary fuel (e.g. heavy oil, kerosene, gas, etc.) is needed to maintain the combustion temperature. The stable combustion temperature in the waste incinerator refers to a temperature range (850^0C or higher) at which dioxins and furans can be decomposed; the low calorific value sufficient to maintain a stable combustion temperature varies, depending on the furnace types and gas cooling system, is usually around 4,200~5,000kJ/kg (1,000~1,200 kcal/kg).

Therefore, in such cases, it is important to homogenize the waste quality as much as possible by, for example, mixing the waste inside of the pit.

(5) Elemental composition (Ultimate Analysis)

Elemental composition is an item necessary for examining the volume of combustion air and exhaust gas, and their composition, as well as harmful gas concentration, etc. in a WTFs such as a WTE-ACC or a gasification melting facility. Also, it is an indispensable item in the consideration of the gasification process and its operation, as well as in the assessment of the quality and economic efficiency of RDF facilities.

(6) Others

In addition to the items described above, for recycling facilities (for non-combustible waste, bulky and packaging plastics, etc.), size and specific gravity for each item will be required for the plan and design optimal system in the receiving, feeding, crushing and sorting equipment. Aside of it, in bio-methanation facility, Physical Composition information will be important to judge the biogas quality, extraction yields, and residues quantities, etc.

4) General trend of waste quality

Municipal wastes discharged from households consist of combustible materials such as wood, paper, plastics; less-combustible materials such as kitchen waste; non-combustible materials such as metal, glass, soil and sand, etc., not to mention the many forms, humidity and sizes of them.

The proportions of these components differ depending on the type of business in the collection areas (rural areas, residential areas, shopping streets, and office building areas, etc.), as well as their separation categories (such as whether plastic packages are sorted for recycle or burned in a mix with combustibles, etc.)

5) Examples of Waste Quality Analysis Result

(1) Results of Waste Quality Analysis in Large Cities of Japan

Table 3-11 shows the Waste Quality Analysis results from 2006 to 2015 in large cities in Japan. Displayed here are the yearly change of Composition in kind (Physical composition), 3 components (proximate analysis), Elemental Composition (ultimate analysis), Low Calorific Value, and Specific Gravity of Target MSW measured in surveyed cities and their respective facilities. Also, in Figure 3-9 and Figure 3-12 , these yearly data are displayed in the graphs.

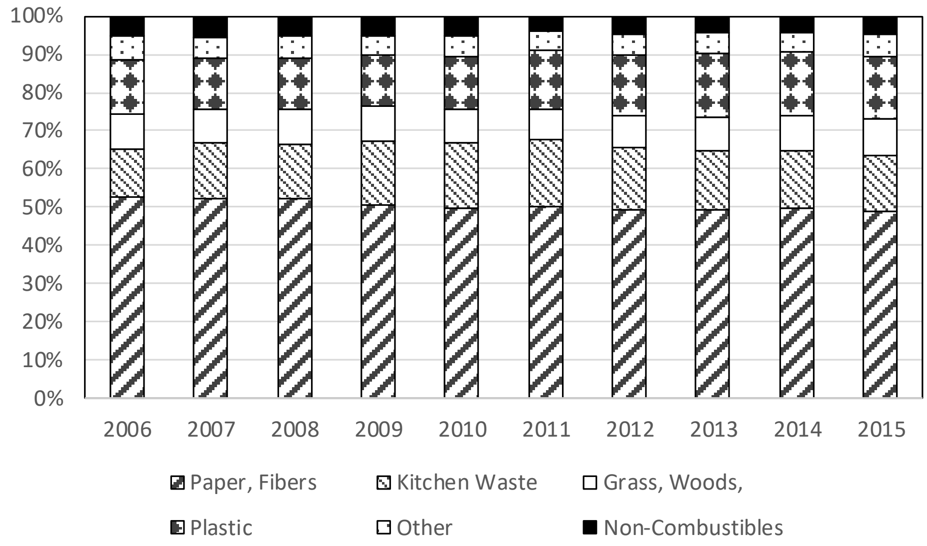
Table 3-11 Results of Waste Quality Analysis in Large Cities of Japan (2006 to 2015)

			Unit	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Composition in Kind (Physical Composition)	Combustibles		%	94.8	94.5	94.7	95.0	94.8	96.2	95.3	95.8	95.9	95.1
		Paper, Fibers		52.9	52.1	52.1	50.5	50.0	50.1	49.4	49.1	49.4	48.7
		Kitchen Waste		12.6	14.6	14.3	16.8	17.3	17.3	16.4	15.4	15.2	14.4
		Grass, Woods,		9.1	9.1	9.4	9.3	8.8	8.0	8.4	8.7	9.1	9.8
		Plastic		14.1	13.3	13.0	13.2	13.7	15.5	15.9	16.6	16.8	16.2
		Other		6.4	5.4	5.9	5.4	5.4	5.2	5.4	5.4	5.0	5.7
	Non-Combustibles			5.2	5.5	5.3	5.0	5.2	3.8	4.7	4.2	4.1	4.9
3 Comp	Combustibles		%	49.5	49.3	48.6	47.7	48.5	49.6	48.4	49.4	48.7	47.4
	Water			41.1	41.0	42.5	43.2	42.8	42.9	43.0	42.3	43.1	44.2
	Ash			9.4	9.8	8.9	9.1	8.7	7.4	8.6	8.2	8.1	8.4
Elemental Composition	C		%	52.7	52.1	52.2	53.1	52.3	53.4	54.7	53.1	52.6	52.3
	H			7.5	7.4	7.4	7.4	7.4	7.5	7.8	7.3	7.3	7.3
	N			1.0	1.1	0.9	0.9	0.9	0.9	1.0	0.8	1.2	1.1
	S			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Cl			0.7	0.6	0.4	0.4	0.3	0.4	0.4	0.4	0.3	0.5
	O			38.0	38.8	39.1	38.3	39.0	37.7	36.1	38.4	38.5	38.7
Low Calorific Value			kJ/kg	9,507	9,534	9,314	9,276	9,198	9,666	9,427	9,573	9,564	9,491
Specific Gravity			t/m3	0.17	0.16	0.17	0.19	0.18	0.18	0.18	0.17	0.17	0.17

*1) Data in the table above is the average of Waste Quality Survey Results in 11 LGUs in Japan (Yokohama, Okayama, Kyoto, Sapporo, Kobe, Sendai, Osaka, Yao, Matsubara, Kita-Kyushu and Nagoya)
*2) Sum of the compositions will not be 100% because of rounding off fractions.

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

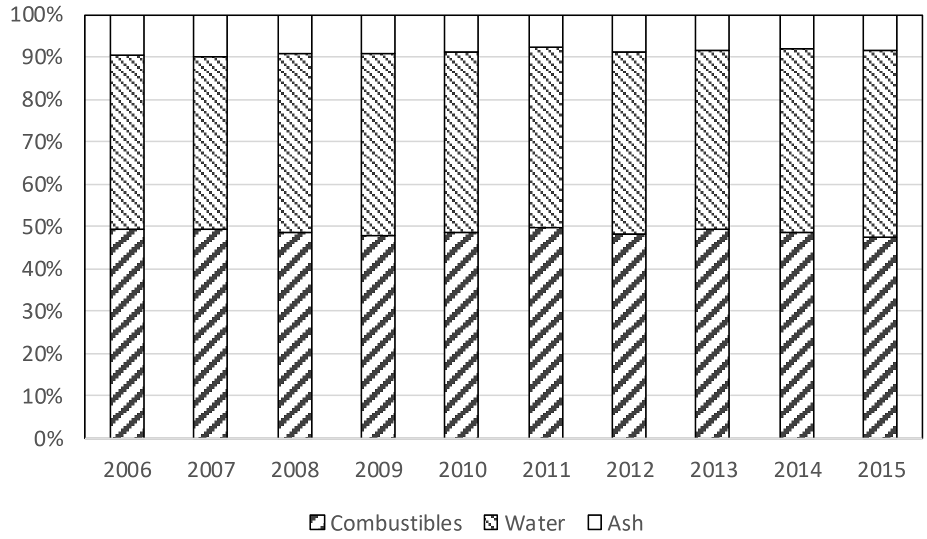
Figure 3-10 shows the trend of annual change of averaged physical composition of 11 LGUs in Japan. It shows that papers and fibers decrease, and plastic increases. This is probably because among the surveyed cities and facilities, some cities who previously treated plastics as non-combustible, changed plastics to combustibles from 2011.



Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Figure 3-10 Yearly change of Composition in Kind

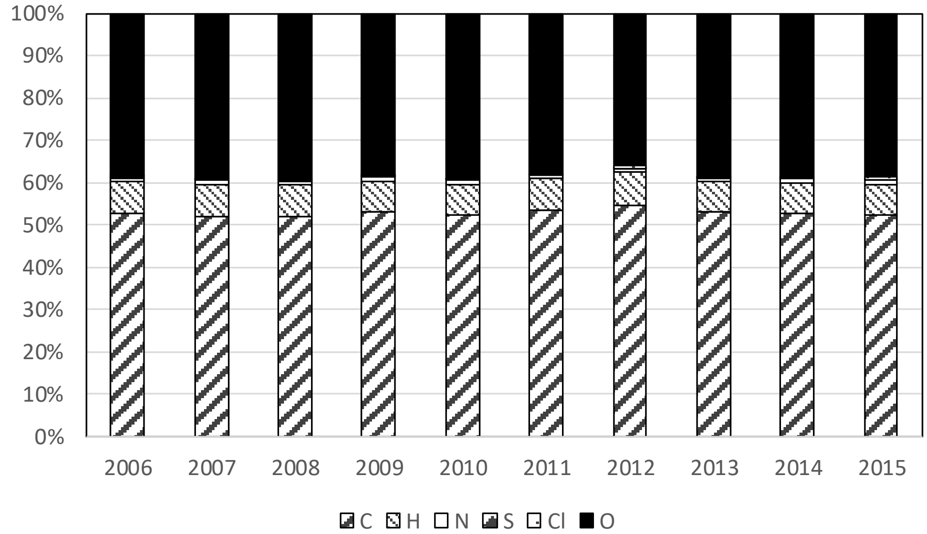
Figure 3-11 shows the annual change of 3 components (water, combustibles, ash) in average of 11 LGUs in Japan. No major change is observed in these 10 years.



Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Figure 3-11 Yearly Changes of 3 Components

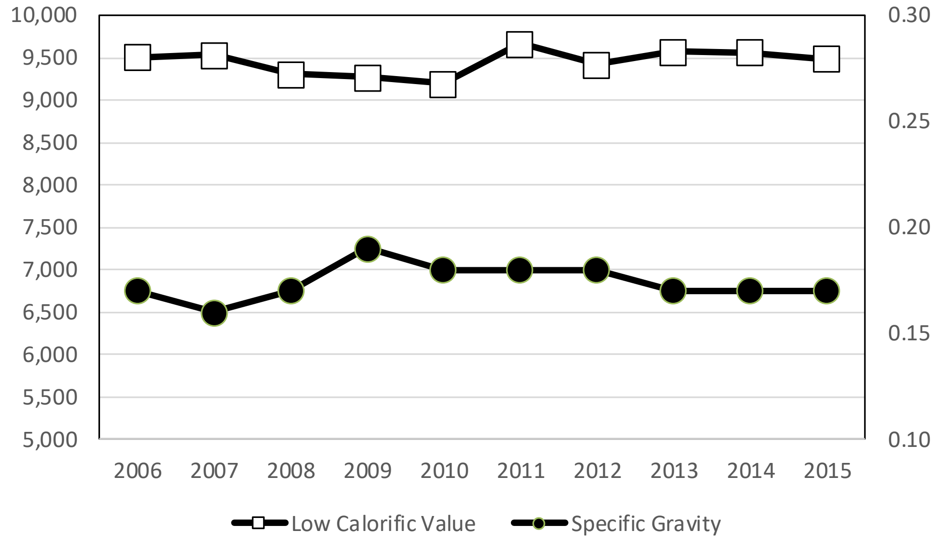
Figure 3-12 shows the changes over time of elemental composition (carbon, hydrogen, nitrogen, sulfur, chlorine, oxygen) in average of 11 LGUs in Japan. No major change is observed in these 10 years.



Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Figure 3-12 Yearly Changes of Elemental Composition

Figure 3-13 shows changes over the year of Low Calorific Value and Specific Gravity. No major change was observed in the past 10 years.



Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Figure 3-13 Yearly Changes of Low Calorific Value (Left axis, kJ/kg) and Specific Gravity (Right, t/m3)

(2) Sample cases of waste quality analysis by Classification in Kind

Generally, in waste quality analysis, the waste that has been transported to, and stored in, the WTE-ACCs will be use as sample for analysis in Japan. However, there are LGs that perform waste quality analyses in each waste segregation categories. In case there are changes of separation category of waste due to development of a new facility (such as new sorting line for plastics), those data will be helpful for ascertaining the waste quality after such changes have been made. The following table introduces an example of waste quality analysis by waste classification in kind conducted in Yokohama City.

Table 3-12 Elemental composition analysis results by Waste Classification in kind (averaged from data in Yokohama between 2006 and 2015)

Element / Classification	Ash	Carbon (C)	Hydrogen (H)	Nitrogen (N)	Oxygen (O)	Sulfur (S)	Chlorine (Cl)
Paper	9.83	42.57	5.87	0.59	41.35	0.00	0.11
Kitchen Waste	13.06	45.15	5.98	2.54	33.00	0.03	0.25
Fiber	1.45	52.43	6.49	2.37	36.90	0.02	0.33
Grass and Woods	9.32	45.99	5.60	1.02	37.91	0.00	0.17
Plastic	4.52	72.28	11.32	0.48	9.89	0.00	1.51
Other (Rubber, Leather)	32.72	36.25	4.30	1.56	25.03	0.01	0.13

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

6) Setup the Target Waste Quality for WTE-ACC

(1) Overview

WTE-ACCs are designed to satisfy all trade-off factors such as capacity, stability, safety and economic efficiency by selection of machineries/equipment considering the required performance and functions in accordance with MSW quality to be *delivered* to the facility. So, WTE-ACCs in Japan have achieved the treatment of all MSW generated in LGUs without any stagnation.

For example, when the LCV of the waste is low, the furnace temperature was lowered, and the stability of the combustion tends to be lost, thus it takes longer time to complete the combustion. As such, if we want to maintain a certain level of incineration ash quality, the incineration capacity will have to decrease. On the other hand, when the water content is low and the calorific value is high, the amount of supplied air and combustion gas will both increase, then the amount of generated heat to increase; that can make the gas cooling system, ventilation system and exhaust gas processing system reach their capacity limit. When that happens, the incineration capacity is also decreased.

Based on the factors above, the grate area necessary to maintain the amount for incineration will be determined by the *Lower-Quality of Waste (Lower limit of design range)*, while the volume of either the ventilation and exhaust

gas equipment (fans, dust collector, exhaust gas treatment equipment, etc.) or the heat recovery equipment (waste heat boiler, water jet gas cooling equipment and other surrounding equipment) will be determined by *Higher-Quality of Waste (Upper limit of design range)*. In short, there is a close correlation between the technical requirement of each equipment and the waste quality.
Table 3-13 shows how differences in waste quality will influence the determination of volume and capacity of the equipment in incineration facilities.

Table 3-13 Relationship of waste quality and facility plan/design

Equipment / Waste Quality	Incineration Equipment	Ancillary Equipment (Design mainly for the capacity)
Higher-Quality of Waste (Upper limit of design range)	Heat Load of Combustion Chamber Capacity of Combustion Chamber Capacity of Secondary Combustion Chamber	Ventilation, Crane, Gas Cooling, Exhaust Gas Treatment, Water Cooling, Elec. Transformer, etc.
Standard-Quality of Waste (Standard Design Point)	Basic Design Point, Maximum Continuous Rate (MCR)	Capacity of Waste Pit
Lower-Quality of Waste (Lower limit of design range)	Grate Firing Ratio (for Stoker) Furnace Bed Firing Ratio (for Fluidized Bed) Grate Area (for Stoker) Furnace Bed Area (for Fluidized Bed)	Capacity of Air Pre-Heater, Supplemental Combustion Equipment

Source: JICA Expert Team based on Planning and Design Guidelines for WTF Development (2017, JWMA)

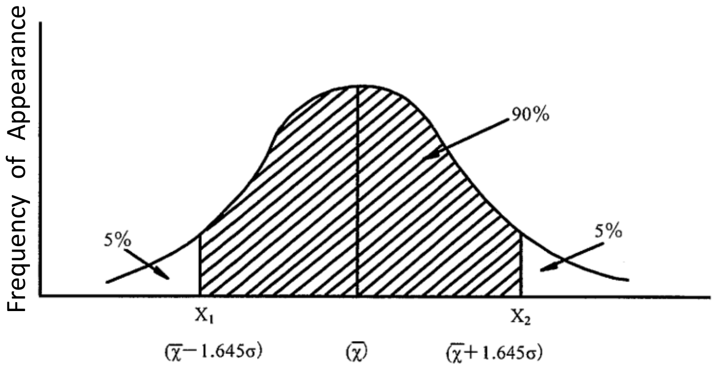
As written in the above, in designing a waste incineration facility or WTE-ACC, it is necessary for each of the items below to be assigned with, at least, average (Standard-Quality of Waste), upper-limit (High-Quality of Waste) and lower-limit (Lower-Quality of Waste) as the range of variation/deviation of Waste Quality should also be made clear. Also, apart from combustible waste, if there is combustible bulky waste transported into the facility, it is necessary to indicate the content, the range of variation, and the weight ratio between regular combustible waste and the bulky combustible waste so that it will be able to accurately grasp the real waste quality after mixture of them in pre-treatment.
Furthermore, Standard-Quality of Waste (averaged and standard waste quality) is an item indispensable to grasp the daily maintenance costs (mostly from utility and consumable expenses) while is showing the standard capacity of the facility.
Therefore, it is desirable to figure out the frequency of appearance of Lower-quality of Waste, Standard-Quality of Waste, and Higher-Quality of Waste.

(a) 3 components (for each of Lower-Quality of Waste, Standard-Quality of Waste, and Higher-Quality of Waste)
(b) Low Calorific Value (same as above)
(c) Specific Gravity (same as above)
(d) Elemental Composition of Combustibles (Only for Standard-Quality of Waste)

(2) Setup Procedure of Target Waste Quality
Followings are the common procedure to setup the Target Waste Quality based on the analysis data of the waste sampled from waste pit in the past.

A. Lower Calorific Value (LCV)
Assuming that the analyzed data of waste found in pit are many and sufficient enough[15], and assuming that the frequency of appearance follows a normal distribution, the Low Calorific Value should be set with the upper and lower limits at both ends of the 90% confidence interval (See Figure 3-14).

[15] Please also refer "3.46) (4) " for the question to "How many samples are enough?"



Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Figure 3-14 Distribution of Lower Calorific Value (LCV)

It is very important to do so because, if we design a WTE-ACC that targets extremely low calorific value of Lower-Quality of Waste with low frequency of appearance, or the high calorific value of Higher-Quality of Waste that rarely appears, the capacity of the equipment will be redundant, and the economy of the facility will be lost. For the appropriate designing of the facility, the ratio of LCV between 'Lower-Quality of Waste' and 'Higher-Quality of Waste' should be within the 2.5 times, otherwise designing of proper facility will be difficult.

The following shows the procedure of setting LCV range based on the past analyzed data of waste.

(a) Evaluation of distribution of measurement data
(b) Validation of outlier value in measurement data
(c) Calculation of Basic statistics (max, min, range, mean, standard deviation, confidence interval of population mean, etc.)
(d) Setup Lower/Standard/Higher-Quality of Waste (adopting 90% confidence interval and less than 2.5 of Higher/Lower calorific value ratio).

The following shows an example for setting the Lower Calorific Value range.
Now, when there are *n* pieces of LCV data (χ_1、χ_2、$\chi_3 \cdots\cdots \chi_n$) and if this can be deemed as a normal distribution, the higher and lower limits of this 90% confidence interval can be obtained as follows. If the data do not represent a normal distribution, remove the outliers so that the data follow the normal distribution, then proceed to carry out the following procedure. In addition, in case outliers are removed, other waste quality data (3 Components, Specific Gravity, Elemental composition) obtained from the outliers will not be used for setting the planned Target Waste quality.

i) Find the average of the calorific value. The LCV of Standard-Quality of Waste will employ this average value.

$$\bar{\chi} = \frac{\Sigma\ (\chi_1 + \chi_2 + \cdots\cdots + \chi_n)}{n}$$

ii) Find the Sum of squared deviation as "S".

$$S = (\chi_1 - \bar{\chi})^2 + (\chi_2 - \bar{\chi})^2 + \cdots\cdots + (\chi_n - \bar{\chi})^2 = \sum_{i=1}^{n} (\chi_i - \bar{\chi})^2$$

iii) Find the Dispersion as "σ^2".

$$\sigma^2 = \frac{S}{n - 1}$$

iv) Take the Square root of the value in iii) above and figure out the standard deviation. In other words, σ is represented by;

$$\sigma = \sqrt{\sigma^2} = \sqrt{\frac{S}{n-1}} = \sqrt{\frac{\Sigma\ (\chi - \bar{\chi})^2}{n-1}}$$

v) Assign X1, X2 as the upper and lower limit of this 90% confidence interval, respectively.

$X_1 = \overline{\chi} - 1.645\sigma$ [16]
$X_2 = \overline{\chi} + 1.645\sigma$

vi) If the ratio of X1:X2 is in the range of 1:(2-2.5), and if the values are not abnormal numbers, then they will become the lower and upper limit value.

vii) If the ratio of X1:X2 is outside of the 1:(2-2.5), consider a correction based on the previous waste analyzed data. For example, if the ratio of X1:X2 is less than 1:(2-2.5) and there are analyzed data out of the X1:X2 range in the past analyzed data, consider selecting X1 and X2 values in a large range to make correction, because the undesired ratio might come from the disposal of waste that did not have sufficient mixing in the waste pit. Additionally, if wastes with extremely low calorific value such as human waste sludges are treated together, then it is important to consider treating waste with low calorific value only for a while and set a lower limit value for low calorific value.

B. 3 components

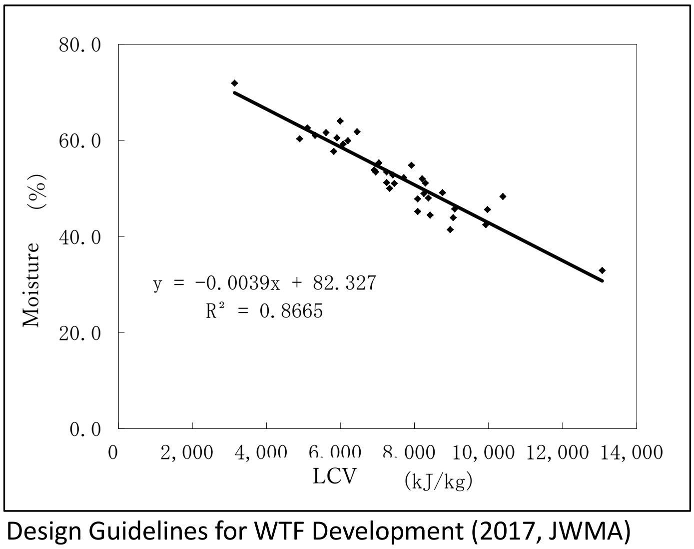
a) Moisture and Combustibles

It is known that Moisture and Combustibles show high correlation with Lower Calorific Value. The moisture content tends to be higher as the LCV is lower, and the proportion of combustible component tends to be higher as the LCV is higher.
Below is an approximated linear function that closely resembles the correlation between the LCV and moisture, and the LCV and combustible component, analyzed from the data of a city for 3 consecutive years in the past. For example, if the LCV of Lower/Standard/Higher-Quality waste are assigned to X1, X2, and X3, then the moisture content of Lower/Standard/Higher-Quality of Waste can be calculated using an approximation of this linear function.

(a) Moisture of Lower-Quality of Waste	- 0.0039X1 + 82.327
(b) Moisture of Standard-Quality of Waste	- 0.0039X2 + 82.327
(c) Moisture of Higher-Quality of Waste	- 0.0039X3 + 82.327

Similarly, the combustible component can also be calculated using an approximation of a linear function.

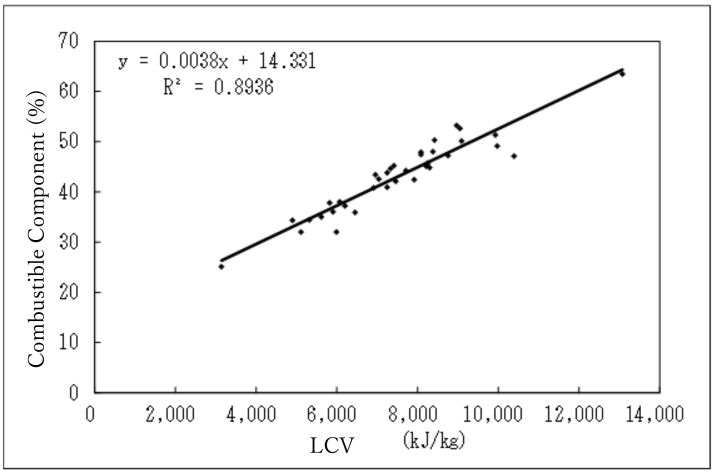
(a) Combustible component of Lower-Quality of Waste	0.0038X1 + 14.331
(b) Combustible component of Standard-Quality of Waste	0.0038X2 + 14.331
(c) Combustible component of Higher-Quality of Waste	0.0038X3 + 14.331



Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Figure 3-15 Approximated Linear Function of LCV and moisture content

[16] 1.645 is a constant number corresponding to the 90% confidence interval, obtained from the normal distribution table. Validation whether the measured data is a normal distribution type or not, can be judged by whether the sequential plots of cumulative frequency on probability paper will be lined up strait or not. Once the slope gradient of the line is determined, calorific values located vertically below of the points of cumulative frequency 5% and 95% respectively will indicate lower/upper limit value of 90% confidence interval.



Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

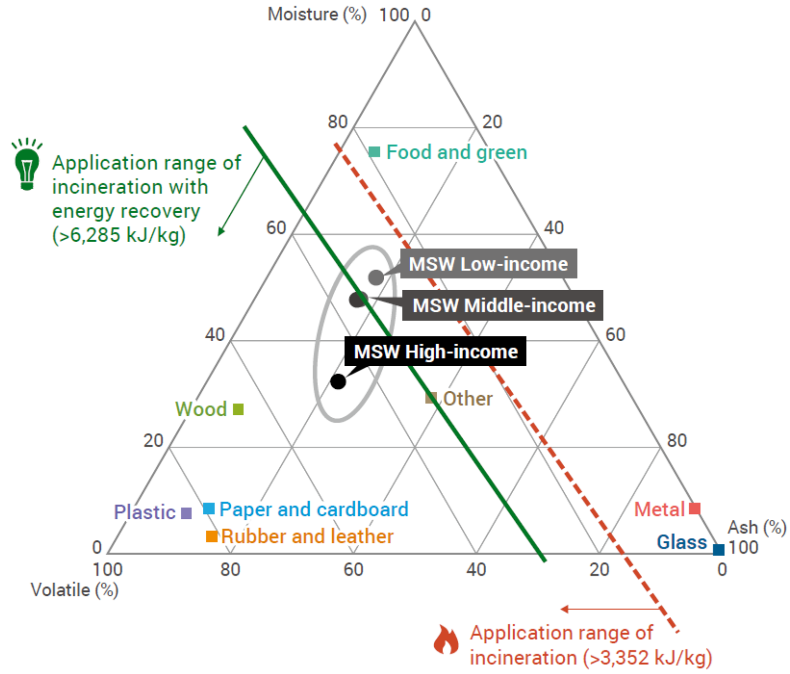
Figure 3-16 Approximated Linear Function of LCV and combustible component

b) Ash

Similar to moisture and combustible content, basic setup of ash contents are considered from the correlation between ash content and LCV. However, it is also often pointed out that ash content from data in waste quality surveys often deviate from reality, and its correlation ratio with LCV is not so high. Therefore, setup the ash content should be estimated from the generation ratio of bottom ash, fly ash, melted slag, etc. from actual input waste quantity, ignition loss, or added water and chemicals. This estimated amount of ash could then be compared with the estimated amount of ash through the correlation with LCV in order to verify the validity of the latter method.

Also, in the case of common combustible waste, ash is the lowest content in the 3 components. Therefore, when adjusting so that the total sum of all three components reach 100%, it is necessary to consider the adjustment of ash content by the moisture and/or combustible component so that to minimize the difference error.

Recent study creates a figure which shows these 3 components (consists in total 100%) in 3 triangle axes as FIGURE. This figure shows the relationship among 3 components and characteristics of materials, for example, glass and metal contains almost 100% ash contents (no combustibles), food waste contains higher water contents, plastic, paper contains high combustible (volatile) contents, etc. By plotting the waste characteristic survey result in this triangle, it can be seen that the target waste in the area can be combustible or not.



Source: IGES, based on Kawai (2016) and World Bank (2018)

Figure 3-17 Proximate Composition Triangle

C. Specific Gravity

Specific Gravity configuration is same way as the LCV.

D. Elemental composition of combustible content

For the setup of Elemental composition of combustible content, it is common to setup only for the Standard-Quality of Waste. If the analyzed data taken from the pit are sufficient enough, the average value will be used for the elemental composition of Standard-Quality of Waste.

(3) Estimation of Target Waste Quality

In the setup of Target Waste Quality, it is desirable to have as much available data as possible, but there are some LGUs who don't have the result of survey/analysis up to the level of actual LCV measurement and elemental analysis. In such case, because estimation methods utilizing the data of Physical Composition or 3 components are established as follows, so it is also possible to use these estimation methods to complementing the setup the Target Waste Quality.

A. Estimation method of calorific value

The calorific value of waste is indicated by a HCV or LCV. JIS or other international standards define the expression of HCV and LCV; however, in cases of incineration of waste which contains broad fluctuation of waste quality, it is necessary to avoid confusion and misreading of these HCV/LCV and range of waste quality as Upper Limit – Standard – Lower Limit of design range.

For the indication of waste quality/properties, as shown in Figure 3-18 , they're indicated as "wet waste base", "dry waste base", "combustible component base", etc.

Therefore, on the occasion when the analysis of waste, calculation and data management of these measured data such as composition, LCV, etc., conversion of LCV, etc., it should be clear which base is employed for the analysis/calculation. Also, it is important not to misunderstand when reading the analysis data. All calorific values appearing in this document will be based on LCVs unless otherwise stated.

The calorific value of waste can be estimated with the following four methods apart from actual measurement by calorimeter.

a) Estimation from 3 components (proximate analysis),

b) Estimation from Physical Composition,

c) Estimation from elemental composition (ultimate analysis)

d) Estimation through heat account

a) LCV Estimation from 3 components

The equation for estimating the LCV (Hl, kJ/kg) from 3 components is:

$$Hl\ (kJ/kg) = \alpha B - 25W,$$

in which: B : Combustible Content in the waste (%)

W : Moisture (%)

α : Average LCV (kJ/kg) of Combustible Content divided by 100, "α≒220".

Therefore,

$$Hl\ (kJ/kg) = 220B - 25W.$$

In recent years, in most cities across Japan, α often ranges 190 to 230.

b) LCV Estimation from Physical Composition

Among the combustible components of MSW, plastics has relatively higher calorific value compared to other combustible components, so it might raise the accuracy of the estimation if combustible fraction in above a) can be divided into plastics and other combustible components.

If we assign weight ratio of plastics in MSW as P (%), and the rest to (B–P)%[17], then: (See Figure 3-19)

$$Hl\ (kJ/kg) = \beta \cdot (B-P) + \gamma \cdot P - 25W$$

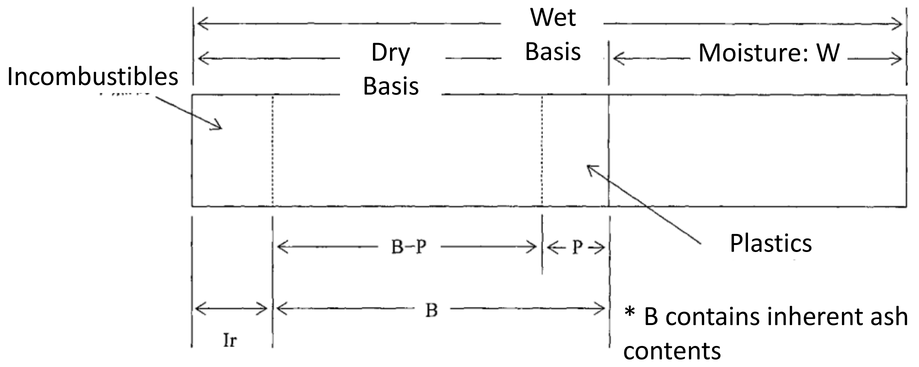
Here, β and γ are averaged from values taken from large cities in Japan during 2006 to 2015.

$\beta = 170 \sim 180$, $\gamma = 280 \sim 310$

[17] However, the weight percent of P and B-P, using the value of % of the dry in waste in terms of % in wet waste containing incombustible.

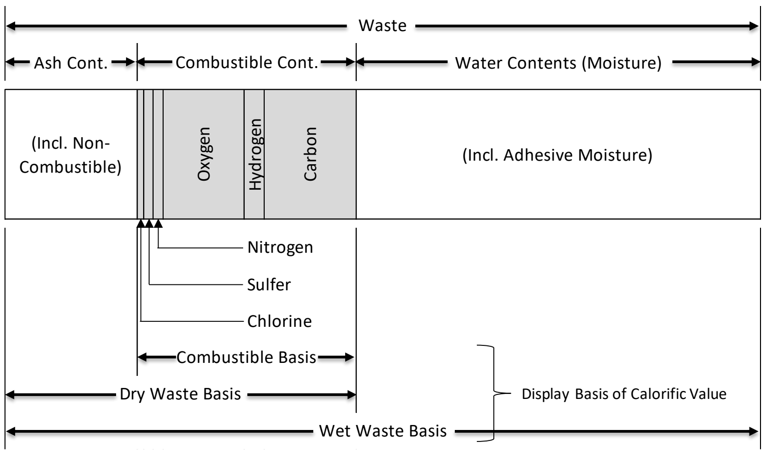
If suppose as: β = 180, γ = 300, then,

Hl = 180 (B-P) + 300P-25W



Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Figure 3-18 Explanation of the LCV estimation formula using Physical Composition



Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Figure 3-19 Waste Composition and Display Basis of Calorific Value

c) HCV Estimation from Elemental Analysis Values

In determining the High Calorific Value (HCV) of combustible component based on the elemental analysis result of combustible content, the Dulong's formula (1), which is often used for fossil fuel, might come out lower than the actual value measured by a calorimeter, and result by the Steuer's formula (2) and Scheuer-Kestner's formula (3) might be closer to the actual value measured by a calorimeter.

$$Hh = 339.4c + 1435.1\left(h - \frac{o}{8}\right) + 94.3s \qquad (kJ/kg) \cdots\cdots (1)$$

$$Hh = 339.4\left(c - 3 \times \frac{o}{8}\right) + 238.8 \times 3 \times \frac{o}{8} + 1445.6\left(h - \frac{o}{16}\right) + 104.8s \qquad (kJ/kg) \cdots\cdots (2)$$

$$Hh = 339.4\left(c - 3 \times \frac{o}{4}\right) + 1435.1h + 94.3s + 238.8 \times 3 \times \frac{o}{4} \qquad (kJ/kg) \cdots\cdots (3)$$

Where; Hh : HCV of Combustible Component (kJ/kg),
c, h, o, s : Weight % of each element in Combustible Component

However, in both latter formulas, due to the differences of attribution concept of oxygen (Assumption of bonding state of oxygen with carbon or hydrogen), formulation of these formulas might vary, thus estimation results might also be different.

d) Estimation through heat account

It can be said that performing accurate waste sampling at any time is virtually impossible due to the ever-changing waste quality.

On the other hand, estimation of Calorific Value of the waste can be calculated by heat account utilizing the measurement data such as waste incineration amount, combustion temperature, steam generation amount (or water injection amount for gas temperature reduction), combustion air ratio, exhaust gas amount, exhaust gas temperature, etc. This method which assumes that the incinerator itself is a calorimeter, and using the data from Automatic Combustion Control (ACC) and the Distributed Control System (DCS) recently introduced in the WTE-ACCs, while assuming several conditions, can be said to be quite accurate estimation methods. However, the calorific value obtained from the heat account is the calorific value of the waste to be fed into the incinerator, and thus is the calorific value of the waste from the waste pit. Therefore, in the case that water is sprayed into the waste pit, and/or in the case that there are large-sized combustible waste being transported into the pit, it is needed to be mindful that the estimated calorific value is not the one of combustible waste transported in the facility.

As mentioned herein, many different methods are used to calculate the calorific value of waste, but the important thing in dealing with mixed waste that ever-changing its quality is that, rather than debating on the accuracy of individual data, we should understand the actual reality of waste quality considering its background such as character of the city, modes of collection, and historical change, etc.

B. Estimation method for elemental composition

a) Measured values

The elemental composition of waste is an important value for estimating the composition of waste and for calculating the mass balance of the combustion process.

The elemental composition of combustibles in waste consists of carbon as “C”, hydrogen as “H”, oxygen as “O”, nitrogen as “N”, sulfur as “S” and chlorine as “Cl”. From these values, the amount of combustion air, the amount of generated combustion gas, and the amount of generated pyrolysis gas, and the calorific value of waste can be estimated from the calculation formula.

When indicating the Target waste quality, it is desirable to use the measured values for the elemental composition of combustibles as much as possible, but if there is no measured value, it is necessary to refer to the analysis examples for other similar composition wastes. References are shown in Table 3-14 and Table 3-15

(1) Table 3-14 is an example of Tokyo Metropolitan Government conducting elemental analysis (C, H, 0, N, S, Cl) for each type of combustible waste. In this Table, it is necessary to take into account the differences in ash content of each substance, but there is a considerable difference in the values of C, H, and O between the cellulosic group (paper, kitchen waste, fiber, grass, and wood) and the artificial product group (plastic, rubber, leather, and so on). In particular, the combustible content of plastic is almost entirely composed of C and H, with a small amount of O, and Cl is prominently present in these artificial products.

(2) Table 3-15 shows the trend of the elemental composition of combustibles from 2009 to 2014 (6 years) according to a survey conducted by the Tokyo Metropolitan Government.

(3) There are many types of plastics, and it is difficult to know the composition of the ingredient from the appearance, but it can be estimated to some extent from the elemental composition. Table 3-16 shows the results of estimating the raw materials of each plastic from the elemental composition. From this result, most plastics discarded as waste are thermoplastics such as polyethylene (PE), polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC), and polyethylene terephthalate (PET). It is considered that there are few thermosetting plastics such as phenol resin and urea resin.

Table 3-14 Waste Category and Composition

Items		3 Components			Elemental Composition						Calorific Value			
	Water	Ash	Combustibles	Carbon	Hydrogen	Nitrogen	Oxygen	Sulfur	Chlorine	HCV (kcal/kg)	LCV (kcal/kg)		HCV (kJ/kg)	LCV (kJ/kg)
Paper	Wet	31.06	6.44	62.50	29.24	4.01	0.09	29.08	0.01	0.06	2640	2236	11049	9362
	Dry		9.35	90.66	42.41	5.82	0.13	42.19	0.01	0.09	3829	3515	16028	14712
Kitchen	Wet	82.18	2.77	15.05	7.36	0.97	0.47	6.19	0.01	0.05	662	117	2772	489
Waste	Dry		15.56	84.44	41.31	5.43	2.64	34.71	0.07	0.28	3716	3422	15553	14326
Textile	Wet	19.56	0.40	80.04	42.30	4.58	0.70	32.34	0.04	0.07	3922	3558	16418	14892
	Dry		0.50	99.50	52.59	5.69	0.88	40.21	0.05	0.09	4876	4569	20410	19124
Plant	Wet	29.86	34.02	36.12	17.93	2.59	0.99	14.47	0.02	0.11	1599	1280	6692	5358
	Dry		48.50	51.50	25.57	3.69	1.42	20.64	0.04	0.15	2279	2080	9541	8708
Plastic	Wet	15.98	2.04	81.98	63.02	8.47	0.21	6.59	0.02	3.67	7459	6906	31224	28908
	Dry		2.43	97.57	75.01	10.08	0.25	7.85	0.02	4.36	8878	8333	37163	34883
Rubber,	Wet	5.18	3.77	91.05	59.24	8.11	2.52	18.61	0.15	2.41	6507	6038	27238	25275
Leather	Dry		3.98	96.02	62.48	8.55	2.66	19.63	0.16	2.55	6862	6401	28726	26794

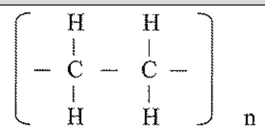
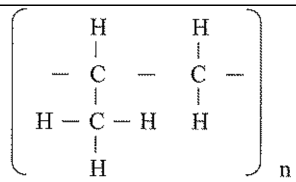
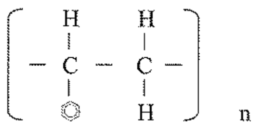
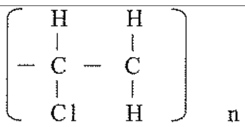
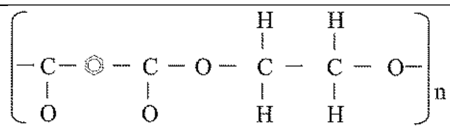
Source: Tokyo Metropolitan Institute of Environmental Sciences Annual Report (1999)

Table 3-15 Composition of Combustible Fraction of MSW

Year (FY)		2009	2010	2011	2012	2013	2014
3 components	Water	41.01	44.65	42.34	40.52	39.26	43.06
	Combustibles	53.15	49.04	52.03	53.36	53.57	50.92
	Ash	5.84	6.32	5.63	6.12	7.17	6.02
Elemental Composition	Carbon	25.6	27.0	27.5	28.2	28.8	25.6
	Hydrogen	4.14	3.89	4.00	4.18	4.11	3.85
	Nitrogen	0.43	0.39	0.38	0.31	0.66	0.47
	Oxygen	22.87	17.48	19.91	20.31	19.76	20.84
	Sulfur	0.02	0.03	0.05	0.06	0.02	0.02
	Chlorine	0.13	0.30	0.19	0.30	0.22	0.14

Source: Clean Authority of Tokyo 23 (Waste Characteristic Survey at WTE-ACCs from 2009 to 2014),
Note: Values for each year are average of four times survey in a year

Table 3-16 Varieties of Plastics

Varieties of Plastics	Elemental composition (wt%)	Structural Formula	Samples
Polyethylene (PE)	C: 85.7 H: 14.3		Garbage bags Frozen food packaging Buckets, Trash cans Cooking oil bottles Kerosene containers Food containers Bath products
Polypropylene (PP)	C: 85.7 H: 14.3		
Polystyrene (PS)	C: 92.3 H: 7.7		Cup noodle containers Food trays Electric appliances Packaging of electrical appliances
Polyvinyl chloride (PVC)	C: 38.4 H: 4.8 Cl: 56.8		Food packaging Cups Cases and trays
Polyethylene terephthalate (PET)	C: 62.5 H: 4.2 O: 33.3		Beverage containers

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

b) Estimating elemental composition from composition by type

(i) Basic estimation method

Ultimate analysis requires a certain level of equipment and technology, but if the composition of each type of waste is known, the data of the elemental composition of each component that prepares the waste (for example, Table 3-17) can be used for the waste to estimate the elemental composition.

Table 3-17 Element content and calorific value for each item of waste as received at WTE-ACC (Dry base)[18]

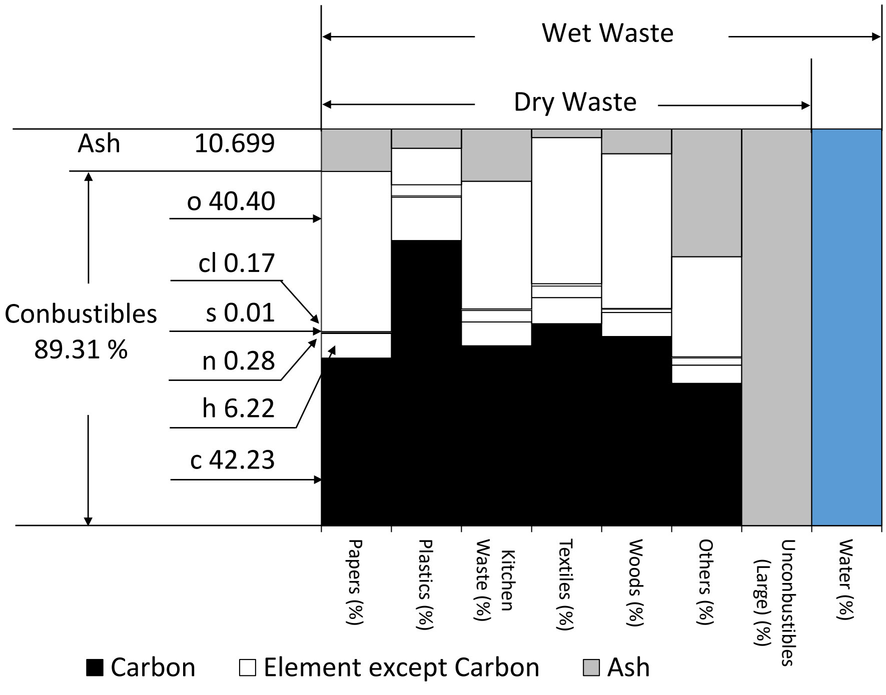
Physical Composition		Papers	Plastics	Kitchen Waste	Textiles	Woods	Others
Combustibles (%)		89.31	95.12	86.84	97.86	93.75	67.78
Elements in Combustibles (%)	Carbon	42.23	71.87	45.31	50.92	47.69	35.86
	Hydrogen	6.22	10.97	6.05	6.56	6.04	4.61
	Nitrogen	0.28	0.42	2.89	2.92	0.84	1.81
	Sulfur	0.01	0.03	0.10	0.12	0.01	0.04
	Chlorine	0.17	2.66	0.25	0.45	0.18	0.22
	Oxygen	40.40	9.17	32.24	36.89	38.99	25.24
Ash (%)		10.69	4.88	13.06	2.14	6.25	32.22
HCV (Dry, kJ/kg)		17,079	37,687	18,653	20,813	19,231	14,425

Source: Yokohama City Resources and Waste Recycling Bureau

Note: Average value from FY1994 to FY2003,

Note: "Others" include miscellaneous goods, soil and sand, rubber, leather, grass and fallen leaves, and do not include metal, glass, stones and pottery.

Note: Since October 1995, separate collection of cans and bottles has been carried out throughout the city.



Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Figure 3-20 Physical Composition and Elemental Composition

Table 3-17 is displayed in the composition by type and elemental composition as shown in Figure 3-19

In this case, the elemental composition of the mixed waste can be calculated by formulating the following formula using the values of the ratios of the obtained elements as shown in Table 3-17 . In other words, the carbon content c in 1 kg of waste (dry waste) can be obtained by adding the charcoal amount in each component, and when converting to 1 kg of wet waste, multiply by (1-w / 100).

[18] The total of combustible and ash of each item is 100%. This is because when waste is separated into plastic, paper, textiles, etc., each has its own unique ash and attached soil and sand. Note that the elemental weight of the combustible fraction shown in the table is% by weight in the separated dry matter.

Carbon $c = (0.4223 \times \frac{Pa}{100} + 0.7187 \times \frac{P}{100} + 0.4531 \times \frac{Ga}{100} + 0.5092 \times \frac{Ce}{100} + 0.4769 \times \frac{Ba}{100} + 0.3586 \times \frac{Rr}{100}) \times (1 - \frac{W}{100})$

Other elements can be estimated in the same way.

Hydrogen $h = (0.0622 \times \frac{Pa}{100} + 0.1097 \times \frac{P}{100} + 0.0605 \times \frac{Ga}{100} + 0.0656 \times \frac{Ce}{100} + 0.0604 \times \frac{Ba}{100} + 0.0461 \times \frac{Rr}{100}) \times (1 - \frac{W}{100})$

Nitrogen $n = (0.0028 \times \frac{Pa}{100} + 0.0042 \times \frac{P}{100} + 0.0289 \times \frac{Ga}{100} + 0.0292 \times \frac{Ce}{100} + 0.0084 \times \frac{Ba}{100} + 0.0181 \times \frac{Rr}{100}) \times (1 - \frac{W}{100})$

Sulfur $s = (0.0001 \times \frac{Pa}{100} + 0.0003 \times \frac{P}{100} + 0.0010 \times \frac{Ga}{100} + 0.0012 \times \frac{Ce}{100} + 0.0001 \times \frac{Ba}{100} + 0.0004 \times \frac{Rr}{100}) \times (1 - \frac{W}{100})$

Chlorine $cl = (0.0017 \times \frac{Pa}{100} + 0.0266 \times \frac{P}{100} + 0.0025 \times \frac{Ga}{100} + 0.0045 \times \frac{Ce}{100} + 0.0018 \times \frac{Ba}{100} + 0.0022 \times \frac{Rr}{100}) \times (1 - \frac{W}{100})$

Volatiles $V = (0.8931 \times \frac{Pa}{100} + 0.9512 \times \frac{P}{100} + 0.8684 \times \frac{Ga}{100} + 0.9786 \times \frac{Ce}{100} + 0.9375 \times \frac{Ba}{100} + 0.6778 \times \frac{Rr}{100}) \times (1 - \frac{W}{100})$

Oxygen $o = V - (c + h + n + s + cl)$

(ii) Simple estimation method

As can be seen from Table 3-17 above, except for plastics, the composition of paper, kitchen waste, textile, wood and other elements are similar.

Therefore, it is possible to roughly estimate the elemental composition of waste by measuring the amount of plastics and combustibles other than plastics.

When assuming the

Plastics in the dried MSW	: V2(%)
Combustibles other than plastic	: V1(%)
Incombustibles (large)	: Ir(%)
Total	: 100%

Following formula can be utilized based on Table 3-17

$$c = (0.4440 \times \frac{V_1}{100} + 0.7187 \times \frac{V_2}{100}) \times (1 - \frac{W}{100})$$

$$h = (0.0590 \times \frac{V_1}{100} + 0.1097 \times \frac{V_2}{100}) \times (1 - \frac{W}{100})$$

$$n = (0.0175 \times \frac{V_1}{100} + 0.0042 \times \frac{V_2}{100}) \times (1 - \frac{W}{100})$$

$$s = (0.0006 \times \frac{V_1}{100} + 0.0003 \times \frac{V_2}{100}) \times (1 - \frac{W}{100})$$

$$cl = (0.0025 \times \frac{V_1}{100} + 0.0266 \times \frac{V_2}{100}) \times (1 - \frac{W}{100})$$

$$V = (0.8711 \times \frac{V_1}{100} + 0.9512 \times \frac{V_2}{100}) \times (1 - \frac{W}{100})$$

$$o = V - (c + h + n + s + cl)$$

(4) Other considerations concerning setting the Target Waste Quality

A. For the setup of the Target Waste Quality, it is necessary to make statistical decision based on waste quality data gathered by year and by season. **Therefore, it is desirable for waste quality data to be collected at least past 3 years, and 2-4 times per year (once in a season, so 2 times per year for wet/dry season countries).** Further, waste quality surveys, including sampling, pre-treatment, physical composition, ultimate analysis, and calorific value measurement, etc. require cost a lot, **so securing budget plan is also important**.

B. For the question "How many samples are enough for WACS?" "In an example in an ASEAN city, 60 samples x 2 seasons were sampled. Is it enough?", "Does designed Target Waste Quality from limited samples number contain a risk of uncertainty?", it is difficult to get practical answer for them in the area where such statistic data is not available. There is some cases which LGU requests the private proponent to conduct WACS and set Target Waste Quality and let them guarantee any kind of waste to accept. This looks good to avoid the waste fluctuation risk to the private entity but in reality it's wrong. In practice, it is common for the operator to set a design waste quality range based on surveys conducted by them, and to guarantee operation and performance of the facility only within that range. This means operator will set boundary and they guarantee within the range and outside of the range LGU has to be responsible. Whether or not LGU can continue to supply waste quality within the range of the operator's guarantee is a risk element that can only be borne by LGU who set waste policy in generation control and segregation classifications. When it is decided to conduct a waste survey, if possible, it is strongly desired to conduct a regular waste composition surveys and manage the data as a method of risk management regarding waste quality and quantity in the project.

C. In arranging the data obtained by waste analysis, such as 3 components, physical composition, elemental composition, LCV, etc. in order so that they can be compared, it is important to know the inter-annual change of waste quality, which can be useful in calculating the heat balance and material balance. Waste quality varies depending on the size of the city, the modes of collection, and the characters of the local industries, etc. In addition, fluctuations in waste quality due to changes in waste separation classification and separation accuracy are not simple like annual change of waste quality, so it is desirable to record the transition of waste management system together with the waste quality.

D. Thanks to the growing environmental conservation awareness nowadays, under the cooperative systems among citizens, businesses, and authorities, there is a possibility that waste quality can be changed due to the reduction of waste and the expansion of recycling market. **Therefore, in setting the Target Waste quality, it is desirable to take into consideration the change resulted/expected by the policies such as 3R plans by LGs.** In particular, it is especially important to consider the case that the objects to be treated by the planned WTE-ACC are different from the objects being treated by the existing WTE-ACC due to the change in the classification of waste separation at source.

7) Setup the Target Waste Quality for MRFs for non-combustibles, bulky and packaging waste

(1) Overview

The Target Waste quality in a MRF (for non-combustibles, bulky and packaging plastic waste) generally indicates a standard composition (% of weight by type) and a unit volume weight (Specific Gravity, t/m^3) for each item to be treated.

A. Classification of objects to be treated

An example of main classifications for objects to be treated in MRFs is as follows.

a) Non-combustible Waste

Non-combustible wastes are glass chips, cans, potteries/ceramics, concrete, debris, etc., mainly composed of non-combustible materials. Meanwhile, small home appliance products shall be followed the collection items, collection methods specified by LGs.

b) Non-combustible bulky (large-sized) waste

Non-combustible bulky (large-sized) waste are relatively large items, such as household appliances (except for 4 items targeted under Electric Appliance Recycling Law 2001), bicycles, sinks, gas appliances, stoves, etc., mainly composed of non-combustible materials.

c) Combustible bulky (large-sized) waste

Combustible bulky (large-sized) waste are relatively large items, such as old lumber, wooden furniture (cabinet, chair, bed, desk, dining room set, reception set, etc.), tatami mats, carpets, mattresses, etc., mainly made of combustible materials.

d) Recyclable waste

(i) Bottles
(ii) Cans
(iii) Plastic containers and packaging
(iv) PET bottles
(v) Paper containers and packaging
(vi) Recyclable papers, metals and glass bottles not categorized in containers and packaging
(vii) Hazardous waste (fluorescent lamps, batteries, etc.)

Target Waste Quality is generally determined by the mode of collection of target waste to be treated (collected in separation or not? If yes, what kind of separation? Or collection in mix?) and the purpose of the treatment. When planning, we should keep in mind several points, for example in the case of large-sized waste, to what extent are bicycles, tatami mats, blankets, mattresses are included; how should we think about the maximum size of the waste to be crushed; what to do about the mode of separated waste collection. Since these are important factors for determining the type and size of the crusher and sorting equipment in a facility, it is desirable to clarify them as one of the facility specifications.

However, in the case of large-sized waste, treatment of only a few particular types of large waste, and specifying excessively large size conveyers and crushers might result in an economical loss for the facility. For this reason it is desirable that particular types of large waste have their own dedicated machine, or that they are treated individually, or that the facility should regulate an acceptance standard of waste, and that only waste within the limit of the standard will be admitted and processed. On the other hand, in the case of recyclable waste, it is necessary to have separation done accurately to suit the recycling process, so it is important to comprehensively consider separation collection and sorting after collection.

(2) Setting of Target Waste Quality

The standard composition and unit volume weight of each object to be treated at the recycling centers shall reflect the waste treatment system of the LG. If the waste treatment system of the planned recycling center is the same as the existing waste treatment system, then it is possible to set the standard composition and unit volume weight based on the records of the existing waste treatment system.

Table 3-18 Table 3-25 show examples of basic units such as physical composition and unit volume weight by the items required for planning and designing the storage space for waste reception area, and the storage space for resource post-treatment. These basic units differ depending on the regional characteristics, the conditions of the waste when transported in, the condition of the collection and transportation vehicle, scope of targeted plastics, and the planning treatment flow, as well as the conditions of the equipment to be used. Therefore, it is not desirable to use the data of these basic units as they are. It is necessary to grasp the situation of the target local area before carrying out the waste quality survey, set up volume unit weight at the time the waste will be transported in, and post-treatment while bearing in mind how the future waste treatment system would work and would be like, and then determine the capacity of the equipment to be used in the facility.

Table 3-18 Records of physical composition of non-combustible waste (Yokohama)

Unit: Weight (t)

Items	Fiscal Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Non-Combustible & Non-Combustible Bulky		14,603	13,839	13,004	12,645	13,214	13,418	12,671	12,766	12,314	11,986
	Metal (Small & Large)	11,423	11,215	11,580	11,529	12,041	12,260	11,684	11,628	11,085	10,758
	Combustibles Residues	3,045	2,309	1,174	958	1,018	944	834	945	1,010	1,019
	Non-Combustibles Residues	135	315	250	158	155	214	153	193	220	209
Cans		11,275	11,049	10,632	10,651	10,489	10,237	9,826	9,654	9,280	8,973
	Ferrous Metal	6,825	6,578	6,219	6,069	5,818	5,666	5,281	5,043	4,717	4,366
	Aluminums	4,450	4,472	4,413	4,582	4,672	4,571	4,545	4,611	4,563	4,608
	Inadequate (Residual)	-	-	-	-	-	-	-	-	-	-
Glass Bottles		26,664	27,283	27,285	27,184	27,408	27,526	27,224	27,561	27,156	27,306
	White	9,345	10,157	10,087	10,338	10,460	10,552	10,283	10,405	10,222	10,200
	Brown	5,826	6,559	6,545	6,673	6,692	6,636	6,583	6,595	6,373	6,358
	Others	3,631	4,418	4,550	4,593	4,821	4,981	5,135	5,337	5,511	5,649
	Glass Residuals	7,862	6,149	6,103	5,579	5,435	5,357	5,222	5,224	5,049	5,098
PET Bottles		11,668	12,238	12,241	12,087	12,421	12,649	12,270	12,064	11,354	11,410
	PET Bottles	11,668	12,238	12,241	12,087	12,421	12,649	12,270	12,064	11,354	11,410
	Inadequate (Residual)	11,668	12,238	12,241	12,087	12,421	12,649	12,270	12,064	11,354	11,410
Container and Packaging Plastics		48,484	50,635	52,903	54,419	54,586	54,457	53,878	54,055	54,474	55,207
	C&P Plastics	47,220	48,592	50,379	51,486	51,771	51,315	50,978	51,067	51,169	51,712
	Inadequate (Residual)	1,264	2,043	2,524	2,933	2,815	3,142	2,900	2,988	3,305	3,495

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Table 3-19 Records of physical composition of non-combustible waste (Nagoya)

Unit: Weight (t)

Items	Fiscal Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Non-Combustible Waste		97,425	95,273	86,463	76,422	72,197	31,410	29,342	29,518	27,775	26,998
Bulky Waste*1		10,562	9,935	8,803	7,894	7,728	8,120	7,550	7,661	6,912	7,162
Clean Up Waste*2		1,281	1,335	1,124	1,214	1,058	1,103	1,314	1,400	1,233	1,354
	Metal	4,835	3,491	3,047	2,900	2,365	1,943	1,842	2,300	2,633	2,633.0
	Aluminum	54	45	54	66	51	48	49	13	14	14.0
	Ash	74,116	59,770	63,530	59,795	29,181	24,644	26,259	22,041	22,660	22,660.0
	Bulky	17,397	12,322	12,614	10,564	7,978	8,171	8,144	8,035	7,992	7,992.0
Cans		5,497	5,080	4,868	4,550	3,787	3,422	3,324	3,125	2,968	2,968
	Metal	4,037.6	3,668.5	3,675.3	3,503.0	3,156.9	3,063.6	2,917.9	2,781.5	2,639.4	2,639.4
	Aluminum	233.0	196.2	177.1	168.8	150.3	144.2	140.5	118.6	114.0	114.0
	Inadequate	367.5	430.3	222.6	196.9	183.5	181.6	227.3	189.6	183.1	183.1
Glass Bottles		21,535	20,868	20,537	20,411	20,088	17,472	15,913	15,955	15,575	15,482
	White	7,832.5	7,459.2	7,954.0	7,940.2	7,556.6	7,406.3	7,353.1	7,197.3	7,182.8	7,182.8
	Brown	5,069.8	4,840.1	5,165.4	5,174.4	4,811.9	4,723.1	4,817.0	4,674.6	4,592.4	4,592.4
	Other	3,296.2	2,842.9	3,166.5	3,074.5	3,002.9	3,062.1	3,137.9	3,069.3	3,044.5	3,044.5
	Returnable	0.0	1,751.2	532.9	445.6	371.7	333.3	328.4	322.5	405.9	405.9
	Inadequate	1,932.0	733.1	694.9	694.3	676.0	227.9	186.3	182.9	174.0	174.0
PET	Bottles	8,851	8,780	8,501	8,644	8,145	8,220	8,537	8,249	8,391	8,391
	PET bottles	7,129.3	7,353.5	6,913.0	7,090.3	6,761.3	6,769.4	7,037.1	6,696.2	6,692.4	6,692.4
	Inadequate	1,721.8	1,426.2	1,587.7	1,554.1	1,383.4	1,450.9	1,499.4	1,552.4	1,698.9	1,698.9
Container and Packaging Plastics		31,388	31,949	31,370	30,752	30,774	28,191	27,313	26,980	26,614	26,901
	C&P Plastics	29,886.6	28,965.6	28,206.0	28,138.6	25,808.2	24,803.2	24,030.1	232,240.0	22,879.3	22,879.3
	Inadequate	2,321.3	2,410.3	2,537.2	2,743.8	2,501.8	2,606.5	3,055.8	3,499.8	4,135.8	4,135.8

*1: In the City, bulky waste is not segregated in combustible/non-combustible so categorized in mixed.

*2: Waste illegally dumped and categorized in Non-combustible.

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Table 3-20 Unit volume weight of non-combustible waste *before* treatment (Kobe City)

Unit: t/m3

Item	Collection Mode	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
PET Bottle	Bag	0.028	0.026	0.029	-	0.037	0.036	0.041	0.047	0.041	0.042
Glass, etc.	Bag	0.36	0.287	0.302	-	0.306	0.224	0.263	0.251	0.29	0.273
Steel Cans	Bag	0.099	0.068	0.092	-	0.081	0.081	0.105	0.111	0.118	0.101
Aluminum Cans	Bag	0.033	0.029	0.041	-	0.036	0.039	0.051	0.055	0.048	0.049

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Table 3-21 Unit volume weight of non-combustible waste *before* treatment (Kitakyushu City)

Unit: t/m3

Items	Years	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cans											
	Molded Iron	-	-	-	-	-	-	0.665	0.716	0.732	0.686
	Molded Aluminum	-	-	-	-	-	-	0.266	0.307	0.311	0.341
PET Bottles											
	Molded PET	-	-	-	-	-	-	0.249	0.231	0.227	0.24
Packaging Plastic											
	Molded Plastics	-	0.335	0.337	0.345	0.342	0.343	0.343	0.342	0.343	0.344

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Table 3-22 Unit volume weight of non-combustible waste *before* treatment (Nagoya City)

Unit: t/m3

Item	Collection Mode	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Non-Combustible Waste	Bag	0.25	0.091	0.204	0.094	0.094	0.142	0.136	0.142	0.144	0.132
Packaging Plastic	Bag	0.06	0.018	0.102	0.017	0.017	0.017	0.018	0.018	0.017	0.014
Packaging Paper	Bag	0.14	0.057	0.255	0.054	0.050	0.046	0.051	0.050	0.044	0.043

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Table 3-23 Unit volume weight of non-combustible waste *after* treatment (Fukuoka City)

Unit: t/m3

Items	Years	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Non-Combustible & Non-Combustible Bulky	Crushed Iron	0.264	0.229	0.246	0.220	0.226	0.224	0.264	0.242	0.254	0.264
	Crushed Aluminum	0.107	0.093	0.107	0.084	0.094	0.083	0.094	0.097	0.096	0.096
	Crushed Combustibles	0.149	0.126	0.125	0.120	0.115	0.120	0.156	0.151	0.174	0.169
	Crushed Non-Combustibles	0.842	0.706	0.796	0.751	0.718	0.987	0.976	0.900	0.872	0.946

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Table 3-24 Unit volume weight of non-combustible waste *after* treatment (Kitakyushu City)

Unit: t/m3

Items	Years	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cans											
	Molded Iron	-	-	-	-	-	-	0.67	0.72	0.73	0.69
	Molded Aluminum	-	-	-	-	-	-	0.27	0.31	0.31	0.34
PET Bottles											
	Molded PET	-	-	-	-	-	-	0.25	0.23	0.23	0.24
Packaging Plastic											
	Molded Plastics	-	0.34	0.34	0.35	0.34	0.34	0.34	0.34	0.34	0.34

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Table 3-25 Unit volume weight of non-combustible waste *after* treatment (Nagoya City)

Unit: t/m3

Items	Years	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Non-Combustible & Non-Combustible Bulky	Crushed Iron	0.71	0.47	0.66	0.45	0.54	0.53	0.45	0.55	0.46	0.50
	Crushed Aluminum	0.40	0.25	0.44	0.35	0.36	0.43	0.38	0.37	0.31	0.33
	Crushed Combustibles	0.12	0.09	0.12	0.11	0.11	0.11	0.11	0.10	0.14	0.10
	Crushed Non-Combustibles	0.55	0.36	0.43	0.46	0.42	0.67	0.62	0.63	0.61	0.64

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

3.5 Pollution prevention standards

In WTE-ACC facilities, the process of incineration might produce exhaust gas, waste water, odor, noise, and vibrations, so they will be subject to laws and ordinances such as the Clean Air Act and Clean Water Act. Also, in recent years, to form consensus with local residents and improvement of pollution prevention technology, <u>it has become common to set stricter standards for pollution prevention as the voluntary standards</u>.
However, stringent pollution prevention standards might include the possibility of low cost-effectiveness and the risks that greater volume will be disposed in the disposal site, and that the facility might not operate stably. Furthermore, stricter pollution prevention standards might mean a trade-off relationship with higher efficiency of power generation. Therefore, <u>in setting pollution prevention standards, it is necessary to set them from a comprehensive viewpoint and take into consideration of not only safety but also stable operation and economic efficiency</u>.

3.6 Waste heat utilization

For a certain capacity size of incineration facilities installed in recent years, almost without exception, the heat generated from incineration of waste has been utilized for various purposes, such as steam boilers, air-preheating, air conditioning, hot water supply, and waste power generation. Of these, high-pressure steam generated by the heat recovered by the waste can be used for waste to power generation, and when converted from steam to hot water, it proves to have very high utility value. Similarly, the generated electric power can be converted for use of air conditioning and heating, and the surplus of the in-house power consumption can be sold also, making it more useful and less wasteful. Therefore, in recent years, as long as the external residual heat supply is not planned clearly, methods for utilizing it for waste to electric power generation are increasing.

In Japan, the number of cases of power generation from waste has increased dramatically due to national policies such as "the national subsidy system for establishing a Recycling-Based Society" and the Feed-in Tariff system for renewable energy, which are partial efforts to transform Japan into a low carbon society. At the same time, technology such as waste heat boilers, steam turbines and generators has also been improved. Recently, for incineration facilities with capacity over 100 t/day, almost all the required power can be supplied at rated operation, and the introduction of waste to power generation into incinerators with capacity of 80t/day also appears more.

However, although these efforts might have brought great contribution to a low-carbon society and for replacing internal power with power generated from waste, waste power generation by small-scale facilities might set for higher construction cost and maintenance cost. Since stable operation is a very important factor as well, it is necessary to bear in that in mind to avoid setting unreasonable plans.

Historical change of the WTE-ACC to be the Stable Power Source Case in Japan which starts from power liberalization from 2000 to date, FiT System from 2012, networking options are described in APPENDIX E: WTE-ACC AS A STABLE POWER SOURCE CASES IN JAPAN.

3.7 Financial model (Case of BOT/BOO)

Typical business model for WTE-BOT are shown Figure 3-21 below.

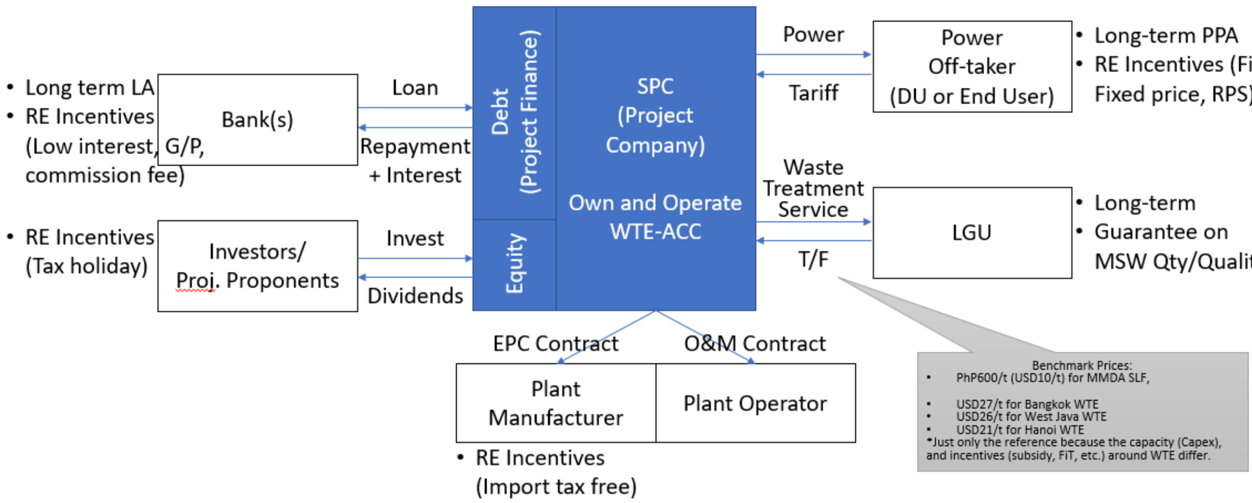
Usually, project company (Special Purpose Company) will be established by the investor(s) which solely owns and operates the WTE-ACC Facility.

To make up the project capital expenditure (Capex), mostly EPC contract cost around 100-200MUSD for 1,000t/day capacity of WTE-ACC Facility (varies depending on the specification), equity part (20-30% of Capex) will be invested by the investors, and debt part (remaining 70-80% of capex) will be borrowed from the development/commercial banks. Usually non-recourse project finance (all project assets and cash flow will be collateral/pledge) is introduced.

After Commercial Operation Date (COD), SPC will operate WTE-ACC and earn 2 revenue flows, power tariff from power off-taker and waste tipping fee (T/F) from LGU.

To attract private investors and commercial banks, "bankability" aspects might be essential, which consist with financial viability, risk optimization, and contractual robustness. In the viewpoint of LGUs, to make the project financially viable, T/F unit cost (Php/t) as one of the revenue sources must be set appropriately. Since WTE-ACC is not yet existed in Philippines there are some misleading that LGU doesn't need to pay T/F because waste can be money by WTE and PPP.

Further, credit of LGUs as sub-sovereign bodies in developing countries are usually low, this T/F payment through the project period (e.g. 15-20 years) will be the one of the important risk factors for the investor/bank. Some ASEAN Countries already provides national guarantee for the default of LGU's obligation in particular the payment of T/F to fulfill the bankability.



➡ To ensure "Bankability" of the Project which is composed of "Financial Viability", "Risk Optimization" and "Contractual Robustness"

Figure 3-21 Typical WTE-ACC Business Model in BOT Scheme

In the Public-Own-and-Operate (conventional business model) or DBO (Design-Build and Operate) business schemes which detailed in the "", all Capex will be procured by LGU and purchase the facility, after COD LGU will own the facility throughout the project period. Operation might be contracted out to the operator in case of DBO. In these cases, national government guarantees for the T/F may not be necessary because there are no initial investment from private company.

3.8 Business scheme

1) Background and Importance of Study on PFI/PPP Introduction (as the Background)

It can be said that the most of Waste Treatment Facilities (WTFs) projects including Waste-to-Energy (WTE) in the Philippines is developed as Public Private Partnership (PPP) in particular Build-Own and Transfer (BOT) business scheme considering their significant financial investment for its establishment, operation, and maintenance. On the other hand, developed countries such as Japan, EU and Singapore, have been adopted government build, own and operate business scheme (or partially contract out its operation to private partner like DBO (Design-Build and Operate)) for the procurement of WTFs as a conventional public infrastructure construction and management projects.

Since LGUs, the main actors that own and maintain WTF/WTEs, have been under severe financial constraints, efficient and economical business models are required for the service and maintenance of these WTF/WTEs. Therefore, instead of the conventional scheme which LGs design, construct, maintain, manage, operate and raise fund by themselves, Private Finance Initiatives (PFI) where partial or full collaboration with the private sector, etc. are being widely adopted in the developing countries.

The Study on PFI/PPP introduction juxtaposes different business schemes to see which can be selected for the LG to introduce private sectors to ensure efficient and economical operation, maintenance, and management of the WTF. Furthermore, the study also compares and evaluates which business schemes should be selected in consideration of regional circumstances, business stability, economic efficiency, and intention of the private operators to make clear the decision making procedure of LGUs.

Regarding the Study on PFI/PPP introduction, it is necessary to evaluate each business methods from the following points of view, and to examine the possibility of introduction. Detail explanations are written in "3.8.3) Items of Study on PFI/PPP introduction (Original Chapter 4)

(i) Whether participation of multiple private companies is expected (Intention survey);
Goal is to check through the study if private entities are interested in investing in the construction and operation of the WTF facility. Another goal is to clarify the division of work between private and public sector in the project to be developed.

(ii) Whether quantitative effects (financial and economic effects) can be expected (Quantitative evaluation);
Goal is to check the financial viability of the project

(iii) Whether qualitative effects can be expected (Qualitative evaluation);
Goal is to benchmark from previous case studies in other countries/municipalities to see the long-term effect of PPP partnerships. Another goal is to understand the risks imposed on all the stakeholders including the private investors, public sector, and residents.

(iv) Whether comprehensive effects is expected after introduction of such mechanisms (Comprehensive evaluation);
Goal is to identify, from the results of the quantitative and qualitative study the best PPP strategy to undertake.

2) PPP legal framework in the Philippines

(1) PPP legal framework in the Philippines

Before the explanation of each study items of PFI/PPP Introduction, this section introduces the PPP legal framework in Philippines as denoted in the Philippines PPP Center website (https://ppp.gov.ph/ppp-program/legal-and-regulatory-frameworks/).

Section 20, Article II of the 1987 Philippine Constitution provides that "The State recognizes the indispensable role of the private sector, encourages private enterprise, and provides incentives to needed investments."

In recognition of this role in sustainable development, Congress enacted two primary laws to implement the same: **Republic Act No. 9184 or the Government Procurement Reform Act (RA 9184)** for the procurement of goods, supplies and services, and Republic Act No. 6957 as amended by **Republic Act No. 7718 or the Philippine Build-Operate-and-Transfer (BOT) law which provided a more focused framework in PPP infrastructure**

development[19][20].

The enactment of RA 6957 allowed Local Government Units (LGUs) to enter into contractual arrangements with the private sector to implement infrastructure projects through two variants – Build-Operate-and-Transfer (BOT) and Build-Transfer-and-Operate (BTO).

RA 7718 enhances the provision of RA 6957 by broadening the list of PPP government implementing agencies such as government owned and controlled corporations (GOCCs), government financing institutions (GFIs) and state universities and colleges (SUCs); putting in place incentives for attracting private sector investments to venture into PPP projects; and allowing negotiated unsolicited proposals provided that these comply with conditions outlined in the law. More importantly, RA 7718 provided for the inclusion of other contractual arrangements or schemes to implement PPP projects.

As provided in the amended BOT law and its Implementing Rules and Regulations (IRR), collaborative partnerships between the government and the private sector can be made possible through a broad spectrum of modalities. The BOT law identifies a number of variants and includes a catch all provision for other variants that may be identified later. However, project implemented using new variants are subject to the approval of the President of the Philippines[21].

PPP Center, mandated to facilitate the implementation of the country's PPP Program and Projects by Executive Order No. 8 series of 2010 and amended Executive Order No. 136 of 2013, issues several guidelines for the implementation of PPP projects to be organized by national/LGs and governmental agencies.[22]

(2) Compatibility of WTF/WTE projects with RA7718

Followings show the result of analysis on the compatibility of WTFs project with IRR of RA7718, Revised BOT Law;

A. Eligibility for PPP financing (Section 2.2, RA7718 IRR)

Eligible infrastructure projects that can be financed through PPP Schemes cover power generation facilities and environmental and solid waste management related facilities, where the WtE facility can be classified under.

B. PPP Project Schemes (Section 1.3 of RA7718 IRR)

As the Contractual Arrangements, Section 1.3 of RA7718 IRR lists the PPP project schemes of BT, BLT, BOT, BOO, BTO, CAO, DOT, ROT and ROO (also tabled in "3.8 3) Items of Study on PFI/PPP introduction"). In addition to these contractual arrangements, other variations thereof, as may be approved by the President, by which infrastructure and/or development projects may be undertaken pursuant to the provisions of these Revised IRR. Internationally accepted PPP business schemes are exemplified in "3.8 3) Items of Study on PFI/PPP introduction (Original Chapter 4)" in this document.

C. Priority Projects (Section 4 of RA7718)

Section 4 of RA7718 explains about priority projects as below;

- ✓ All concerned government agencies, including government-owned and controlled corporations, and LGUs, shall include in their infrastructure programs their priority projects that may be financed, constructed, operated, and/or maintained by private agencies. LGUs must understand the importance of a centralized development plan, to handle not just proposals sent through bids, but also for unsolicited proposals.
- ✓ The lists of these national projects must be part of the medium-term infrastructure programs of the agencies concerned and must be duly approved by Congress. Local projects funded and implemented by the LGUs concerned shall be submitted to the local development councils for confirmation or approval. These shall be reflected in, but not limited to, the Medium-Term Philippine Development Plan (MTPDP),

[19] RA7718, An Act Amending Certain Sections of Republic Act No. 6957, entitled "An Act Authorizing the Financing, Construction, Operation and Maintenance of Infrastructure Projects by the Private Sector, and for Other Purposes" (Published on 29 March 2006) https://ppp.gov.ph/wp-content/uploads/2021/04/Republic-Act-7718-IRR-29March2006.pdf

[20] RA7718 IRR, Revised Implementing Rules and Regulations of R.A. No. 6957, "An Act Authorizing the Financing, Construction, Operation and Maintenance of Infrastructure Projects by the Private Sector and for Other Purposes", as Amended by Republic Act No. 7718 (Published on 20 July 2012) https://ppp.gov.ph/wp-content/uploads/2019/06/BOT_IRR_2012_2017_2.pdf

[21] Source: PPPC website, https://ppp.gov.ph/ppp-program/legal-and-regulatory-frameworks/

[22] Source: PPPC website, https://ppp.gov.ph/guidelines-and-issuances/

the Regional Development Programs (RDPs), Regional Development Investment Programs (RDIP), as well as the LGU's local development plans.

- ✓ It is the duty of these infrastructure agencies to disseminate the information on these priority projects through publication in national newspapers every 6 months, and issue official notification of contractors registered with them. This list must also be made available on the website of the infrastructure agency, if available. This awareness campaign shall allow the private sector to prepare proposals or plans for the said projects, in time for the call for bids to be issued.

D. Undertaking of PPP Bidding Process (Rule 5 Qualification of Bidders, RA7718 IRR)

Rule 5 Qualification of Bidders, IRR of RA7718 explains PPP bidding process as follows;

a) Bidding Announcement and Pre-bid Conference

- ✓ Upon approval of the priority projects list, infrastructure agency leads shall publish, once every week for 3 consecutive weeks, in at least 2 newspapers of general circulation, and at least 1 local newspaper, inviting qualified contractors to participate in a public bidding for the projects to be established.
- ✓ Aside from these public announcements, the agency shall also hold a Pre-bid conference to clarify the scope of work required from the proponents, discuss the bidding documents and submission requirements from prospective bidders, review the evaluation criteria and procedure, and discuss the contract terms and conditions.
- ✓ The facilitation of the pre-bid conference shall depend on the scale of the project. For local projects, the conference is held 30 days before the deadline of the bid submission. On the other hand, for national projects, especially those that will incur project cost exceeding 300 million pesos, the conference may be set 90-120 days before the bid submission.

In these bid announcements and pre-bid conferences, the infrastructure agency shall share with the prospective bidders the following information and documents:

- ✓ Project Objective and Description
- ✓ Minimum Design and Performance Standards, and Specifications such as discount rate, inflation factor, and foreign exchange rates if applicable
- ✓ Draft Contract, including Terms and Conditions
- ✓ Prequalification Criteria and Procedures
- ✓ Instructions to Bidders, including bid form
- ✓ Current applicable rules and regulations of the BSP
- ✓ Bid Evaluation Criteria

The details of each of these documents is detailed in Rule 4 Sections 4.2-4.4 of RA 7718. The deadline for the submission of bids must be made clear in these announcements, and the infrastructure agency must be available to accommodate any questions or concerns from the bidders during this time period to ensure compliance with the imposed requirements. Late bid submissions shall not be considered.

b) Proponent pre-qualification

- ✓ The infrastructure agency must ensure that the prospective bidders have the capability to actualize the project proposal properly. In order to ensure this, bidders are required to submit pre-qualification documents within 30-45 days after the last bid posting.
- ✓ The prequalification documents shall include, but not be limited to, a list of similar projects undertaken by the Proponent to show track record and experience in dealing with similar projects, and proof of technical capability through establishing expertise in the technologies needed to implement the project.
- ✓ Proponents are also required to submit their financial statements, where the infrastructure agency shall ensure that the cost of the project shall be 10% or less of the net worth of the proponent, in order to

ensure that they have the financial resources necessary to implement the project.

- ✓ A quantitative rating criterion must be developed by the infrastructure agency to assess the prequalification documents from the bidders. Proponents must be informed of their qualification or otherwise for the submission of bids. The infrastructure agency shall issue its decision within 15 days from the deadline of the submission. Only qualified bidders will be considered in the bid evaluation process.

c) Bid submission

- ✓ Pre-qualified bidders shall be given sufficient time to prepare the bid submissions for the consideration of the infrastructure agency. Preparation period may span between 60 days to 180 days from the first day of issuance of bid documents to the prequalified bidders, depending on the scale and nature of the project. The infrastructure agency must make clear the deadlines for submission of the bidding documents.
- ✓ The Pre-qualifications, Bids, and Awards Committee (PBAC), instituted by the infrastructure agency, shall receive all the bids sent by the Proponents. The composition of the PBAC is prescribed in RA 7718 Section 3.1 and must be observed to ensure a well-rounded committee capable of assessing the bids for the implementation of the project. These bids must include the following attachments and information:

(i) Feasibility study (F/S)

Shall include preliminary engineering design that must conform to the standards and guidelines stipulated by law. The F/S study may also be done by the LGU instead, in order to ensure the validity and accuracy of the results. The F/S shall encompass the following feasibility studies:

- Marketability

Ensure balance between supply and demand given the product or service to be provided through the facility.

- Technical soundness

From the preliminary engineering design, the minimum design and performance standards must be met, and the technology to be used must be discussed to ensure that the Proponent has the means to implement the proposed design. The estimates in the design must be within a 20% standard deviation with respect to the final values and quantities.

- Economic feasibility

Economic savings, e.g., travel time savings, must be defined. The project should yield an economic IRR of at least equal to the social discount rate, to be reviewed by NEDA.

- Financial viability

Sources of financing must be discussed, along with the repayment scheme proposed to recover the project cost, denoted in present value. The Rate of Return that will be assessed in this part shall be previously determined by the LGU.

- Operational feasibility

The proposed organizational arrangements must be detailed to ensure that the project shall be implemented, operated, and maintained properly according to the project plan.

- Environmental standards

Compliance to national guidelines and LGU impositions must be clarified, and measures to be implemented to ensure compliance must be incorporated in the F/S.

(ii) Proposed capital investment recovery scheme

Depending on the PPP structure, the Proponent must discuss the capital investment recovery scheme to be made either through payment by the infrastructure agency, or through imposition of fees and charges.

(iii) Bid bond

The bond will be determined as a percentage of the total project cost (in Philippine pesos) and must not be less than 2% (if less than 5 Billion PhP), 1.5% (if cost is between 5-10 Billion PhP), or 1% (if cost is above 10 Billion PhP).

(iv) Other supporting documents

The LGU may impose additional requirements for the bidders to comply with depending on the nature of the project to be undertaken.

d) Evaluation of bids

- ✓ The review of the submitted documents is done in two stages. The first stage entails a review of the preliminary engineering design in order to determine the technical feasibility of the proposal. Once cleared, qualified proposals shall then undergo a financial evaluation to determine the most economical among the bids received.
- ✓ National projects shall be submitted to the NEDA ICC for approval, for projects costing not more than 300 million pesos. For projects that shall incur a higher cost, the NEDA Board shall be the one to issue approval upon the recommendation of the ICC.
- ✓ Local projects shall be reviewed by the Municipal Development Council for project costing not exceeding 20 million pesos, the Provincial Development Council for projects costing between 20-50 million pesos, the Regional Development Council for projects costing 50-200 million, and NEDA-ICC for projects incurring cost of more than 200 million pesos.
- ✓ For projects with a cost not exceeding 300 million pesos, 60 days is given to issue a decision. Projects that exceed a 300-million-peso cost will be reviewed for no longer than 120 days.

e) Awarding of bid and failure of bidding

- ✓ The Project will be awarded to the lowest complying bidder that passed both technical and financial review of the PBAC, NEDA-ICC and other relevant agencies. If a foreign and local contractor submit an equally advantageous bid, the local contractor will be favored.
- ✓ There may also be a case where none of the bids cleared the review process. In this case, a failure of bidding is declared, and the infrastructure agency must reconsider the project specifications through consultations with the Proponents.

f) Direct Negotiation

- ✓ For instances where only one contractor has successfully submitted a compliant proposal, direct negotiation may be facilitated with the Proponent for the finalization of the implementation plan of the Project.
- ✓ Disqualified bidders may ask for reconsideration to the agency head within 15 working days from the receipt of the notice of disqualification. The infrastructure agency shall the

E. Repayment scheme

- ✓ Implemented according to the submitted bid, the Proponent must follow the repayment scheme agreed upon with the infrastructure agency. This scheme shall depend on the PPP structure observed, where some entail a fixed payment schedule with the infrastructure agency, while others require the imposition of fees and charges to allow the Proponent to recover the project cost.
- ✓ It must be noted that these charges shall be approved by the infrastructure agency, except in the case of the establishment of public thoroughfares, where approval must come from the Toll Regulatory Board

F. Contract Termination and Adjustment

- ✓ If the project is revoked, canceled, or terminated by the Government, through no fault of the contractor, the Government shall compensate the contractor for its incurred expenses plus a reasonable rate of return not exceeding the stated value in the bidding documents, provided that the construction of the project is insured through GSIS, or other entity accredited by the Insurance Commission

G. Obligations of the LGU

The role of the LGUs is pivotal for the implementation of appropriate strategies to support better Solid Waste Management in their jurisdictions. By developing appropriate development plans, assessing proposals, and awarding contracts to a compliant, feasible, and economical proposal, LGUs can ensure that the WTE project can be successfully installed.

On top of these responsibilities, the LGUs are also responsible for the following tasks:

1. Grant of franchise
2. Approval of detailed engineering design
3. Approval of charges except when regulatory board is in charge of approval
4. Provision of right of way facilities
5. Project supervision
6. Audit of collections

3) Items of Study on PFI/PPP introduction (Original Chapter 4)

Followings are the typical item of the study on PFI/PPP applicability in Japan.

(1) Intention Survey (Market Sounding)

A. Study on Business Scheme in the case study

There are many types of business schemes. Among these schemes, there are one or more that does not match with the conditions of the WTF development as well as the situation of LGs' expectation. As such, by summarizing the features of each business scheme, and carrying out the case study, LGs shall find out the business schemes that are compatible with the conditions of LGs.

Table 3-26 shows the PPP/PFI Business Scheme applied in WTFs in the world. PFI business schemes, covers BOO, BOT and BTO, which private partner is responsible for finance, while in DBO, DBM and public own and operate schemes, public sector (LGs) shall be responsible for finance. In Japan, there are generous national subsidy program which provides 1/3 to 1/2 of Capex as well as ultra-soft loan for the LG bond. By them, LGs in Japan only have to pay for 10-20% of Capex during construction period in case of DBO or public own and operate schemes.

In PFIs, private investor shall finance 10% of Capex (other 90% can be subsidized as same as DBO) plus operation cost, however, because of high Japanese LGs credits, there is economic advantage in Local bond rather than bank loan borrowed by private investor. Because of these circumstances, such as subsidy, ultra-low interest local bond, and easiness to obtain local residents' consensus, etc., employment of DBO and public own and operate schemes is being highest in Japan.

Table 3-26 PPP/PFI Business Scheme (PPP Modalities) applied in WTFs in the world

PPP Modalities		Role					Owner of Facility			Explanation
		Construction Period			Operation Period		Const. Period	Op. Period	After Op. Period	
		Design	Const.	Finance	Op.	Mt.				
PFI	BOO	Private	Private	Private	Private	Private	Private	Private	Private	PFIs cover BOO/BOT/BTO, which Private sector raise funds, design, construct, and operate the facility thru project period. [BOO] Ownership will not be transferred to the public even after the operation period.
	BOT	Private	Private	Private	Private	Private	Private	Private	Public	[BOT] Ownership will be transferred to the public at the end of operation period.
	BTO	Private	Private	Private	Private	Private	Private	Public	Public	[BTO] Ownership will be transferred to the public after completion of the facility.
Non-PFIs	DBO	Public	Public	Public	Private	Private	Public	Public	Public	The public sector raises funds through bonds and grants, and comprehensively outsources the design, construction, operation of the facility to the private.
	DBM	Public	Public	Public	Public	Private	Public	Public	Public	The public sector raises funds through bonds and grants, and comprehensively outsources the design, construction, maintenance of the facility to the private.
	Public Build + long term O&M contract	Public	Public	Public	Private	Private	Public	Public	Public	The public sector designs and constructs the facility, and the private is entrusted with the operation for multiple years.

Source: JICA Expert Team

Table 3-27 shows the different PPP schemes that can be explored for the agreements that can be arranged between the private and public entities. For ease of discussion, the government agency, including government-owned and/or controlled corporations, and LGUs, will be referred to as the Infrastructure Agency, while the private entity will be referred to as the Project Proponent.

Table 3-27 Different PPP schemes

PPP Scheme	Role of Project Proponent	Role of Infrastructure Agency
Build- Operate- Transfer (BOT)	Financing and construction, including operation and maintenance over a fixed term period, not exceeding 50 years. During its operation, the Proponent may impose fees and charges to recover its initial investment. Provide supply- and- operate scheme to capacitate the infrastructure agency in assuming control in operations and maintenance of the facility.	Reviews and approves imposed fees of the Proponent, with the help of NEDA-ICC, and the Toll Regulatory Board for public thoroughfares. Assumes ownership after the fixed term period, and shall tap the help of the Proponent, if necessary, for the technology transfer to allow for a smooth transition in the operation and maintenance of the facility.
Build- and- transfer (BT)	Financing and Construction	Assumes control and ownership after completion of construction and shall issue payments in fixed terms including a reasonable rate of return, to the Proponent.
Build- Own- and- Operate (BOO)	Financing and construction, and shall own, operate, and maintain the facility after completion. Fees During its operation, the Proponent may impose fees and charges to recover its initial investment.	Reviews and approves imposed fees of the Proponent, with the help of NEDA-ICC, and the Toll Regulatory Board for public thoroughfares.
Build- Lease- and- Transfer (BLT)	Financing and construction and assumes ownership over a fixed term after completion. During this time, the Proponent will lease the facility to the infrastructure agency to recover its expenses.	Leases facility from the Proponent over a fixed term and assumes ownership after the given period.
Build- Transfer- and- Operate (BTO)	Financing and construction and is contracted by the infrastructure agency to handle operation and maintenance.	Assumes ownership after construction and contracts Proponent for the operation and maintenance of the facility.
Contract- Add- and- Operate (CAO)	Financing and construction of an addition to an existing infrastructure. Pays rent to the infrastructure agency over an agreed franchise period and transfer arrangement may vary from case-to-case.	Leases space to the Proponent to add to an existing government facility, over a fixed term period. May or may not assume ownership of the extended facility over the given period.
Develop- Operate- and- Transfer (DOT)	Develop infrastructure adjoining a government infrastructure project	Develop infrastructure project alongside the Proponent
Rehabilitate- Operate- and- Transfer (ROT)	Refurbish, operate and maintain a government-owned facility over a fixed term.	Assumes control after fixed term
Rehabilitate- Own- and- Operate (ROO)	Refurbish, operate, and maintain a government-owned facility, with no imposed time limitation on ownership. May continue to operate the facility in perpetuity if no violation in the agreements is incurred	Audits the operation and maintenance of the Proponent of the facility. May assume ownership if the Proponent violates the Franchise agreements.

B. Project Condition for WTF

It is quite important to clarify the scope of work both LGU and the private partner, along with conditions such as the technology type, size (capacity), locations of WTFs, etc. Generally, the collection and transportation of waste are within the scope of work of LGUs, while operation, maintenance and management of the WTFs from reception, weighing waste, and the storage of by-products are considered within the scope of work of the private partner. However, it depends on the view of LGU how to use or dispose by-products, such as bottom ash and fly ash, and who shall be responsible for the revenues from generated electricity in case of WTE projects.

Based on the asset inventory, capability and capacity of LGU, appropriate role demarcation shall be designed. A few examples of actual WTE-PPP role demarcation are explained in “3.9 Role demarcation“

C. Market sounding survey of the private sector

Conduct a market sounding survey targeting private business operators to see if they are willing to participate in the WTF projects planned by LGs. In this market survey, the business schemes and conditions deemed compatible to the LGs shall be demonstrated to confirm the willingness of private enterprises.

Table 3-28 Example of Market Sounding Survey in Japan

Purpose	To obtain following information; 1. Investors intention for the expected PPP scheme, 2. Basic economic/financial information for the calculation of Value for Money, 3. Specific request from private partners,
Method	Questionnaire Survey (Send/collect by email with phone call request)
Target	Plant manufacturers 11 companies who passed criteria such as; - Having 5 or more same kind of contract record in recent 10 years, - Having healthy financial score for the Waste Management Facility Construction, etc. Number of answered firms: 3 firms
Items	1. Intention to submit proposal, preferable PPP scheme, 2. Comment on project conditions (e.g. project period, scope, risk allocation, any idea to improve project outcome, etc.) 3. Information on project cost (Expected Capex, Opex, Operators allocation plan, IRR, equity of SPC, etc.)
Example of result	1. (PPP/PFI modality) All of answered 3 firms have willingness to submit proposal. 2/3 prefers DBO, 1/3 prefers Government own and operate modality, 0/3 prefers PFI/BOT, 2. (Duration) 2/3 firms prefer 20 years or more operation period, 1/3 prefers 15 to 20 years. 3. (Scope) 1/3 prefers city to cover the scopes of, (1) collection of tariffs from business, (2) Visitor handling, (3) handling of refused items/recyclables, 4. (Expected Equity-IRR) 1.0~1.5% or more (In Japan long-term interest rate is below 1.0%).

Source: A market study result provided by JICA Expert Team

(2) Quantitative evaluation (VFM estimation)

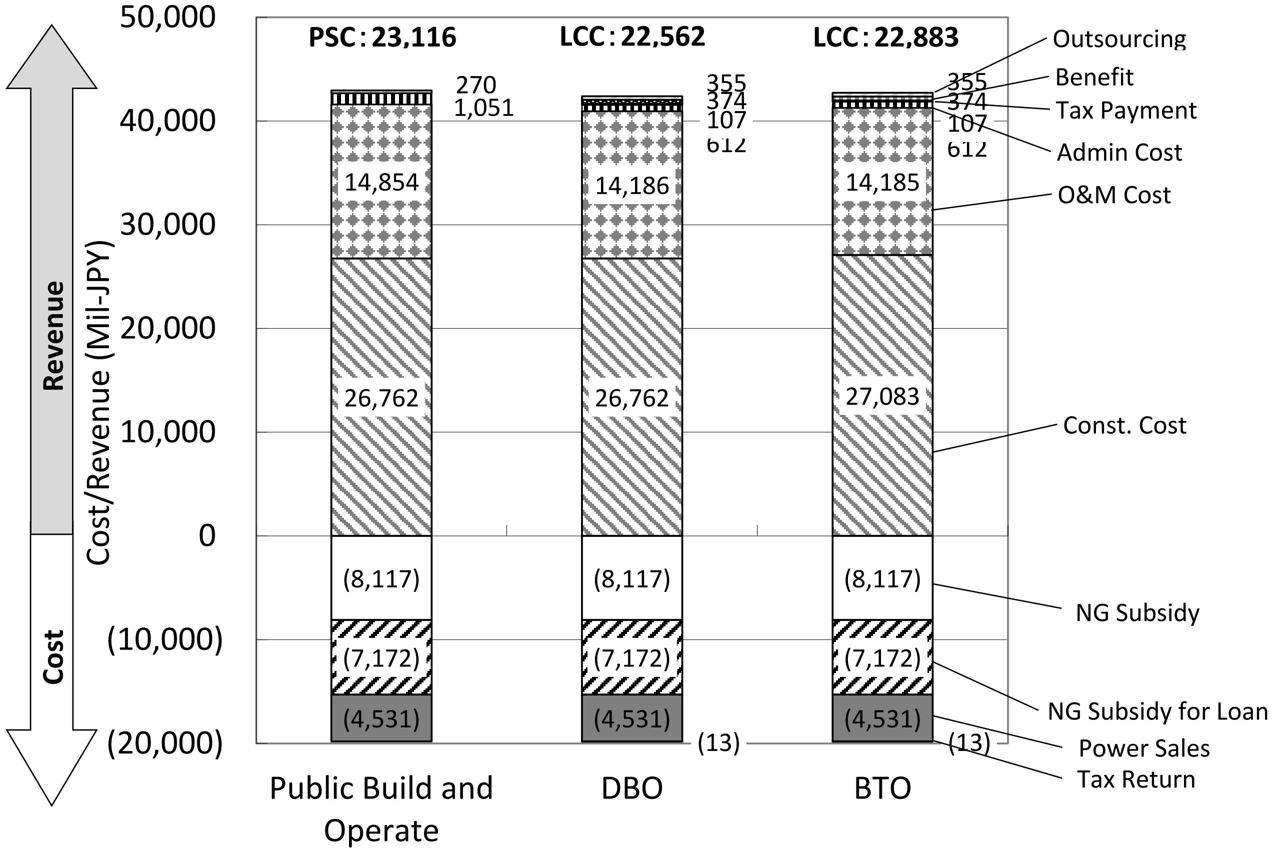
In quantitative evaluation, an indicator called VFM (Value for Money) is utilized to compare economic efficiency of different business method.

According to the "Guidelines for VFM" (formulated by the Cabinet Office of Japan on July 27, 2001), the view on VFM is shown as follows.

The present value of the expected public financial expenditure over the entire project period, conducted by the public sector themselves, is called as PSC (Public Sector Comparator), and, the present value of the expected public financial expenditure over the entire project period, when implemented as a PFI project, is called as LCC (Life Cycle Cost). Under the same level of public service level, the evaluation of VFM is done by comparing the PSC and LCC. If LCC is below PSC, then it can be concluded that there is VFM in the PFI business. If LCC is above PSC, it can be concluded that there is no VFM.

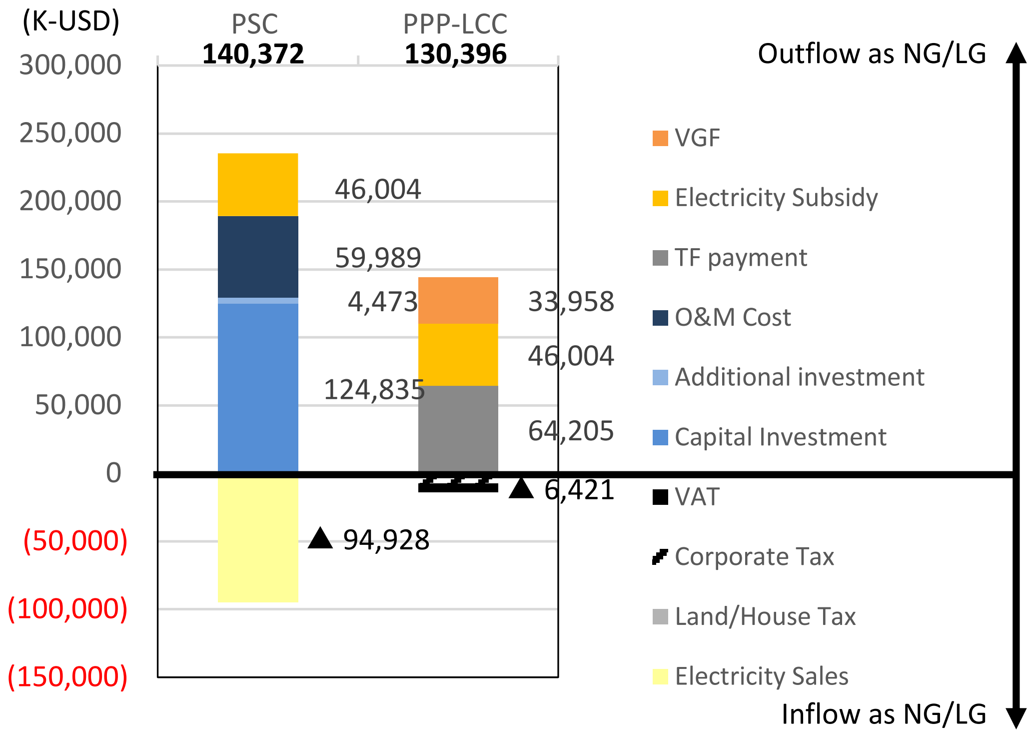
VFM is calculated based on PSC, which is the present value of the expected public financial expenditure over the entire project period (assumed based on Capital and Operational expenses from previous case studies and market survey) when implemented by the public sector itself, and LCC, the present value of the expected public financial expenditure over the entire project period when implemented by private entity under PFI business schemes.

Figure 3-22 shows an example which compare conventional "Public Build and Operate" scheme as PSC, and DBO-LCC and BTO-LCC for clustering cities in Japan. As the result of this comparison, LCC of DBO and BTO schemes are lower than PSC then DBO and BTO have VfM about 2.3% and 1.0% respectively.
Figure 3-23 also show an example in VfM comparison in ASEAN city. PSC is 140,372 K-USD for 20 years while LCC under BOT is 130,396 K-USD for 20 years, this results PPP (BOT)-LCC has VfM around 9,976 K-USD which is 7.1%.



Source: A VFM Calculation Result provided by JICA Expert Team

Figure 3-22 Sample of PSC and LCC Comparison in a Japanese City



Source: A VFM Calculation Result provided by JICA Expert Team

Figure 3-23 Sample of PSC and PPP (BOT) LCC Comparison in an ASEAN City

(3) Qualitative Evaluation
In the Qualitative Evaluation, the differences of each business schemes for the following main items will be identified/analyzed:

a) Introduction Record of Business Scheme in other LGs,
b) Amount of long-term debt burden for LG,
c) Risk allocation between public and private sector,
d) Acceptability of residents,

(4) Comprehensive evaluation
Based on the results from the above 1) to 3) components, a comprehensive comparative evaluation will be conducted to identify the most suitable business scheme for the LG.

3.9 Role demarcation

As briefly explained in "3.8 Business scheme", it is indispensable that task/role allocation between public LGU and private company shall be well considered and set forth clearly in the contract. The optimal risk sharing is to share the work so that an entity that can manage the risk well bears the risk.

For example, with regard to land security, LGUs are more proficient in land prices and knowledgeable in land convenience than international technology providers, so in WTE PPP projects, LGUs are more suitable to carry out the work to secure land. On the other hand, in the WTE, rather than an amateur LGU performing the design, construction, and operation work of the facility, it is more appropriate to stipulate only the required output specifications, let the private sector take care of the details, and supervise whether the work is being carried out as requested.

Table 3-29 and Table 3-30 shows the examples on task allocation between LGU and private partner, in case of DBO and BOT respectively.

Under the DBO scheme, ownership of the facility throughout the project period is LGU, all permits including EIA are usually obtained by LGU. However EIA must have technology specific information including layout, exhaust gas treatment system settings, etc. private partner is also obliged to cooperate to LGU. Prior to the operation, even DBO or BOT where private operates the facility, manuals for the facility operation, maintenance, emergency plan, and other related manuals must be prepared by private entity for LGU's approval. During the operation phase, since waste quantity and quality are not able to be handled by the private entity, security of waste feedstock must be belong to the LGU's responsibility. Meanwhile, selling right of recovered material such as power, heat or any sellable material can be determined project by project. Since LGU shall pay annual O&M cost based on the DBO bid for the operation period, such sales revenue belongingness must be designed during bid process.

An example of BOT in Table 3-30 , this project was developed by host national/local governments together with international donors. Since there are several failure cases of WTE-ACC in the country, it was required to attract internationally reputed investors and technology providers by the fair task allocation. Local government shall be responsible for all the task related to the waste, land, utilities, etc. where LG is better to manage while WTE-ACC part from fund rising, design, construction and operation for 15 years shall be obliged to private.

Since it is sometimes difficult for LGU to find the suitable land for this kind of NIMBY project, LGU tend to rely on the private for such task. However, this has contains 2 important risks.
(1) By leaving the important task of land security to the private sector, bidders are often led by local investors who are good at securing land. However, the local strongman often lack the ability to select the appropriate technology, and as a result of adopting an inexperienced technology, they can get frustrated during the construction and operation phases.
(2) Even if the performance on the private operator is poor and the LGU wants to cancel the contract based on the terms of the contract, it is sometimes difficult to cancel the contract in a situation where the private sector holds ownership of the land. Even if the contract can be terminated, it will be necessary to continue to lease the land.

In view of these factors, considering the continuity of projects that provide public services and the ease of contract cancellation, it is preferable for LGU to secure the land unless there are special circumstances.

Table 3-29 Sample task allocation between LG and Private Partner (in the case of DBO)

Phase	Responsibility of LG	Responsibility of Private Partner
Design and Construction Phase	✓ Security of Land ✓ Topographic Survey ✓ Geological Survey ✓ Obtain project approval from government agencies, ✓ EIA*, ✓ Application of the permission*, ✓ Supervision of Design/Construction*, etc.	✓ Support LG on Topo/Geo Survey, ✓ Support LG on the documentation for applications to gov. agencies, ✓ Design and Construction of WTE, ✓ Process and disposal of construction waste, ✓ Preparation of manuals for operation*, ✓ Provision of spare parts, etc.
Operation and Maintenance Phase	✓ Delivery of Waste Feedstock, ✓ Sales of Recovered Material, ✓ Monitoring of the operation, etc.	✓ Reception, weighing, collection of fee, ✓ Operation management (prepare plan, implement, etc.) ✓ Consumables management (prepare plan, procurement, etc.), ✓ Maintenance management (prepare plan, regular inspection, repair, back up, etc.),
Note: In DBO facility will be owned by LG so permissions including EIA usually be secured by LG.		

Source: JICA Expert Team

Table 3-30 Sample task allocation between LG and Private Partner (in the case of BOT)

Category	No	Role	Gov.	SPC
Land Acquisition	1	Project Site and water supply facility	✓	
Design and Construction (including commissioning & testing)	2	MSW Acceptance Facility (Weighbridge and Registration Office, etc.)		✓
	3	Sample sorting facility (Dumping box, etc.)		✓
	4	Processing system and visitor center		✓
	5	Water supply piping	✓	
	6	Adherent Landfill and Leachate Treatment Facility	✓	
	7	Supporting Infrastructure (Road, rainwater drainage, etc.) in MSWM complex but outside of Waste Treatment Facility Plot	✓	
	8	Supporting Infrastructure (Road, rainwater drainage, etc.) in Waste Treatment Facility Plot		✓
Operation and Maintenance	9	MSW supply to site and Unsuitable Waste removal prior to site delivery	✓	
	10	Processing system (from MSW weighbridge until residue loading station), visitor center		✓
	11	Water supply	✓	
	12	Landfill and Leachate Treatment Site operation including residue transfer to landfill	✓	
	13	Supporting Infrastructure (Road, rainwater drainage, etc.) in MSWM complex but outside of Waste Treatment Facility Plot	✓	
	14	Supporting Infrastructure (Road, rainwater drainage, etc.) in Waste Treatment Facility Plot		✓
Financing	15	Land for Project Site	✓	
	16	Weighbridge, Registration Office, Sample Sorting, Processing System, visitor center		✓

Category	No	Role	Gov.	SPC
	19	Water supply facility	✓	
	20	Supporting Infrastructure (Road, rainwater drainage, etc.) in MSWM complex but outside of Waste Treatment Facility Plot	✓	
	21	Supporting Infrastructure (Road, rainwater drainage, etc.) in Waste Treatment Facility Plot		✓

Remarks: The above risk allocation table only shows some of the risks of the Project. Further detail of the risk allocation shall be developed under the Bidding Document.
Source: An ASEAN WTE-PPP PQ document obtained by JICA Expert Team

3.10 Value Chain Analysis

As described in “3.9 Role demarcation”, the provision of MSWs in accordance with the contract terms and conditions is one of the project's key responsibilities belong to the LGU. As shown in “3.3 Target Waste Amount-” and “3.4 Target waste quality”, a careful upstream Value Chain Analysis for the WTE-ACC Feedstock over a long term is required.

In Figure 3-24 - Figure 3-26 , the three waste treatment flows shown in "3.2 Technology selection" are represented. One is a case where a WTE-ACC is newly installed in addition to the existing MRF (Figure 3-24), and a Compost facility or a Biomethanation facility that processes Biodegradables is installed together with the WTE-ACC (Figure 3-25), the last case is when the RDF Fluff production facility is installed as a feedstock for WTE-ACC (Figure 3-26).

These three scenarios are planned and determined on unique circumstances such as how LGUs want to treat their MSW, whether they have off-takers of compost, biogas, digestate, and whether they will convert combustible fraction of MW to RDF for saving the cost of transportation to the WTE-ACC, etc.
Therefore, it is necessary to design waste segregation classification for residents according to the treatment system in the downstream (Intermediate Treatment/Utilization and Disposal in the figure) and request citizens for cooperation. Of course, in addition to dividing fleets by segregation category, collection and transportation systems that do not impair the public health as well as convenience of residents and minimize the cost of equipment and operation are required.

The cases in which a new WTE-ACCs are installed (Figure 3-24) are common in large urbanized cities, and in addition to the 3Rs at the source, almost all MSWs after resource recovery by MRF will be the WTE Feedstock. The recovery rate of 3Rs and MRFs at the source should be set on the safety side based on the past track record, and the capacity of WTE-ACC needs to set appropriate in light of future population growth and waste volume increase. At the same time, it will be essential to secure a sanitary landfill site that will accept the bottom ash and fly ash that are residues of WTE-ACC. Since fly ash contains heavy metals and dioxins, it is necessary to perform fly ash treatment to prevent elution and to install leachate treatment facilities at landfill disposal sites.

The case where a Compost facility or a Biomethanation facility that processes biodegradables is attached in conjunction with WTE-ACC (Figure 3-25) is unsuitable in large urban cities and can be studied in urban suburbs close to agricultural land. Compost requires a large plot of land, and since a large facility would discharge hundreds of tons of compost and digestate every day, it would require a large area of farmland that could accept it year-round. Naturally, a system for separating food waste at the source, separated collection and transportation are necessary. In reality, it is impossible for all households to completely separate garbage, so it is necessary to plan a mass balance flow based on reality-based numbers.

There are not many examples of cases in which a manufacturing facility for RDF fluffs is installed to produce a feedstock for WTE-ACC (Figure 3-26). For example, a cluster of municipalities may construct a single WTE-ACC, and a municipality in a distant suburb that participates in the cluster may pack unrecyclable plastics and paper as fluff fuel and transport them to the WTE-ACC.

In this way, since the options for waste disposal systems differ greatly depending on the unique circumstances such as the current waste management and disposal system and future plans of LGUs, Value Chain Analysis in several scenarios is indispensable when introducing WTE-ACC facilities in order to materialize the terms and conditions of the contract and potential risks.

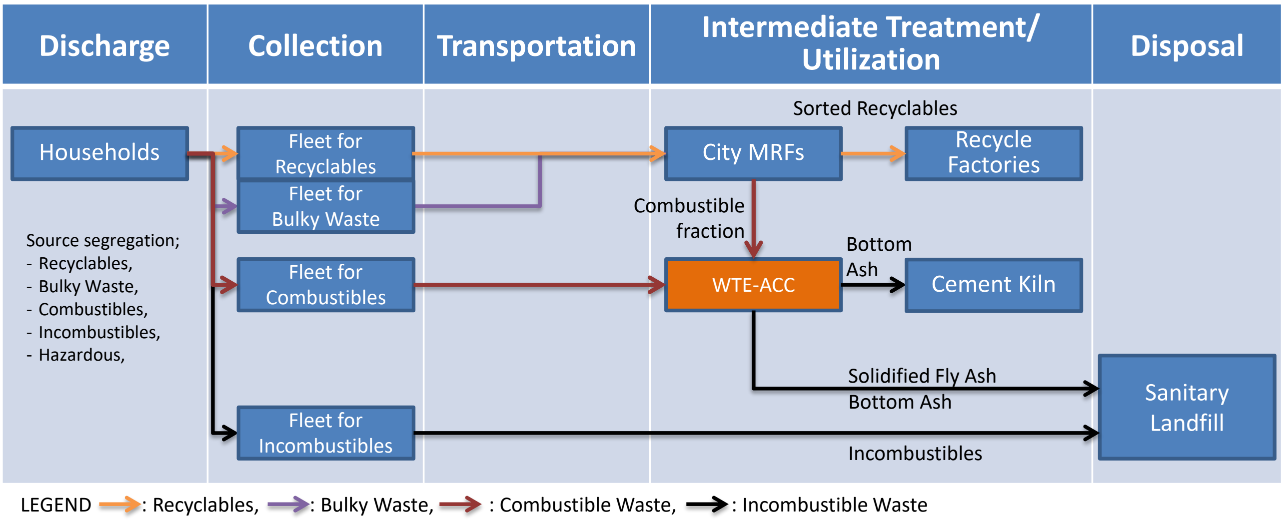


Figure 3-24 Waste Treatment Block Flow with WTE-ACC

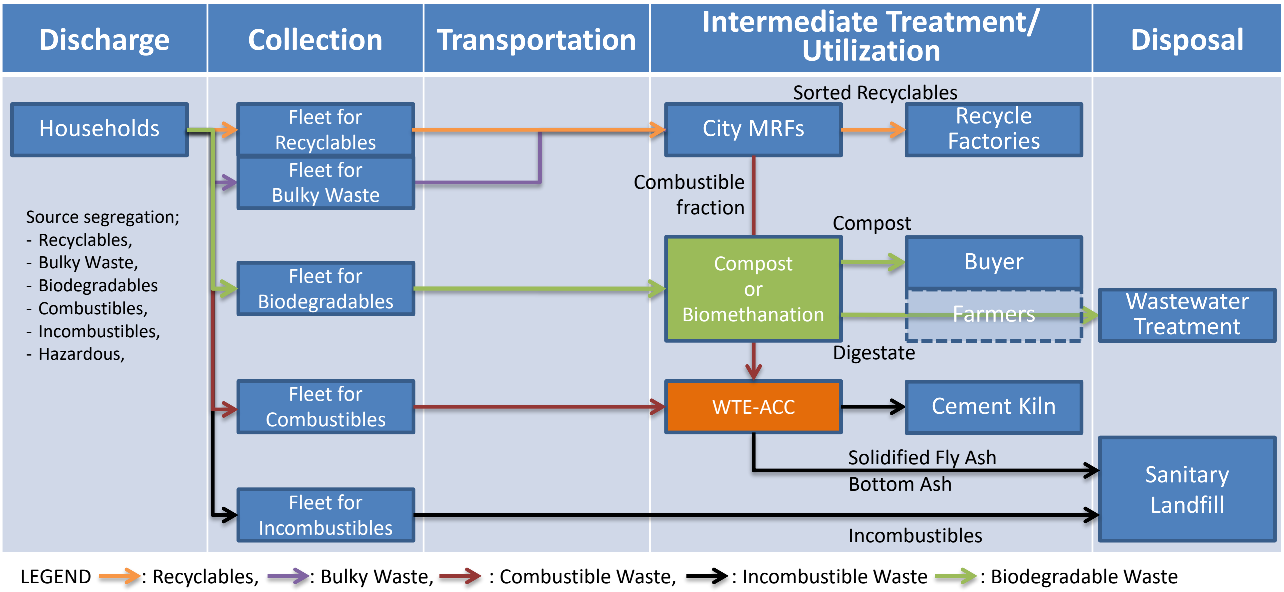


Figure 3-25 Waste Treatment Block Flow with Compost/Biomethanation

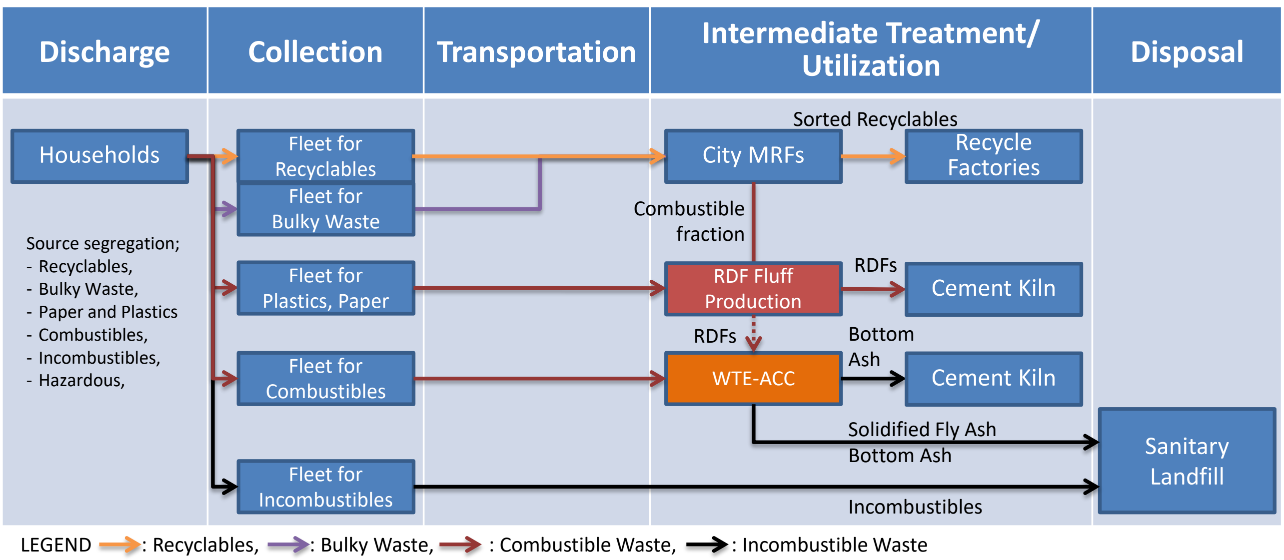


Figure 3-26 Waste Treatment Block Flow with RDF

Some municipalities in developing countries have "Waste Removal Contracts" that place orders for transportation, disposal, and final disposal to the waste collectors in a lump sum, but it is important to have a mechanism to properly monitor what kind of treatment and disposal is being carried out and to properly reflect this in payments. If the waste tonnage is weighed at the Transfer Stations within the municipality and then disposed of in the SLF outside of the municipality, there is a risk of illegal dumping.

In this case, since the setting and guidance of waste segregation classification for residents according to the treatment system in the downstream does not function sufficiently, and when the momentum to introduce a new WTE-ACC increases, there is no option to have it implemented by anyone other than the existing collector, etc., and since the degree of freedom of planning and design of the waste treatment system as a LGU is reduced, each scope of the collection and transportation, intermediate treatment, and final disposal should be separated as much as possible. It is necessary to put into operation a mechanism that allows LGUs to supervise the seams of scopes.

3.11 Other Aspects

1) Applications/notifications to the governments

When designing facilities, it is essential to comply with the ESWMA (RA9003) and Electricity Related Acts, especially the laws and regulations relevant to the installation of power generation equipment. Furthermore, in addition to complying with relevant laws and regulations, standards, and notifications in each field, based on regulations and rules of LGUs, various notifications/applications must be submitted to government agencies. Some of these procedures take long time, and if the contents are not well grasped in advance, it can lead to serious changes to the procurement timeline, so preliminary research of relevant laws and regulations is a very important task.
The example of the application procedures to various government agencies concerning the WTF/WTE design in Japan is shown in APPENDIX B: Applications/Notifications to the Governments (EXAMPLE IN JAPAN). The application procedures shown in APPENDIX B: Applications/Notifications to the Governments (EXAMPLE IN JAPAN) may be revised to the Philippines situation. So the latest laws and regulations must always be checked while proceeding with the design.

2) General Structure of WTF

The items that the designer, design supervisor as well as contract manager in LGU needs to check when designing a facility is listed in APPENDIX C: GENERAL STRUCTURE OF WTE/WTF.

3) Safety Measures

In WTFs/WTEs, since the property of waste is not uniform and it is difficult to grasp all the contents, an unexpected accident may occur. In some cases, the accident might affect not only the facility but also the surrounding people and the environment. The MOEJ summarized in March 2009 the accidents at WTFs across the country occurred from FY 2004 to FY 2007. According to this, among the WTFs, the occurrence of accidents in the bulky waste treatment facility is the largest, followed by those in waste incineration facility and in the recycling facility. In the bulky waste treatment facility, it is considered that explosives such as cylinders get mixed in the waste and the explosion or ignition is caused by the spark generated by the impact of the crusher. In addition, cotton-like combustibles generated from crushing are also estimated to cause fire. In the waste incineration facility, some kind of fire is carried in, and accidents such as burning up in the waste pit are reported. Table 3-31 shows the number of occupational accidents and property damage accidents by facilities.
Examples of serious personal injury accidents in WTFs include i) burns from hot ash, hot water, ii) caught in machines, iii) fall from a high place, and iv) lack of oxygen. In terms of the number of incidents, there are many accidents involving cuts, flying objects and falls. Specific examples of recent accidents at WTE-ACCs are shown in Table 3-32 . How to prevent these accidents in the aspect of LGUs are summarized in APPENDIX F: SAFETY MEASURES.

Table 3-31 Number of occupational accidents and property damage accidents by facilities

Facility Types		Total No. of facilities (FY2007)	4 yrs (FY2004-FY2007)		
			Work-related injury or death	Property damage incidents	Total
Waste incineration facility	Conventional incineration facility	1,285	248	130	378
	Gasification pyrolysis melting furnace		21	34	55
Recycling facility	Recycling facility	1,211	97	11	108
	RDF producing facility etc		6	13	19
Oversize waste treatment facility		676	150	324	474
Sewage treatment facility	Sludge reclamation treatment facility	1,041	11	5	16
	Sewage treatment facility		23	10	33
Final disposal site		1,831	12	20	32
Total		6,044	568	547	1,115

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Note: If the explosion causes damage to the facility as well as injuries to the workers, it was counted as both a property damage incident and a work-related injury or death.
Personal injury in the collection works covers accidents with four or more days of absence from work, and although many reports were received on fires and traffic accidents, these were not included in the total.
The number of questionnaires sent to LGUs via prefectures was 2,454 and the number of responses by mail or e-mail was 1,352, for a collection rate of 55.1%.

Table 3-32 Accident in WTE-ACC

Type of accident	Status of accident
Fall	While moving during inspection work around the furnace, a worker fell through a machine hatch that had been opened for the work to the first floor, 5 meters below.
Flying objects	A clinker (a lump of ash with a diameter of about 30 cm) near the spraying nozzle at the top of the cooling tower fell on the worker's back while he was making a hole in the ash accumulated in the refuse hopper at the incineration plant.
Tumbling	While working with a 10-ton truck and a vacuum truck to lift sludge from a sludge storage tank at a drainage facility, he was injured when he fell.
Entanglement	While opening the inspection port of the molten fly ash conveyor to check the status of the molten fly ash, he dropped the measuring cup he was holding for ash sampling into the conveyor. When he quickly tried to remove it, his right arm was caught in the conveyor.
Lack of oxygen	During the construction of the facility, a subcontractor went under the floor to check on the completion and cleaning of the water piping for firefighting and the first person collapsed. After the first person collapsed, the second person also went under the floor to check on the situation and collapsed. A nearby worker noticed the abnormality and used a work fan to ventilate the subfloor.
Pinch	At around midnight, the tension of the conveyor chain was adjusted and he was caught between the flight and the padding plate when he tried to check the tension during the inspection.
Cut	A worker received instructions for inspection by radio communication, but misheard them and went to another piece of equipment. He thought he had stopped the gas-cooled rotary valve of the fly ash conveyor system of the other equipment, but he had not, and the tips of the three fingers of his right hand, which he inserted through the inspection port, were cut off.
Burn	When the worker noticed water leaking from the inspection port at the bottom of the gas cooling tower, he opened the door of the lower inspection port and found ashes had accumulated, so he scraped them out with an iron bar. When he opened the door of the upper inspection port and was scraping out the ashes, he was exposed to boiling water that came out of the inspection port and was burned on his hands and feet.

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

4) Responsiveness of Disaster Waste

The Philippines' geographical location on the "Pacific Ring of Fire" and along the Pacific typhoon belt makes the country prone to many forms of natural disasters such as typhoons, earthquakes, floods, volcanic eruptions, landslides, and fires.

Typhoon Haiyan/Yolanda in 2013, along with about 6,300 deaths, initially 3,631, (28,688 people had severe/minor injuries, 1,062 went missing, 16,078,181 were affected and 5,130,580 were forced to evacuate), generated 19 million tons of waste and required additional budgetary arrangement of USD301 million and foreign support, including the removal of debris by UN volunteers.

According to “Disaster Waste Management (DWM) in the Philippines” (2021, Maria Antonia N. Tanchuling, UP Diliman, jsmcwm.or.jp), waste management in the event of such a catastrophic disaster in the Philippines suggests that emergency waste is not separated and that most cities do not have pre-designated temporary storage for disaster waste. Therefore, there is an urgent need to "establish a disaster waste management economic plan that minimizes health and environmental risks."

APPENDIX G: RESPONSIVENESS TO DISASTER WASTE provides information on the handling of disaster waste for future waste treatment plans in the Philippines by giving an overview of disaster waste treatment in Japan.

5) Measures to regional characteristics

There must not be any problem in the operation of the WTF due to facility damage associated with material corrosion in the coastal area. In the facility planning, it is necessary to investigate the empirical case of other facilities already operating under similar conditions to the details and to take measures according to the conditions of the location.

In recent years, the number of cases where WTFs are being built near the seashore is increasing. It is important to sufficiently take measures against salt damage at the design phase against the influence of sea breeze in light of stable operation and life time of the entire facility.

The basics of measures against salt damage in facility planning are to store equipment inside the building, to consider the wind direction from the local topography and surrounding conditions, to consider locations of major openings in the buildings such as entrance and air outlets, or to consider the entire layout plan of the facility such as to establish a green zone.

For devices that must be installed outdoors, it is necessary to prevent the wind by covering, and to respond by material selection, salt resistance coating, salt resistance paint, etc. Adequate maintenance is necessary for salt damage, such as repairing the floating of coating and painting at an early stage.

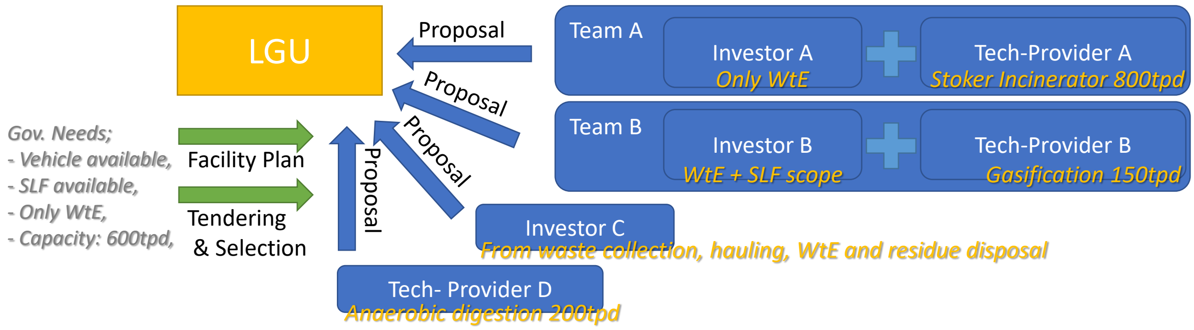
In addition, especially for outdoor electrical equipment, it is necessary to plan after sufficiently discussing with the relevant electric power companies about the construction standard to meet the location conditions.

Chapter 4 Evaluation Phase

It is quite frequently asked “how to evaluate unsolicited private WTE proposal” from LGUs in the Philippines and other ASEAN countries.
LGUs who are obliged to manage MSW in their jurisdiction, also have the right to select technology and implementation partner. But as this document discussed many times, LGUs are facing the lack of experience and capacity to evaluate the WTE system.

Unsolicited proposals from private entities, are usually the project based on the private entities’ interest in terms of their scope of work, capital size, applied technology, etc. Since existing situation and effort/achievement of LGUs in MSW management is different by LGUs, it is quite difficult to evaluate the proposal is fit with the LGUs or not if there is no WTE-ACC plan in LGUs.

- ✓ How to evaluate “Unsolicited WTE-PPP Proposal”? is one of frequently asked questions,
- ✓ Unsolicited Proposal is usually the project based on the private investor’s interest in terms on scope, capital size, applied technology, while existing status and effort/achievement of LGUs in MSW management is different in LGUs, so, simply it’s quite difficult to evaluate,
- ✓ Simple comparison of different schemes / types / technologies of private proposals is not make sense,
- ✓ **LGU shall have own MSW MP-based FS or even WTE-ACC conceptual plan as “NEEDS”** to ease the evaluation and/or selection of the **better** private proposal,



➡ Solicited approach is widely applied for the WTE-PPP project development in the world. If unsolicited approach will be adopted, at least WTE-ACC conceptual plan should be formulated beforehand.

Source: JICA Expert Team

Figure 4-1 Difficulty to evaluate different basis unsolicited proposals

The figure above shows an actual case in which several private consortiums proposed the WTE-ACC to a LGU in the Philippines. Team A consisted of Investor A and Technology Provider A who proposed an 800tpd stoker type of WTE-ACC in 20 years BOT. Team B consisted of Investor B and Technology Provider B who proposed a 150tpd of gasification process, the proposed scope of Team B was not only WTE-ACC but also SLF which would accept the WTE residues for 20 years BOT. Team C’s member was only an Investor C, the proposed scope was from waste collection, transportation, WTE-ACC and residue proposal (i.e. waste removal service) without specific technology of WTE-ACC. Team D contained only the Technology Provider so they didn’t intend to invest and be the operator. This Team D proposed the LGU to purchase their anaerobic digestion system of 200tpd.

It’s tough for the LGU to evaluate and find a most appropriate proposal from these different scopes/technologies of the proposals. In the actual case mentioned in above, after the comparison of the proposals, no project was awarded.

JET strongly recommends LGUs to materialize the will of LGU by drafting a WTE-ACC plan using the information shown in “0” “Chapter 2 ”and “Chapter 3 ” in this document. Whether garbage collection vehicles are available? SLF has still active for coming 10 years? LGU needs only WTE-ACC or wants to consider more comprehensive SWM system? How much is the capacity of WTE-ACC? It is the better and efficient way that these kinds of items should be shaped through the Conceptualization and F/S formulation then evaluate the private proposals.

Chapter 5 Contract Management Phase

5.1 Background

Contract management of WTE-ACC PPP Project is, LGU as implementation agency to efficiently and effectively supervise each work in the construction and operation phases of the Project based on the PPP Agreement to be concluded with the successful bidder.
This chapter is structured to introduce how the Japanese local government, as the procuring entity in Japan, which has introduced many waste incineration and power generation facilities to date, supervises and oversees each task performed by the construction and operation companies, and to provide suggestions for application to the future projects planned in the Philippines.

In Japan, the business scheme is generally based on public facilities (public facilities, public management, DBO, etc.) where the local government is the owner, while this project is based on the BOT method where the private sector is the installer, and there are major differences, especially in contract management during the construction period. The BOT business scheme has the clarity that the local government entrusts the private company with the full responsibility for the design and construction of the facility as well as financing. However, it tends to be unclear who and how to supervise the design, construction, and operation of the facilities to ensure that they are designed, constructed, and operated according to the quality and functions specified in the request for proposal. This chapter aims to provide examples of management methods for facilities owned and operated by local governments in DBO and other projects in Japan, and to provide materials for examining the contract management methods in the future project, taking into account the state of the prior readiness of the LGU, the supervisory capabilities, and the credibility and implementation capabilities of the project operator.

Figure 5-1 shows the position of Contract Management Phase through the lifetime of the Project.

Contract monitoring starts with the bidding process, and the extent to which it is written in the Request for Proposal (RfP) in the Bidding Document, especially in the Employer's Requirement (ERQ), is critical. If it is unclear, disputes will arise later. After the contract is awarded, LGUs check in turn whether what is written in the ERQ is reflected in the design, construction, and commissioning. Intervention level in design/construction supervision can also be designed in the RfP/ERQ.

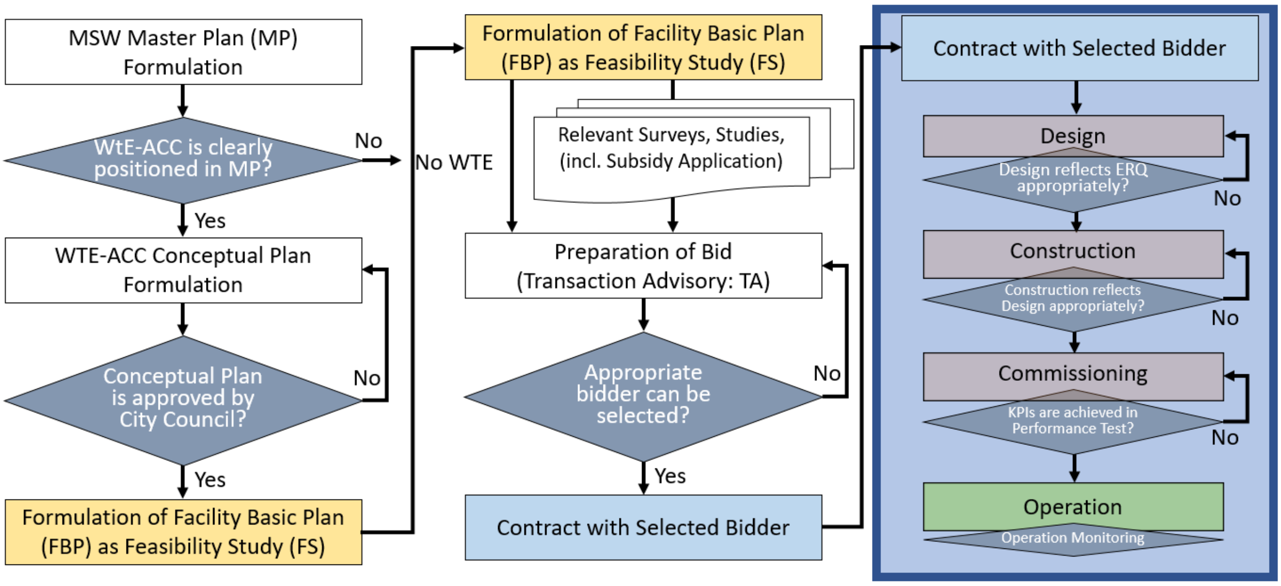


Figure 5-1 WtE project procedure: Contract Management Phase

5.2 Purpose of Contract Management

Contract management (monitoring) is conducted by the LGU to monitor and confirm whether the services provided by the private partner (private operator) are properly and reliably performed in accordance with the PPP agreement, RFP, and the project proposal submitted by the proponent for the project.

During the construction (design and construction) phase, LGU which is the client of the project, directly or indirectly through the project operator, will monitor the design and construction (EPC) contractor's drawings, including the detailed design documents, equipment manufacturing drawings, and construction drawings, as well as the commissioning procedures and performance test procedures, etc. The purpose of monitoring is to confirm, through approval and confirmation of drawings and implementation of inspections and tests, whether the construction work is planned and executed in accordance with the agreement, RFP, and the project proposal.

In the operation phase, the purpose of monitoring is to provide citizens with high-quality public services based on an appropriate division of roles between the LGU and the operator by monitoring and confirming the implementation status of tasks related to the operation of the operator and reflecting the results in the payment of fees.

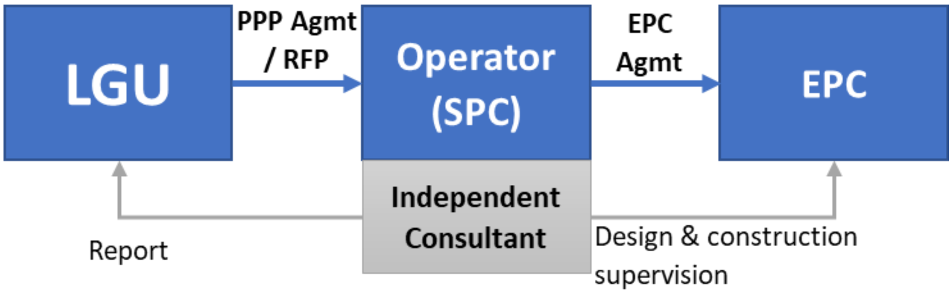


Figure 5-2　Relationship among LGU, Project Operator, and EPC in the Project (Design & Construction Stage)

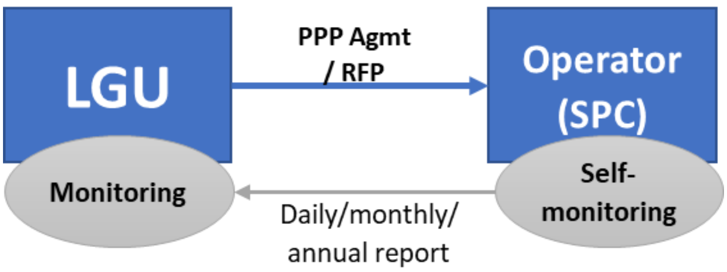
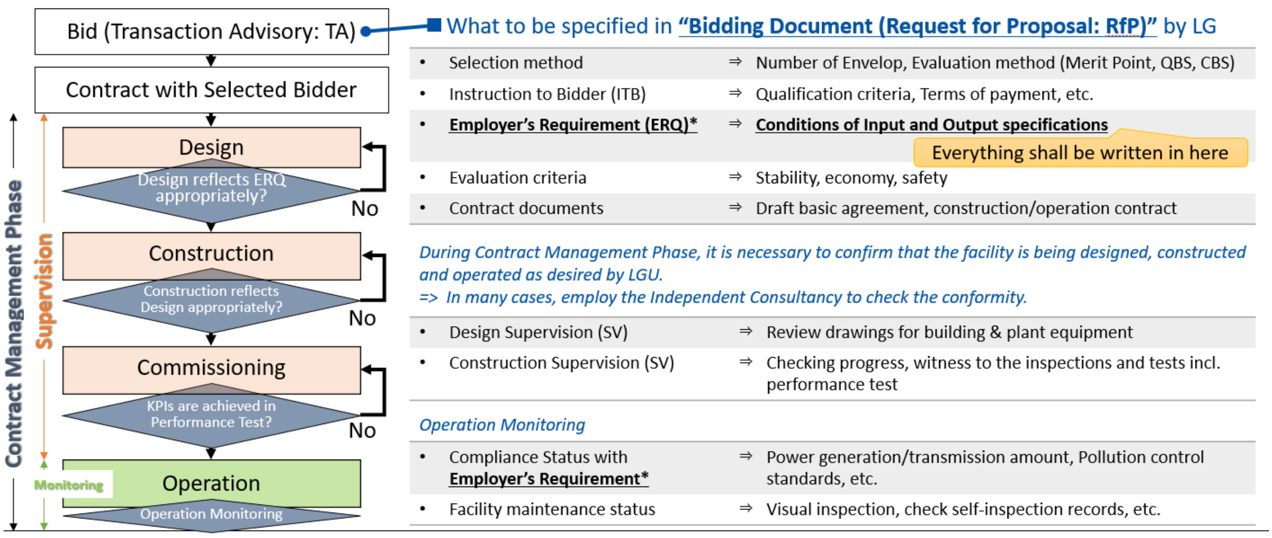


Figure 5-3　Relationship between LGU and Project Operator (Operation Stage)



***Employer's Requirement (ERQ)** is defined as the document specifies the purpose, scope, and/or design and/or other technical criteria for the execution of the Works in FIDIC general conditions. It is used as "Technical Specification" in the Design-Build ordering system where the Employer specifies only some output/input conditions and let contractor to propose their best options.

Figure 5-4　Flow of Contract Management Phase

5.3 Differences in Business Schemes and Contract Management between Japan and Philippines

Japan has built and operated many WTE-ACC facilities and has a wealth of knowledge and experience in planning, procurement, construction, operation, and supervision of these facilities. In Philippines, where WTE-ACC is to be introduced in the future, the Japanese knowledge will be useful, but it cannot be applied as-is due to the differences in contract culture and waste treatment systems, and it is necessary to adjust and adapt the Japanese knowledge to the Philippines situation.

Table 5-1 Summary of Contract Management in the Construction and Operation Phases

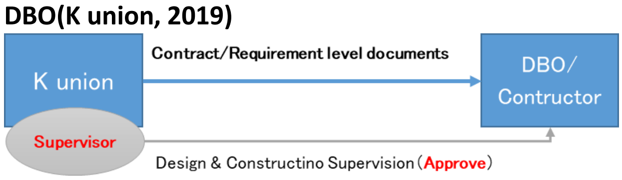
Phase	Work	Contents
Construction	Design supervision	Checking whether there are any discrepancies between the requirements document/contract and the basic design/detailed design documents
	Construction supervision	Confirmation that construction work is being carried out in accordance with the requirements, contract, and design documents
Operation	Operation supervision	Confirmation that operation and maintenance are being carried out in accordance with the requirements and contract documents

Source: JICA Expert Team

In Japan, in recent years, 90% of the WTE-ACC facilities have been ordered by the public or DBO business scheme. In the DBO business scheme, the local government responsible for waste disposal raises funds, and the operator who designs and constructs the facility (EPC contractor), and the operator who operates and maintains the facility (O&M contractor). The local government directly or entrusts a specialized consultant to supervise and oversee whether each contractor is designing, constructing and operating the plant in accordance with the RFP and the agreement (Table 5-5).

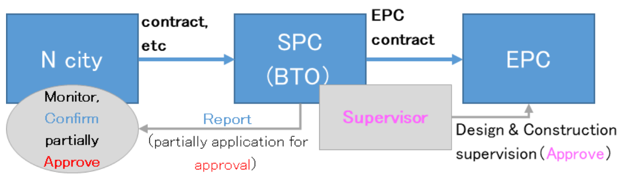
On the other hand, WTE-ACC facilities in Southeast Asia such as Philippines are generally owned and operated by the private sector, especially in the BOO or BOT business scheme (hereinafter collectively referred to as the "BOT method"), in which a private investor commissioned by a local government responsible for waste disposal raises funds and carries out design, construction, and operation in a comprehensive manner. In the construction of WTE-ACC facilities under the BOT method, the local government is in a position to indirectly monitor whether the design and construction supervision conducted by the BOT operator for the EPC contractor is appropriate (hereinafter referred to as "indirect supervision"). The method and degree of indirect supervision must be set and determined for each individual project and must be specified in the RFP.

DBO(K union, 2019)



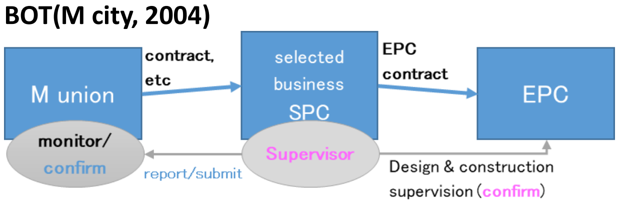
- No SPC. No monitoring on the business side.
- The union supervisor approves the various drawings and procedures. When the union lacks the capacity, it outsources the work.
- The consent of the union is a condition for proceeding to the next step.

BTO(N city, 2019)



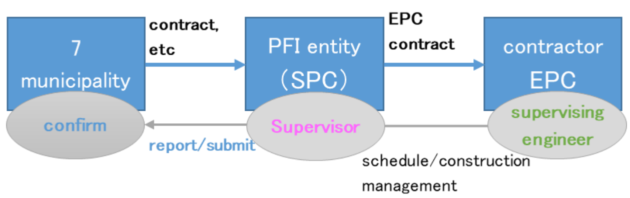
- City asks SPC to hire supervising company.
- The supervising company (supervisor) approves the various drawings.
- Only the list of approved books and test procedures are approved by the city.
- Other drawings are reported by SPC to the city. When the city lacks the capacity, it outsources the work.

BOT(M city, 2004)



- The union requests SPC to supervise the construction.
- SPC approves the various drawings.
- Report and obtain confirmation of the approved documents from SPC to the city.

BOO(K city etc, 2019)



- The city requests SPC to supervise the construction.
- Supervisor of SPC approves the various drawings.
- Report and obtain confirmation of the approved documents from SPC to the city.

Note that in Japan, the city's request for "confirmation" does not differ significantly from "acceptance/approval" in practice.

Figure 5-5 Contract Management System for WTE-ACC in four cases in Japan (Design and Construction Phase)

5.4 Design and Construction Stage

1) Basic Approach to Construction Monitoring

Monitoring during the design and construction phase will be carried out to achieve the objectives of monitoring during the construction phase, as described in "5.2 Purpose of Contract Management" by paying attention to the following:

- ✓ In general, WTE-ACC facilities are ordered under the lump-sum design-build (performance order) system, so LGU shall confirm that the contents specified in the RFP are reflected in the design documents.
- ✓ LGU shall confirm that the work is being performed in accordance with the approved design documents.
- ✓ The facilities must be developed to reflect the intentions and requirements of the client, keeping in mind that they are environmental infrastructure facilities that provide public services over a long-term operational period (see Table 5-2).
- ✓ This is a public project led by the private sector, and the private sector's ingenuity and know-how must be used to the maximum extent possible.
- ✓ Quality control must be carried out by project operators to ensure that only economic efficiency is not pursued, such as the use of poor quality materials, poor quality construction, and economic design.
- ✓ Each process must be prevented from being delayed without clear and unavoidable reasons, and the provision of public services must be prevented from being delayed.
- ✓ When applying for subsidies, etc., the progress and completion of construction must be confirmed and reported in an appropriate and transparent manner.
- ✓ The commissioning of facilities, performance tests and various inspections and completion inspections must be carried out properly in accordance with predetermined methods.

Table 5-2 Examples of Client (Local Government) Requests that should be emphasized

• Facility capable of safe, secure and stable processing • Facility that are familiar to citizens and contribute to the community • Continue to build trusting relationships with local residents • Ensuring the implementation of the proposed content and further improvement of the facility’s functions and performance • Proactive opening of facilities and disclosure of information • Adhere to the construction schedule and ensure the safety of local residents and workers • Clarification of the concept and direction of environmental learning and awareness-raising facilities • Environmentally friendly facility • Reduction in the amount of waste disposal support during the construction period • Economically viable facilities

2) Division of Roles between Local Government and Operators in the Construction Phase

Table 5-3 and Figure 5-6 show an example of the division of roles between local governments and project operators in DBO projects in Japan.

Table 5-3 Example of the Division of Roles between LG and Operators in DBO Projects in Japan (Const. Phase)

Main Actor	Roles
Local government	It is the client of the facility development and operation project and acts as the supervisor as the owner. Since this is a performance-based ordering system, the supervisor examines and approves the implementation design documents, construction drawings, etc. submitted by the project proponent, and conducts various inspections and witnesses.
Project operator（Construction JV etc.）	Considering the fact that the construction is a performance-based order system and a public project, the project team shall prepare an implementation design document based on the requirements and proposals and obtain the approval of the local government before carrying out equipment fabrication and construction. In addition, various procedures, inspections, tests, trial operations, etc. necessary before the start of operation will be carried out with the approval of the local government. In addition, the project company will prepare the necessary official documents such as the application documents for the grant on behalf of the local government.
Design and construction supervisor	Support the duties of supervisors carried out by the local government and support the construction supervision work of the local government in accordance with the construction supervision work specifications. Specifically, we will review from a professional standpoint various types of approval application documents such as implementation design documents and construction drawings, as well as conduct various inspections and witnessing under the direction of the local government. Among the procedures to be carried out by the

	various government agencies, the project manager will examine those that are prepared by the project manager, and the supervising company will support the preparation of those that need to be prepared by the local government. In addition, to ensure that the construction supervision work of the municipality proceeds smoothly, we will keep in close contact with the municipality and report promptly. The company will be responsible for various services such as contact work with the operator, document management work, and meeting management work. Furthermore, it will assign a construction supervisor, as defined in Article 2, Paragraph 7 of the Architects and Building Engineers Law, to perform the construction supervision work required by the Building Standards Law on its behalf.

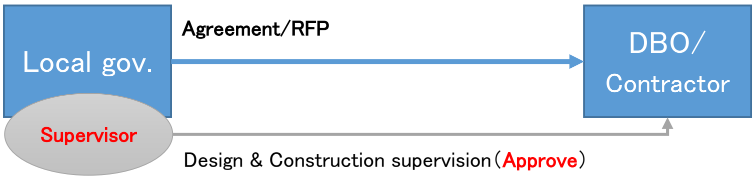


Figure 5-6 Example of the Division of Roles between the Local Government and the Project Operator in a DBO Project in Japan (Construction Phase)

The roles of LGU, SPC, EPC and Independent Certifier (hereinafter referred to as “I/C”) in the Project are shown in Table 5-4 and Figure 5-2 .
LGU, as the client for this facility construction and operation project, will be responsible for supervising the installation and operation of the facility by SPC. SPC, as the installer of the facilities, will place orders with the EPC contractor, supervise the design and construction, and conduct completion inspections, etc. The EPC contractor will design and construct the facilities upon SPC's approval as a construction contractor using the lump-sum design and construction method. It’s depending on the project, in a case, SPC shall propose and jointly appoint with LGU a suitably qualified and experienced consultant as I/C. I/C is responsible for approving various plans and drawings prepared by the EPC contractor on behalf of SPC until the Commercial Operation Date (COD).

Table 5-4 An example on Roles of LGU, SPC and EPC in BOT project (Construction Phase)

Main Actor	Roles
LGU	LGU is the client for this facility construction and operation project. LGU shall confirm the status of IBE's review and approval of the design documents and construction drawings, as well as various inspections and witnessing. (indirect supervision)
SPC	SPC shall carry out the project as the owner of the facility development and operation project on behalf of LGU. Since the design and construction work will be carried out under the performance order system, SPC will appoint a supervisor who will review the design documents and construction drawings submitted by the EPC contractor, implement the approval process, and conduct various inspections and witnesses.
EPC (construction JV etc)	Considering that this work is a performance order system and a public project, the EPC contractor shall prepare a detailed design documents based on the requirements and proposals and shall implement equipment fabrication and construction after obtaining the approval of SPC (and LGU). In addition, various procedures, inspections, tests, and trial operations necessary before the start of operation shall be carried out with the approval of SPC (and LGU). EPC contractor shall prepare the necessary documents such as application documents for permits and approvals.
Independent Certifier (I/C)	The I/C shall assist SPC (and LGU) in its supervisory duties and will support SPC's (and LGU's) construction supervision activities in accordance with the Indicative Independent Certifier Activities in Table 5-5 and the TOR of Independent Certifier Contract. Specifically, I/C shall review from a professional standpoint various types of approval application documents such as detailed design documents and construction drawings and conduct various inspections and witnesses under the direction of SPC (and LGU). Among the procedures to be carried out with the various government agencies, I/C shall review those that are prepared by EPC contractor and shall assist SPC (and LGU) in preparing those that require SPC (and LGU) to take the initiative. In addition, I/C shall keep in close contact with SPC (and LGU) and report promptly so that the construction supervision work of SPC (and LGU) can proceed smoothly. I/C is responsible for various services for EPC companies, such as contact office work, document management work, and meeting management work.

Source: JICA Expert Team

Table 5-5 Indicative independent certifier activities

Contract Phase	Independent Certification Service
Works	Review PPP Agreements Works Inspection Status of snagging issues
Commissioning	Test & Commissioning Plan Mechanical Completion Readiness Test Cold Commissioning Hot Commissioning Acceptance Test
Operations	Annual Performance Tests Performance/data review Modification
Handback	Condition survey

Source: JICA Expert Team

In the case of the BTO project in N City, Japan, as in the case of the I/C for this project, RFP requires the SPC (construction and operation company) to hire an independent design and construction supervising company to supervise the various design and construction activities of the EPC company and has the SPC report the results of the design and construction supervision to N City. However, since the supervising company is hired by the SPC, the N city side also hires a third-party consulting company to conduct the supervision in order to evaluate the validity of the results of the supervision by the SPC. In the Project, it is necessary to further examine the supervisory capability of the ordering local government and the scope and specifications of the work when the SPC hires the supervisory company.

5.5 Detailed Procedure in DBO Case and implication to BOT/BOO;

Figure 5-7 shows the overall flow of design and construction supervision work in DBO projects in Japan, where the local government, as the owner, approves the design and construction drawings prepared by the SPC. However, not all local governments are familiar with the technology of WTE-ACC facilities, so specialized consultants who are familiar with WTE-ACC facilities are often commissioned to act as design and construction supervisors (Figure 5-7 , center) and provide support services such as various examinations and approval procedures, and inspections and attendance of construction work.

One of the most important and cumbersome tasks in the design and construction supervision is the approval procedure for various documents. Therefore, it is important to clarify the rules for procedure such as submission (receipt), Inspection, direction, consultation, revision, resubmission, and approval of the documents, and to ensure the implementation of these rules.

On the other hand, the Project to be carried out under the BOT method, the "local government" in Figure 5-7 will be SPC in the first instance, and I/C procured by SPC will serve as the design and construction supervisor. A PPP agreement usually requires SPC to submit a detailed design document to LGU for LGU's review, and SPC shall submit a construction plan for LGU and I/C's approval. From the above, it can be read that the "local government" in Figure 5-7 includes both SPC and LGU, and that the drawings and plans submitted by EPC shall be reviewed and approved not only by SPC but also by LGU.

Table 5-6 shows the four cases in Japan introduced in "5.3 Differences in Business Schemes and Contract Management between Japan and Philippines", and the difference in whether or not the local government needs to approve the documents in the design and construction phases of the project. In Japan, BOT and BOO projects often use the term "submit/confirm" and the act of acceptance itself is left to the project operator, while DBO projects, which are publicly funded, require all books and documents to be approved. In the BTO project in N City, a list of items to be approved and reported is submitted immediately after the start of work to determine which items are to be approved by the local government and which items are to be approved by the SPC. All design drawings other than those in the list are considered as "reports" and the approval is limited to the guidelines for commissioning, etc., thereby reducing the time and cost incurred by double-checking.

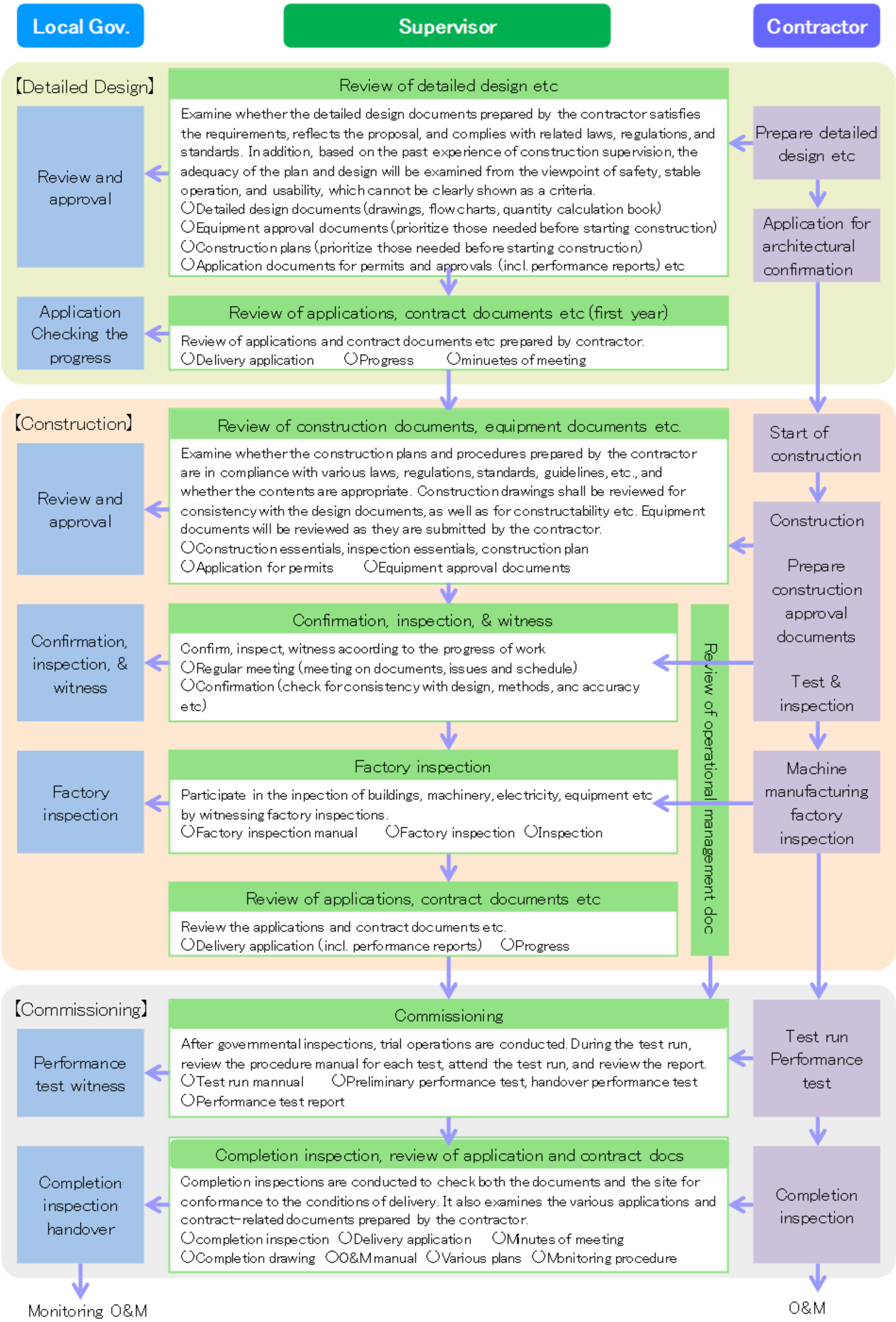
It should also be noted that the Japanese case is based on a good-faith theory that the design and construction by the Japanese EPC contractor will be properly supervised and monitored by the Japanese SPC. In addition, it should be mentioned that there is a custom in the industry that even though the contract requires only "submission and confirmation," if the city requests correction, the contractor will comply with the request, which makes no difference with requiring "approval".

Furthermore, it should be noted that if the local government is to review all of these various documents and procedures, it will require additional assessment capacity and time on the part of the local government. It is necessary to continue to examine the most appropriate framework for approval for various types of documents, based on the capacity of the local government and the international credibility of the list of companies participating in the project, to determine whether SPC, as the owner, should be responsible for approval or whether the local government, as the client of the project, should be responsible for all or part of approval.

Table 5-6 Documents subject to Approval and Confirmation by the Local Government

	K union DBO	N city BTO	M city BOT	K city BOO	B city BOT
List of documents and reports for approval	-	**Approve**	NA	NA	NA
Notice of work commencement, implementation structure, work schedule	**Approve**	Report*1	Submit*1	Confirm*1	**Approve**
Detailed design documents	**Approve**	Report	Submit	Confirm	**Approve**
Before construction／Application for permits and approvals, construction approval documents	**Approve**	Report	Submit	Submit	**Approve**
As needed／Application for permits and approvals, manufacturing approval document	**Approve**	Report	Submit	Submit	**Approve**
Procedures of commissioning, preliminary performance test, performance test	**Approve**	**Approve**	Confirm	Submit	**Confirm**

Source: JICA Expert Team



Source: JICA Expert Team

Figure 5-7 Flow of Design and Construction Supervision in DBO Projects in Japan

5.6 Operation Phase

1) Basic Approach to Operational Monitoring

As described in “5.2 Purpose of Contract Management”, the purpose of operational monitoring is to provide citizens with high-quality public services based on an appropriate division of roles between the local government (LGU) and the operator (SPC) by monitoring and confirming the implementation status of various tasks related to the operation of the operator (SPC) and reflecting the results in the payment of commission. In order to achieve this objective, the following specific activities will be implemented.

- ✓ Collection of data to ascertain the status of implementation of public services by the operator and to verify the status of implementation
- ✓ Verify from the data provided that the level of public service requested is met.
- ✓ When it is confirmed that the level of public services provided does not meet the required level, instructions for improvement measures and confirmation of the implementation status of improvement measures, etc.

In implementing these contents, the following sections provide the basic items for the operator to perform the operation and maintenance management tasks.

2) Division of Roles between Local Government and Operators in the Operation Phase

Table 5-7 shows the division of roles between the local government and the operator in DBO projects in Japan. In the monitoring, it is confirmed whether the required standard is met for each task shown in "Scope of the Operator's Work" in the same table.

Table 5-7 Example of Division of Roles between Local Government and Operator in DBO Projects in Japan

	Roles of Local Government	Roles of Operator
Operational work	・Carrying in the subject waste ・Recycling of recyclable waste ・Final disposal of incinerated ash and unsuitable materials etc. ・Monitoring ・Dealing with residents ・Others	・Reception and weighing ・Operation management ・Environmental management ・Operations related to byproducts and resources ・Inspection, testing, repair, and renewal of plant facilities ・Service management ・Equipment management ・Building maintenance and management ・Administration ・Information management ・Community contribution projects

3) Submissions from the Operator

Various plans, reports, etc. to be submitted to the local government by the operator for the project implementation are stipulated in the “PPP Agreement”, “Bidding Documents (RFP, Invitation to Bidders, Q&A, etc.)”, “Project Proposal”, etc. These submissions by the private entity will be used as reference materials in the monitoring, and their contents and submission status will also be subject to monitoring. Examples of submissions from operators in Japan's DBO projects are shown below.

(1) Various Manuals and Plans

The operator is required to submit the plans, etc., shown in **Error! Reference source not found.**to the local government by the respective deadlines specified in accordance with the provisions of the RFP, etc., and the [PPP agreement], and to obtain approval.

(2) Reports

The operator shall prepare various reports in accordance with the provisions of the operation plan and the RFP. The contents of these reports shall be compiled as an operation report (monthly or annual report) and submitted to the local government. The local government monitors and inspects the work according to the contents of the work report and other reports.

Table 5-8 Manuals and Plans to be submitted by the Operator (Example of DBO in Japan)

Documents to be prepared:	Manuals	Work Plans／Work Implementation Plans			Reports
Description	Procedural Standards	Work plans for the pre-determined period (all, annual, monthly) based on the requirement in Manuals			Reports correspond to the work plans
Name of Works / Period applied for	Thru Operation Period	Thru Operation Period	Annually	Monthly	* Correspond to the period in left;
Operational Management	Operational Management Manual				
Operation Works)			Annual Operation Plan (AOP)	Monthly Operation Plan	Annual/Monthly Operation Report (A/MOR) *1
Reception, Collection Charges)			(included in AOP)	(included in above)	(included in A/MOR)
Delivery Control)	* Inspection, unsuitable MSW		(included in AOP)	(included in above)	(included in A/MOR)
Efficient Utilization)	* Power generation and resource recovery plans		(included in AOP)	(included in above)	(included in A/MOR)
Maintenance Management	Maintenance Management Manual				
Procurement)			Annual Procurement Plan	Monthly Procurement Plan	Annual/Monthly Procurement Report
Check and Inspection)		(Overall) Check and Inspection Plan	Annual Check and Inspection Plan		Annual Check and Inspection Report
Repair and Renewal)		(Overall) Repair and Renewal Plan	Annual Repair and Renewal Plan		Annual Reipair and Renewal Report
Corrective Maintenance)		(Overall) Corrective Maintenance Plan			(Overall) Corrective Maintenance Report
Functional Inspection)	*Required in Japanese reg.	(Overall) Functional Inspection Plan			(Overall) Funcitional Inspection Report
Environmental Management	Environmental Management Manual				
Environmental Protection)		(Overall) Env. Protection Plan	(included in AOP)		(included in A/MOR)
Working Environment Protection)		(Overall) Working Env. Protection Plan	(included in AOP)		(included in A/MOR)
Emergency Response	Emergency Response Manual	* Schemes for accident prevention, emergency contact, etc.			Accident and Disaster Reports
Others	Manuals for other tasks				
Clean up)		(Overall) Clean-up Plan	Annual Clean-up Plan		Annual Clean-up Report (+every time)
Planting Plan)		(Overall) Planting Plan	Annual Planting Plan		Annual Planting Report (+every time)
SPC Management)		(Overall) SPC Management Plan	Annual Managemetn Plan		Annual Management Report
Fire Prevention)		(Overall) Fire Prevention Plan	Annual Fire Prevention Plan		Annual Fire Prevention Report
Guard Duty)		(Overall) Safety Management Plan	Annual Safety Management Plan		Annual Safety Management Report
Residents' Response)		(Overall) Residents' Response Plan	Annual Residents' Response Plan		Annual Residents' Response Report
Visitors' Response)		(Overall) Visitors' Response Plan	Annual Visitors' Response Plan		Annual Visitors' Response Report
Education and Training)		(Overall) Education and Training Plan	Annual Education and Training Plan		Annual Education and Training Report
.: Daily reports should be attached					

Source: JICA Expert Team

B. Monthly Report

Table 5-9 shows the example of monthly report.

Table 5-9 Monthly Report (Example of DBO project in Japan)

Contents		Description in the report	Deadline
Reception & weighing	・Volume ・management of carry-in	Monthly operation results Volume received	Within 10 business days of the following month
Operational management	・Processing volume ・Property analysis of carry-in items ・Proper treatment and operation ・Operator's education ・Measurement results	Monthly operation results Operating performance Waste disposal volume Measurement and analysis results Garbage quality analysis	
Environmental management	・Compliance with environmental conservation standards	Measurement and analysis results Exhaust gas measurement Analysis of incombustible materials Analysis of fly ash processing materials Noise and vibration measurement Odor measurement Work environment measurement	
Operations related to byproducts and resources	・Volume of byproducts ・Storage and management status	Monthly operation results Amount generated	
Utility management operations	・Use of electricity, water, fuel, chemicals, etc. ・Amount of power sold ・Power generation efficiency	Services (volume received, volume used, and basic unit) Status of power sold	
Inspection, testing, and renewal of plant facilities	・Status of inspection, repair, renewal ・Accident records and awareness of preventive maintenance ・Status of response to initial failures and problems with each facility	Operation and maintenance Inspection and testing outline Repair and renewal outline History of facility failures	
Management of equipment etc.	・Procurement and management of consumables and spare parts	Operation and maintenance Procurement of consumables and spare parts	
Building maintenance and management	・Maintenance and management status of buildings and building facilities (mechanical and electrical equipment) ・Maintenance and upkeep status of exterior facilities ・Safety management and security	Operation and maintenance Inspection and testing outline Repair and renewal outline History of facility failures, Snow removal Cleaning, Planting management Security and crime prevention	
Administration	・Status of Safety education, and evacuation drill etc. ・Evaluation and implementation status of emergency response manual ・Interaction with visitors ・Response to residents	Others	
Information management	・Reporting to the local government ・Status of data storage	Information management	
Contribution to community	・Order amount	Others	

Source: JICA Expert Team

C. Annual Report

The table below shows an example of annual report.

Table 5-10 Annual Report (Example of DBO project in Japan)

Contents		Deadline
Tabulation of monthly reports	・Volume of carry-in ・Processing volume ・Amount of service ・Measurement results	By the end of May of the following year
Summary and discussion for each outsourced task	・Reception and weighing ・Operational management ・Environment management ・Operations related to byproducts and resources ・Inspection, testing, repair and renewal of plant facilities ・Utility management ・Management of equipment ・Building maintenance and management ・Administration ・Information management ・Contribution to community	
Inspection and testing results	・Results of inspection and testing	
Repair results	・Results of repair and renewal	
Environmental conservation	・Results of environmental conservation activities	
Work environment management	・Results of work environment management	
Environment report	・Details of environmental load reduction etc	
Comparison with initial plan	・Comparison with initial plan for each work	

Source: JICA Expert Team

D. Error/Failure Report

During the operation period, when a mechanical failure occurs at a level that does not interfere with the operation of the facility, the operator is required to prepare and submit an error/failure report. An example of an error/fault report is shown in Table 5-11 .

Table 5-11 Error/Failure Report (example)

Contents	Deadline of submission
Status of error/failure	As soon as possible after the occurrence

Source: JICA Expert Team

E. Accident Report

During the operation period, when an accident occurs that interferes with the operation of the facility, the operator is required to prepare and submit an accident report. After implementation of corrective measures, the operator shall submit a corrective action report immediately. Examples of accident reports and corrective action reports are shown in Table 5-12 .

Table 5-12 Accident Report and Corrective Action Report (example)

Contents	Deadline of submission
Accident report (Operation record at the time of the accident shall be attached)	As soon as possible after the occurrence
Corrective action report	As soon as possible after the occurrence

Source: JICA Expert Team

F. Financial Report

In order to ensure the required level of public services and business continuity for the project, the local government needs to confirm that the operator is in a financial position to provide public services in a stable and continuous manner. Specifically, by having the operator submit a financial report with audited financial statements, etc., and confirming the contents of the report, the local government will check whether there are any events or causes that may hinder the sound operation of the project. An example of a financial report is shown in Table 5-13 .

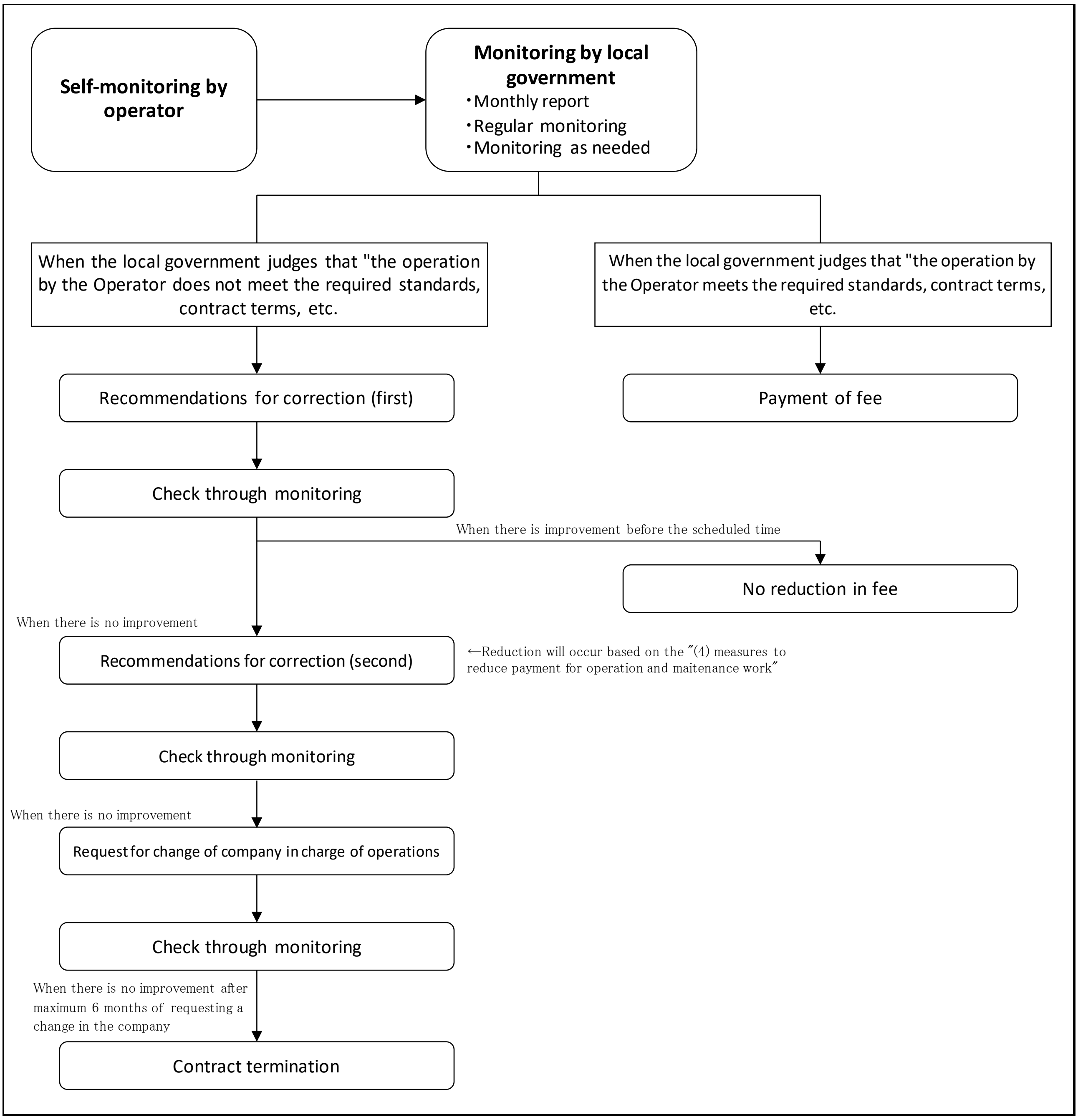
Table 5-13 Financial Report (example)

Contents	Deadline of submission
Budget plan for each fiscal year	On or before the last day of the second quarter (end of September) of each fiscal year, prepare and submit in writing to the local government an outline of the budget for the following fiscal year.
Financial documents for each fiscal year	Submit to the local government together with the audit report within 3 months of the last day of each fiscal year

4) Implementation and Evaluation Method of Operational Monitoring

(1) Operational Monitoring Method

With reference to DBO projects in Japan, the method of conducting operational monitoring for "3) Submissions from the Operator" is shown below. The purpose of monitoring is not to reduce the commission fee for operation and maintenance work, but to maintain the implementation status at a certain level at all times so that the project can be continued in a stable manner through dialogue with the local government and the operator.



Note: If the suspension criteria specified in the "Project Implementation Agreement" are violated due to reasons attributable to the operator, the operation and maintenance fee will be reduced without following the above flow.

Figure 5-8 Flow of Monitoring and Corrective Action in Operation Phase (example of DBO project in Japan)

(2) Preparation and Implementation of Self-Monitoring Implementation Plan

After concluding the [PPP Agreement], the operator shall prepare a self-monitoring implementation plan including the timing, procedures, contents, format, and system of monitoring based on the RFP and the project proposal, and obtain the approval of the local government. Based on the self-monitoring implementation plan, the operator shall conduct self-monitoring at its own cost and responsibility, confirm the performance of the operation and maintenance work, and prepare and submit various reports and other documents specified in the PPP Agreement to the local government by the respective due dates.

(3) Monitoring by Local Government

The monitoring procedure for operation and maintenance work in DBO projects in Japan is shown below.

A. Confirmation of Monthly Report

The local government shall confirm the implementation status of the work specified in the [PPP Agreement], the RFP, and the project proposal through the monthly business reports, etc. submitted to the local government by the operator.

Submission deadline:

Monthly Report : 10th of every month (in the case of a holiday, the following day when the office is open)
Annual Report : End of May every year (in the case of a holiday, the following day when the office is open)

B. Regular Monitoring and Occasional Monitoring

a) Regular Monitoring

The local government shall conduct a site survey once a month to check the contents of the monthly business report, etc. submitted by the operator and the status of contract performance.

b) Occasional Monitoring

The local government shall conduct a site survey of the facility as needed from time to time.

(4) Method of Monitoring

The local government monitors the implementation of the operational services from the documents and materials submitted by the operator, and confirms that the operator is reliably carrying out the tasks stipulated in the agreement. The procedure is as follows.

A. Procedures for Checking Monthly Reports etc.

a) Procedures for Checking Monthly Report (Regular Monitoring)

(i) The operator prepares a monthly report and submits it to the local government within 10 working days of the following month, including attached materials.

(ii) The local government confirms the implementation status of the operator's business based on the monthly report prepared by the operator.

(iii) If, as a result of the local government's confirmation, there are any items that do not meet the evaluation criteria, the local government and the project operator shall discuss and identify the causes. (See "5) Method of Reducing the Fee" below.)

(iv) If there is any doubt about the contents of the monthly report, or if the local government judges that the operator is not performing its duties properly, the local government shall request an explanation from the operator. In this case, the local government shall request the operator to submit additional materials or improve its operations to the extent necessary to fulfill its accountability as the manager of the facility.

(v) The local government notifies the operator of the monitoring results, and the operator submits the invoice to the local government. The local government shall pay the relevant commission fee to the operator within 30 days from the date of receipt of the invoice.

(vi) If there is a reduction in the amount of the commission fee, the commission fee shall be paid after the reduction measures are taken in accordance with "5) Method of Reducing the Fee" below.

b) Procedures for Checking Annual Report

(i) The operator prepares an annual report and submits it to the local government by the end of May of the following year, including attached materials.

(ii) The local government confirms the implementation status of the operator's business based on the annual report prepared by the operator.

(iii) If, as a result of the local government's confirmation, there are any items that do not meet the evaluation criteria, the local government and the project operator shall discuss and identify the causes. (See "5)

Method of Reducing the Fee" below.)

(iv) If there is any doubt about the contents of the annual report, or if the local government judges that the operator is not performing its duties properly, the local government shall request an explanation from the operator. In this case, the local government shall request the operator to submit additional materials or improve its operations to the extent necessary to fulfill its accountability as the manager of the facility.

B. Procedure for Regular Monitoring and Occasional Monitoring

In addition to checking monthly reports, etc. (periodic monitoring), the local government may enter the facility from time to time and take other necessary actions for the purpose of checking the status of the operator's performance of the services. The local government may request the operator to explain the status of the execution of the Project and the status of income and expenditure related to the Project, including management costs. (Should be stipulated in the PPP Agreement)

If, as a result of occasional monitoring, there is an item that does not meet the evaluation criteria, the local government shall confirm the cause of the item, and if the event is attributable to the operator, the local government shall take measures such as recommending correction or reducing the commission fee in accordance with below, "5) Method of Reducing the Fee for.

(5) Measures to Improve Operations

A. Recommendations for Correction (first)

If, based on the results of the above monitoring, the local government judges that the operation by the operator does not meet the requirements and the provisions of the operation and maintenance contract, the local government shall take the following initial actions according to the details.

a) Recommendations for Correction

If the confirmed problems are found to be recurring or serious even at the first occurrence, the local government will notify the operator to take appropriate corrective measures (corrective action recommendation). If the operator receives a recommendation for correction from the local government, the operator shall promptly consult with the local government regarding the improvement measures and the deadline for improvement (within 90 days in principle), and shall submit a business improvement plan describing the improvement measures, deadline for improvement, and measures to prevent recurrence to the local government, and obtain the approval of the local government.

b) Measures in Case of Unavoidable Circumstances

In the event that the operator is unable to meet the requirements of the RFP and the [PPP Agreement] due to unavoidable reasons, the operator shall promptly and in detail report this to the local government and shall consult with the local government on measures to improve the situation. If the local government judges that the reasons reported by the operator are reasonable, the local government will not make the recommendation again after considering the review of the subject content, etc.

B. Confirmation of Improvement

The local government shall conduct monitoring from time to time upon receipt of the report on the completion of improvement from the operator or the scheduled deadline for improvement and shall confirm the implementation status of the improvement in accordance with the business improvement plan.

C. Recommendations for Correction (second)

If, as a result of the monitoring in (B) above, the local government determines that improvements are not being made within the time frame and with the content in line with the business improvement plan, the local government shall make a second recommendation for correction to the operator, and again request the submission of the business improvement plan, consult with the operator, accept the plan, and confirm improvements through monitoring as needed.

D. Request for Change of Company

If the local government judges that the contents specified in the second business improvement plan have not been improved within the specified period even after the procedures in (C) above, the local government may request the operator to change the company in charge of the business in question.

E. Contract Termination

The local government may cancel the [PPP agreement] when it judges that there is no improvement after a maximum of six months after the request to change the company in charge of the work described in (D) above, and does not wish to continue the contract.

5) Method of Reducing the Fee

An example of how to reduce the commission fee when the monitoring results do not meet the required level is shown below.

(1) Reduction of Operation and Maintenance Fee

Depending on the implementation status of the operation and maintenance work, the following reduction measures will be taken for the operation and maintenance work commission fee.

1） If, as a result of the monitoring, the local government makes a recommendation for correction (the second recommendation), the operation and maintenance commission fee to be paid to the operator (hereinafter referred to as "(i) fixed cost") shall be reduced on a pro-rated basis of 365 days per year, starting from the date of the second recommendation (including the same date) until the date on which the local government recognizes that the event subject to the said recommendation for correction has been resolved.

2） The extent of the reduction in the operation and maintenance commission fee shall be 10% of the (i) fixed cost for each corrective action recommendation. The limit on the reduction of (i) fixed costs due to multiple recommendations for correction shall be 50%.

3） In the event of an event exceeding the shutdown threshold set forth in the [PPP Agreement] due to reasons attributable to the operator, regardless of 1) or 2), 10% of the (i) fixed costs shall be reduced on a pro-rata basis of 365 days per year, starting from the day the facility is shut down until the day the operator recognizes that the said excess has been eliminated.

(2) Return of Operation and Maintenance Fees

If, after the payment of the operation and maintenance commission fee, a false report to the local government including a false statement in the business report is found, and the operation and maintenance commission fee would have been reduced without the false report, the operator shall return the amount equivalent to the operation and maintenance commission fee that should have been reduced.

In this case, for the number of days from the date on which the local government paid the operator the operation and maintenance fee to be reduced to the date on which the fee is returned to the local government, there shall be a penalty fee calculated at the rate determined by the Minister of Finance based on the provisions of Section 8.1 of the Act on Prevention of Delay in Payment of Government Contracts (Act No. 256 of 1949).

Chapter 6 Dismantling of WTE-ACC

6.1 Dismantling of WTE-ACC

With the Ministry of Health, Labor and Welfare revealing that in July 2000 high concentrations of dioxins were detected in the blood of some workers who were engaged in the dismantling work of the Toyono-gun Clean Center in Osaka Prefecture, the Ministry revised the “Occupational Safety and Health Regulations” in April 2001, and formulated the “Outline of Measures to Prevent Exposure to Dioxins in Work at Waste Treatment Facilities” (hereinafter referred to as “Outline of Measures”), notified the LGs and related industries of measures to prevent exposure to dioxins at waste incineration facilities, and instructed that the dismantling work of the incineration facility should be conducted in accordance with the provisions of these regulations and Outline of Measures.

On the other hand, for waste incineration facilities, the standards for policies on dioxins, emission standards, and the standards for maintenance and management of facilities are established based on the "Special Measures against Dioxins Act" (hereinafter referred to as “Special Measures Act”) and the Waste Disposal Act in order to promote the prevention of environmental pollution by dioxins and protecting the public's health.
In municipalities, based on enforcements such as Special Measures Act, for deteriorating facilities that cannot meet the provisions of the law, the rehabilitation or reconstruction of such facility has been promoted.

Although dismantling of the old facilities has become necessary due to rehabilitation and new construction, the implementation of this dismantling work has not progressed sufficiently because some municipalities have issues with cost rather than technical issues.

In addition, there are many places and facilities that used asbestos products for blowing materials of buildings in waste treatment facilities. Therefore, in dismantling the facility, it is necessary to strive for appropriate dismantling and processing that correspond to the current regulations as well as future regulations for asbestos as well as measures against dioxins.

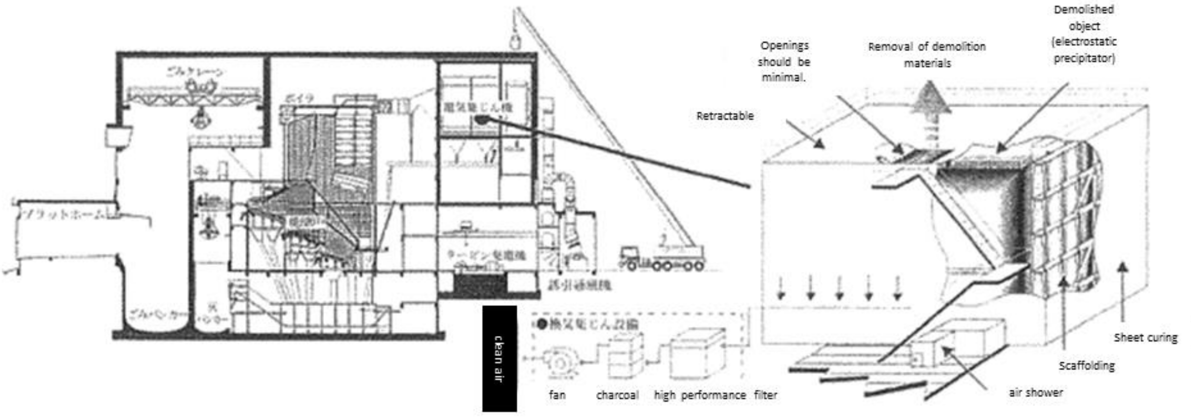
6.2 Dismantling manual

1) Revisions of the Occupational Safety and Health Regulations, Outline of Measures, and the Waste Incineration Facility Dismantling Work Manual

The revised regulations stipulate that when performing dismantling work of facilities such as waste incinerator installed in waste incineration facility and equipment such as dust collectors, it is required to report the plan, measure the concentration and content of dioxins, wet the source, use protective equipment, appoint a work leader, and provide special education for workers.
Also, the Outline of Measures indicates, based on the matters stipulated in the revised Occupational Safety and Health Regulations, the basic measures that business operators should take to thoroughly prevent workers from dioxins exposure.
The Waste Incineration Facility Dismantling Work Manual (hereinafter referred as “Dismantling Manual”), which was developed in parallel with the formulation of the Outline of Measures, explains the provisions of the regulations and the Outline of Measures, and describes the contents of the dismantling work more specifically.
Furthermore, since the provisions of the Occupational Safety and Health Law are directed at businesses that directly require workers to perform dismantling work, it is then understood that LGs basically have management and supervision responsibilities for businesses as a client. In addition, some municipalities may develop original dismantling work outlines; while outline of measures and dismantling manual mainly prescribe the securing of occupational safety and health in dismantling work, there are cases in which the provisions for consideration of the surrounding environment are added in the regulations established by municipalities, etc.

2) Method of dismantling

Dismantling work must be conducted according to the stipulation, starting with the maintenance of the promotion system as described in the Dismantling Manual and notifying the Labor Standards Inspection Office of the plan. Figure 6-1 shows an image of dismantling the plant, and Figure 6-2 shows the procedure of dismantling the waste incineration facility.



Source: Tokyo's 23 wards cleaning office work union brochure

Figure 6-1 Image of dismantling plant

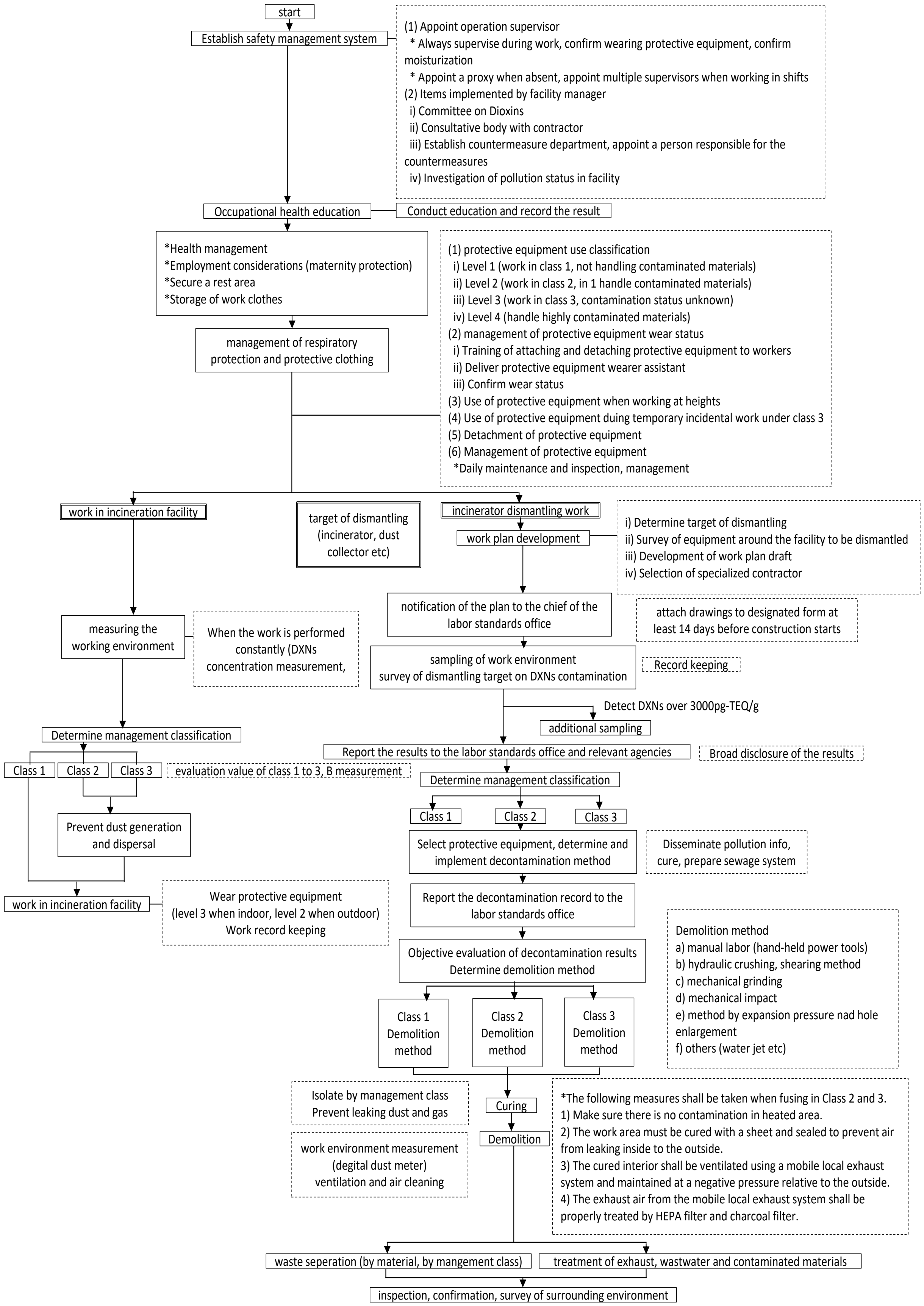


Figure 6-2　Flow chart for preventing exposure to dioxins

6.3 Estimation of dismantling costs and financial resources

At the beginning of the enforcement of regulations, nobody had the experience regarding dismantling facility which carried out the dioxin exposure measures indicated in the notification, therefore with new trials and experiences, the estimation of the cost necessary for dismantling work has greatly expanded. After that, the number of companies dismantling and the actual records of dismantling work are increasing, and it is possible to estimate the appropriate level of cost.

For city A, the estimated cost of dismantling is, for example, the ordinary cost of dismantling by the conventional method in the case of city A, plus the temporary cost of sheet curing of the object to be dismantled and ventilation equipment etc., plus the cost of protective equipment etc., plus measurement costs for dioxins, etc. In addition, it is calculated by adding the coefficient of efficiency reduction due to work by wearing protective equipment.

Additionally, the subsidy system in 2005 stipulates that if the business entities use the whole, or part of the site of dismantled facility to develop a new facility, then it is eligible for the facility.

Chapter 7 APPENDIX

7.1 APPENDIX A: CONSIGNMENT OF PROFESSIONAL ENGINEER

(Necessity and effects of hiring Waste Treatment Consultants)
To develop a WTF, it is necessary to smoothly and reliably fulfill various surveys, devise some plans, and follow certain procedures. However, because projects like these take place once every 20-30 years for each LG, it is not realistic to place engineering experts in the LG for these projects.
Therefore, most of LGs in Japan employ waste treatment specialists who are well-versed in procedures to develop a facility as well as familiar with laws and technologies in the field of waste treatment (hereinafter, called as "Waste Treatment Consultants"). These Waste Treatment Consultants in reality are involved with LGs throughout all the life cycle of a projects, from support to formulate waste treatment master plan, to support planning the development of the facility, to conducting a variety of surveys, environmental impact assessment, to supervising the designing, construction, maintenance, operation and management of the WTFs, etc.
This section explains the examples how to procure Waste Treatment Consultant(s) in Japan.

1) Consignment items to Waste Treatment Consultants
Contents for contracting a Waste Treatment Consultants are exemplified as follows. It is necessary to determine the consignment items in accordance with the progress of the development of the facility.

Table 7-1 Consignment Items to Waste Treatment Consultant

Consignment Items to Waste Treatment Consultant	Brief Explanation
a. Drafting a Waste Treatment Master Plan;	a. Future plans for waste control, treatment (including recycling), disposal, etc., of waste generated in the municipality.
b. Drafting a Waste Treatment Master Plan for clustered LGs;	b. A plan that defines how treatment and disposal of MSW will be carried out in the event of joint treatment with neighboring municipalities.
c. Drafting a Waste Collection/Transportation method;	c. Study on efficient collection and transportation of waste in the municipality.
d. Selection of candidate construction sites;	d. Consideration of where it is desirable to locate waste treatment facilities when they are developed.
e. Drafting a plan for application for subsidy on WTF from the central government;	e. A plan required to obtain grants from the national government for the development of waste treatment facilities.
f. Surveys (e.g., topographical surveys, geological surveys, soil surveys, groundwater surveys);	f. Various surveys required for facility design, etc. at the site where the waste treatment facility is planned to be constructed.
g. Analysis (e.g., waste compositions, exhaust gas, wastewater);	g. Various types of analysis required for the operation of waste treatment facilities using methods prescribed by laws and regulations.
h. Drafting a conceptual plan for WTF;	h. A plan that sets the direction for the development of waste treatment facilities.
i. Comparative consideration of different treatment/processing systems;	i. Comparative study of desirable future waste treatment systems in the municipality in question when developing waste treatment facilities.
j. Drafting a basic plan for the WTF;	j. A plan that specifies the various aspects of the waste treatment facilities to be developed.
k. Consideration of the business method	k. Study on how to develop and operate waste treatment facilities.
l. Survey for the possibility of Private Finance Initiative (PFI)/Public-Private Partnership (PPP) introduction;	*Same with above k.*
m. Environmental Assessment (Status Survey);	m. Survey of the current status of the proposed construction site for environmental impact assessment.

n. Environmental Assessment (Impact assessment);	n. Assessment of the impact on the surrounding environment of the development of waste treatment facilities in the environmental impact assessment.
o. Support for the integration of the facility into urban land-use plan;	o. Assistance with the procedures required to change the use of land in accordance with laws and regulations when developing waste treatment facilities.
p. Cost-benefit analysis;	p. Study to confirm the validity of the plan in question by comparing the costs and benefits of the development and operation of waste treatment facilities when obtaining subsidies from the government.
q. Design the WTF;	q. Prepare specifications when ordering waste treatment facilities by performance-based ordering system, or design facilities when ordering by drawing-based ordering system.
r. Transaction advisory for PFI/PPP project procurement;	r. When implementing a project under the PFI or DBO Business Scheme, consultants provide support for the client from the selection of a project operator to the conclusion of a contract (called as Transaction Advisory).
s. Supervising the construction process;	s. Supervision of proper construction of waste treatment facilities, which includes design supervision, construction supervision and commissioning supervision.
t. Provide support for long term operating contracts;	t. When operating a facility under the Long-term concession Scheme, LGUs are provided with consulting services to support a series of procedures from the selection of a business operator to the conclusion of a contract (Transaction Advisory).
u. Operations and Maintenance (O&M) Management monitoring (maintenance costs evaluation);	u. Evaluation of the appropriateness of estimates submitted by operators when carrying out repair work, etc. on waste treatment facilities. Support municipality for its operation monitoring work if the operation of private contractor is in accordance with KPIs and manuals set in RfP, contract, and proposal of the operator.
v. Drafting disaster waste treatment plan;	v. Plan for the proper disposal of disaster waste generated in the event of a disaster.
w. Conduct performance inspection of facility equipment;	w. An inspection required by Japanese law to be conducted every three years to confirm that the facility is maintaining the specified performance and that no repairs are necessary.
x. Drafting plan to prolong life cycle of the WTF;	x. Plans consisting of maintenance plans, life extension plans, etc., necessary to extend the service life of waste treatment facilities.
y. Deposition of the property of the WTF; and	y. Examination to confirm that the purpose of the waste treatment facilities developed, with government subsidies, has been achieved when they are decommissioned.
z. Designing and supervising the dismantling process of WTF.	z. Supervision of proper demolition of incineration facilities and bulky waste disposal facilities.

Source: JICA Expert Team

2) Selection methods of Waste Treatment Consultants in Japan

(1) Types of selection methods for consulting services

According to “Public Accounting Act (March 31, 1947, Ordinance No. 35)”, and the Act on Promotion of Quality Assurance of Public Projects (March 31, 2005, Ordinance No. 18), there are four types of selection methods for the consulting services: Competitive bidding (Cost Based Selection as CBS), No-bid contract (negotiation), Comprehensive evaluation (or Quality and Cost Based Selection as QCBS), and proposal (Quality Based Selection as QBS).

A. Competitive bidding (Cost Based Selection as CBS / Public or Selected bidding)

General competitive bidding is a method that involves making a public announcement regarding a certain bid, accepting application, and entering into a contract with the party who won the bid at competitive price, etc.

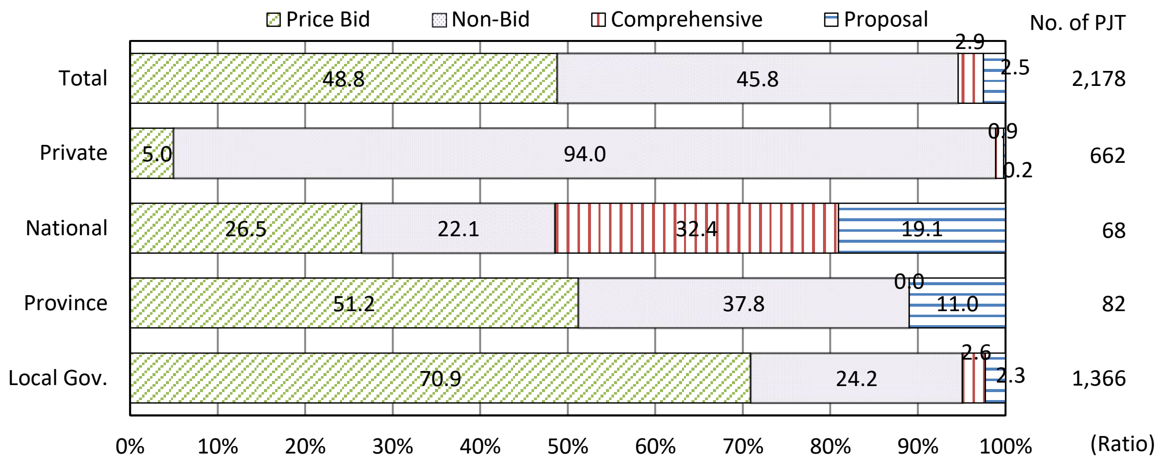
Designated competitive bidding is a method that involves nominating competing companies based on their performance record, announcement regarding the bid, accepting application, and entering into a contract with the party who won the bid at competitive price, etc.

B. No-bid contracts (Negotiation contracts)
No-bid contract is a method of selecting and entering the contracts with a partner without competition.

C. Comprehensive evaluation bidding (Quality & Cost Based Selection as QCBS / Public or Selected bidding)
Comprehensive evaluation bidding is a selection method of a contracting partner by comprehensively evaluating the merits and demerits of the technical proposal submitted in addition to the price factor. This selection method is classified into “general type, designated/simplified type, and standard type,” according to the selection method of nominated firms and of comprehensive evaluation procedure.

D. Proposal (Quality Based Selection as QBS / Public or Selected bidding)
“Proposal” is a method in which participating companies, in consideration of the project implementation policy and its contents, submit a technical proposal, the superiority of the proposal will decide the company entering into the contract.

(2) Features of Selection methods for Waste Treatment Consultants
According to Figure 7-1 , at LG level in Japan, competitive bidding (CBS) accounted for about 71% of all selection bids, and no-bid contracts accounted for about 24%. However, in recent years, the method of comprehensive evaluation system (QCBS) is gradually increasing.



Note: Based on the Projects implemented by 42 firms affiliated in JWMCA (FY2014)

Source: JWMCA (Japan Waste Management Consultant Association)

Figure 7-1 Selection method of waste treatment consultant in Japan (2014)

(3) Required experience and qualifications for product manager
The Table 7-2 shows the requirement of project manager and specific activities PICs for the WTE-ACC Planning, F/S, T/A and S/V in case of Japan.
The project manager of these assignment shall be usually required to have similar sized WTE-ACC project assignment experience with Professional Engineer title for Sanitary Engineering. At this moment, there is no WTE-ACC projects in Philippines, so it is recommended to hire international consultancy for a while.

Table 7-2 Requirement for Project Manager and PIC for Specific Activities in case of Japan

	Plan	F/S	T/A	S/V
Experience	*1	*1	*1	*1
Education	*2	*2	*2	*2
Titles	*3	*3	*3	*3, *4

*1: Need to have experience(s) of similar sized WTE-ACC project.
*2: More than bachelor’s degree of engineering or science.
*3: Required to have Professional Engineer titles for sanitary engineering, or environmental conservation,
*4: Required to have the team associated by Professional Engineer titles for mechanical engineering, electrical engineering, and registered architect,

(4) Procedure for the selection methods in Japan

Consultant selection method should be determined based on whether or not there are public man-day number and rate for the relevant assignment, whether or not there are instruction or guidelines, and whether or not the difficulty of the assignment. Examples for selection of waste treatment consultant are shown as follows.

A. Primary decision

If the assignment is routine work, or if there are public provisions for man-day number, labor costs and/or direct expenses (for example, topographical survey, geological survey, analysis, etc.), the competitive bidding method is adopted, with the premise that business site registration and technically qualified engineers are required.

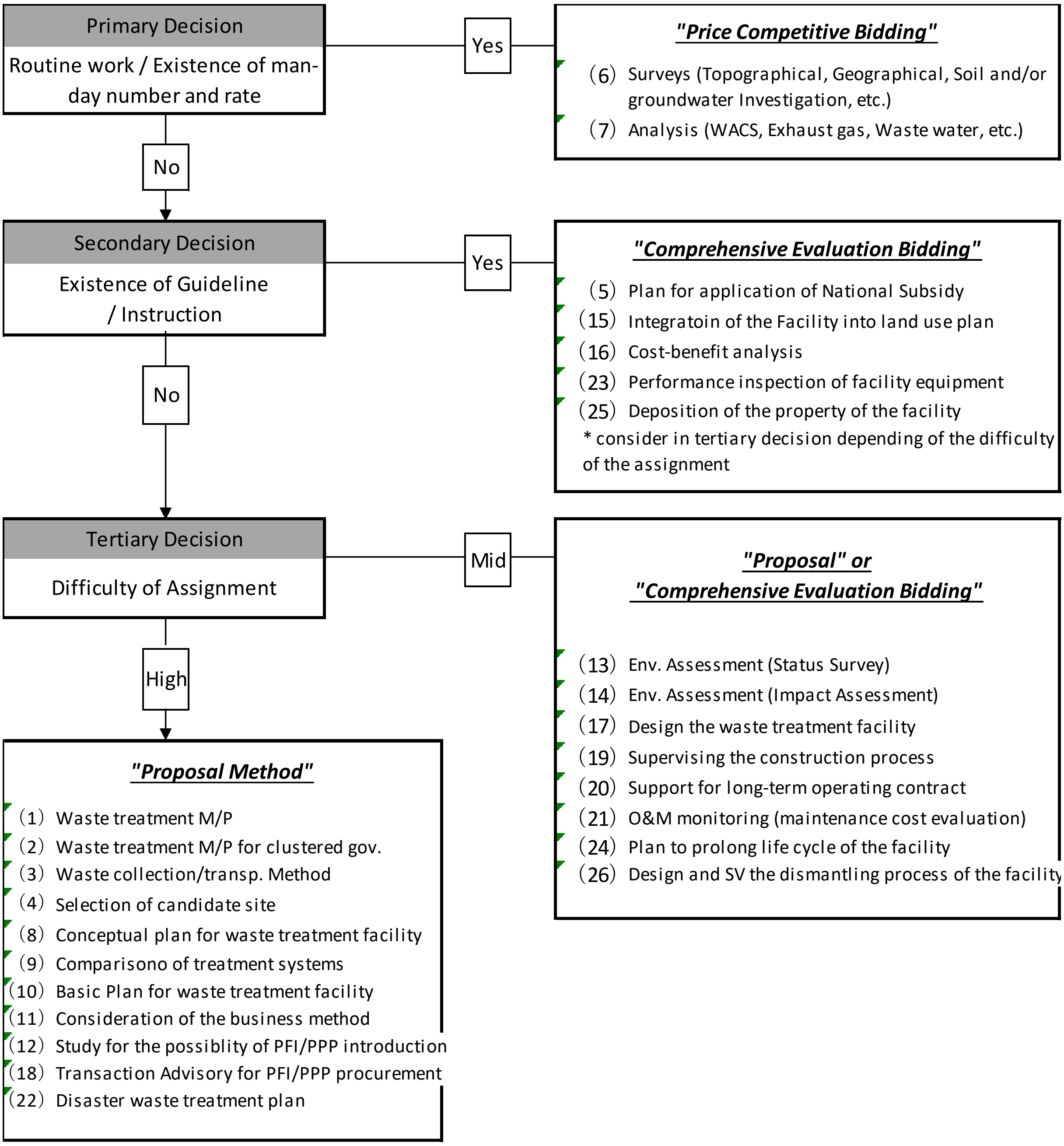
B. Secondary decision

If there are no public provision of man-day and rate but are guidelines and instruction for the assignment, waste treatment consultants will be selected based on the “simplified comprehensive evaluation bidding”, in which, comprehensive evaluation of price and technical capability (as exhibited in their project implementation policy) of the consultants.

C. Tertiary decision

If there are neither public provisions nor instruction or guidelines, it is recommendable to adopt the proposal-based selection. However, if there are some rooms to consider the price factors, comprehensive evaluation selection method can also be considered.

Figure 7-2 shows the flow of these decisions



Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Figure 7-2 Selection procedure for waste treatment consultants (Example in Japan)

3) Procurement methods of the Consulting Services in the Philippines

(1) Government Procurement Reform Act (GPRA)

The GPRA serves as a consolidated manual of all laws and policies aligned to public procurement. Its passage in 2003 under the Arroyo administration was highly celebrated as it served as a milestone in streamlining the procurement process in the country. Aside from unifying all pertinent laws and issuances on procurement, it also established the Government Procurement Policy Board (GPPB)[23] as a governing body for all public procurement activities.

Over the years, further measures have been enacted to reform the procurement process, including revisions in the GPRA IRR[24], implementation of the Early Procurement Policy, modernization of the PhilGEPS, among other updates.

[23] Section 63, RA 9184, Government Procurement Reform Act, Jan2003

[24] https://www.gppb.gov.ph/laws/laws/RA_9184.pdf, https://www.gppb.gov.ph/assets/pdfs/Updated%202016%20IRR_31%20March%202021.pdf

(2) Procurement Methods for Consulting Services

Among the stipulations of the GPRA encompasses the process of procurement for consulting services. This shall guide Procuring Entities in finding and selecting consultants to undertake projects, including technical advisory for WTE projects. The default procurement method for consultancy services is Competitive Bidding[25]. In some cases to give an opportunity for the Procuring Entity to procure consulting services at advantageous terms without having to undergo the time-consuming public bidding process, alternative methods of procurement are considered. Alternatives may also be undertaken if public bidding has twice failed, or under other special circumstances as detailed in the GPRA IRR.

The law allows alternative methods[26] of procurement in some cases provided that there is prior approval of the Head of the Procuring Entity on the use of alternative methods, and these alternatives come in the form of Limited Source Bidding Method[27] and Negotiated Procurement Method[28].

A. Limited Source Bidding Method[29][30][31]

Also known as Selective Bidding, it involves the issuance of a direct invitation to bid by the concerned Procuring Entity to a list of pre-selected consultants with known experience and proven capability to provide the services required in a contract.

These pre-selected consultants are all required to be invited. The Invitation to Bid, which is issued by the BAC, should indicate the relevant information required to enable the prospective bidders to prepare their bids as prescribed under the contract.

This alternative method is mostly used to procure highly-specialized types of consulting services, where only a handful of consultants are known to be capable and available, since opening the bid to public bidding will not results in the participation of any additional consultants participating[32].

B. Negotiated Procurement Method[33][34][35]

This is a method of procurement whereby the Procurement Entity directly negotiates a contract with a legally, technically, and financially capable consultant. This is only allowed to be undertaken under conditions such as:

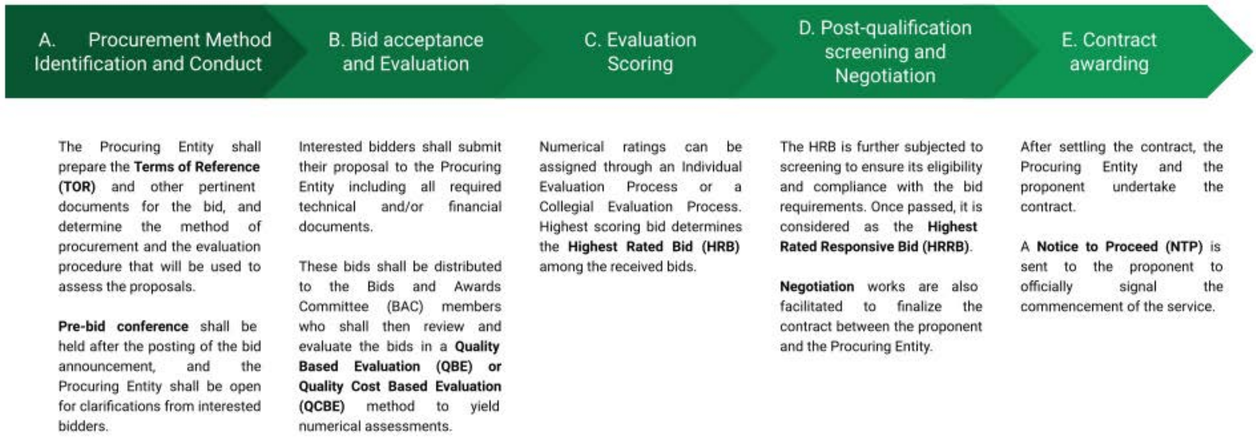
- If public bidding has failed twice, and negotiation is considered only with a consultant in good standing and with a proven track record with the Procuring Entity
- If time is of the essence (i.e. in emergency situations, calamity response) and immediate action is necessary to prevent damage or loss of life or property
- If the project is adjacent to another ongoing consulting services project
- To facilitate take-over of contracts for prematurely terminated projects
- If there is exclusivity of technology and services to a specific supplier

The other cases where Negotiated Procurement is undertaken are detailed in GPRA Section 53.

(3) Feature for selection methods

The following figure shows a simplified process flow of the procurement process for consulting services.
Figure 7-3 shows the flow of the procurement method in Philippines.

[25] Section 10, RA 9184, Government Procurement Reform Act, Jan2003
[26] Section 48 of the same
[27] Section 49 of the same
[28] Section 53 of the same
[29] Section 49 of the same
[30] Appendix 12, Government Procurement Reform Act Implementing Rules and Regulations, Jul2002
[31] Section 3 Part 2, GPPB Manual of Procedures for the Procurement of Consulting Services, Nov2015
[32] Section 49.1.a of the same
[33] Section 53 of the same
[34] Annex H. Section V.D, Government Procurement Reform Act Implementing Rules and Regulations, Jul2002
[35] Section 3 Part 2, GPPB Manual of Procedures for the Procurement of Consulting Services, Nov2015



Source: JICA Expert Team

Figure 7-3 Procurement method in the Philippines[36][37][38][39][40]

A. Procurement Method Identification and Conduct

Procurement of consulting services start through a Pre-procurement Conference, facilitated by the Procuring Entity, to flesh out the details of the service to be procured, and identify the details including the method of procurement and evaluation method that will be used to assess the bids. The bid notice is then issued for posting, and a pre-bid conference is facilitated to meet with potential suppliers and discuss any clarifications.

B. Bid acceptance and evaluation

Interested bidders shall then facilitate submission of proposals to the Procuring Entity before the agreed deadline, including all required technical and/or financial supporting documents.

The alternative procurement methods are only the ones listed above, including Limited Source Bidding Method and Negotiated Procurement Method. Once bids are received through these procurement methods, they will be evaluated through a predetermined method to signify the weights that will be assigned to the technical and financial aspects of the proposal. GPRA IRR Section 33 specifies the procedure for bid evaluation, noting that bids may be assessed either through a Quality-Based Evaluation (QBE)[41] or a Quality-Cost-Based Evaluation (QCBE)[42] procedure. Each bid will be evaluated by the members of the BAC, and the numerical rating will determine the Highest Rated Bid (HRB).

a) Quality Based Evaluation

Quality Based Evaluation (QBE) is a bid evaluation process that involves the review of only the Technical proposal in the bid. This is applied to complex or highly specialized assignments where the scope and depth of the outputs required from the consultants cannot be precisely defined, and where projects can be carried out in different ways, making the proposals incomparable to one another.

The Technical proposal is first opened and distributed to the BAC for evaluation. An Individual or a Collegial Evaluation Process is performed to determine the ratings and designate the HRB. The BAC then invites the HRB for the opening of the Financial Proposal and for contract negotiation, and also uses the opportunity to clarify items in the Technical Proposal that can be settled during negotiations.

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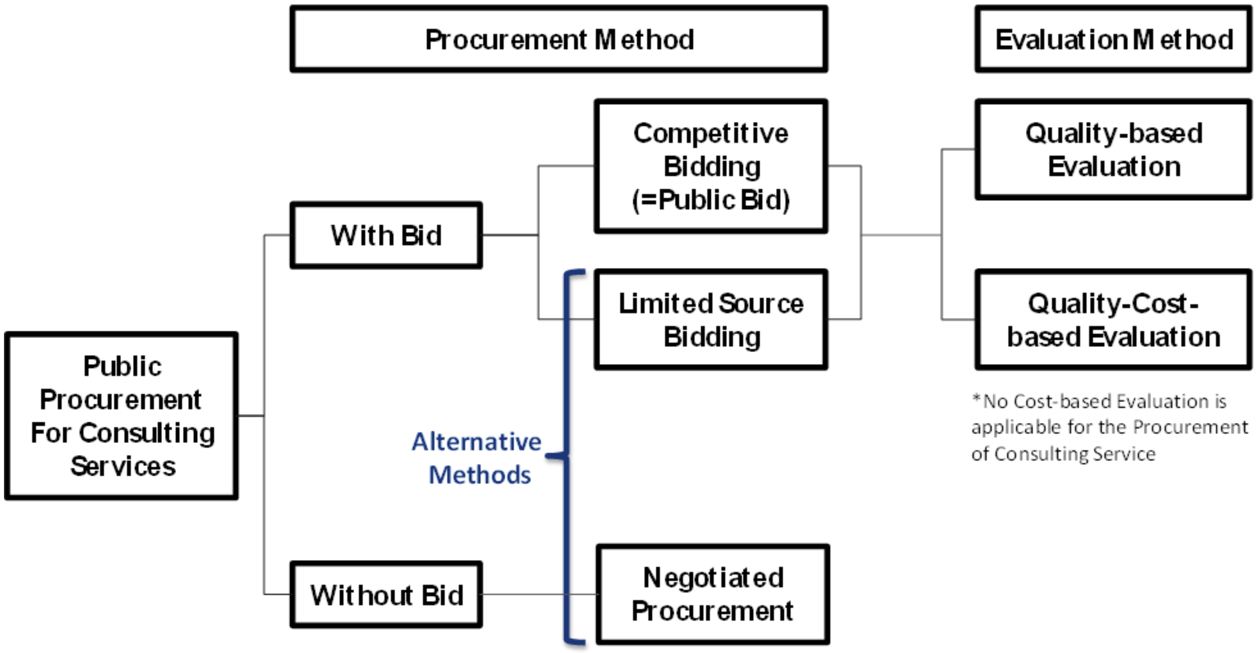
[36] Section 17, Government Procurement Reform Act Implementing Rules and Regulations, Jul2002
[37] Section 25.2.c of the same
[38] Section 33 of the same
[39] Section 34 of the same
[40] Section 37 of the same
[41] 33.2.1.1 of the same
[42] 33.2.1.1 of the same

b) Quality and Cost Based Evaluation[43][44]

Quality and Cost Based Evaluation (QCBE) considers both Technical and Financial Proposals in ranking bids. The corresponding weights of the Technical and Financial Proposals are announced during the pre-bid conference and indicated in the bidding documents. Financial Proposals are given a weight of 15%-40%.

The Technical Proposal is determined as a minimum technical rating requirement by BAC and eliminates bids that scored below this value in the Individual or Collegial Evaluation Process. For those who earned the minimum required rating, proponents are evaluated according to their Financial Proposals. Financial bids that do not exceed the contract approval budget (ABC) will be scored based on the ratio of the lowest price proposal.



Source: JICA Expert Team

Figure 7-4 Public Procurement Methods of the Consulting Services in the Philippines

C. Evaluation Scoring

The method by which the BAC assigns numerical ratings to the bids is done either through an individual or a collegial evaluation process[45]. The Individual Evaluation Process entails each BAC member assigning the ratings individually. These scores are tabulated, and the average of the scores is calculated excluding the highest and lowest ratings. In contrast, the Collegial Evaluation Process involves a group review and evaluation of bids by consensus of the BAC members.

D. Post-qualification screening and Negotiation

The HRB is further subjected to screening to ensure its eligibility and compliance with the bid requirements. Once passed, it is considered as the Highest Rated Responsive Bid (HRRB).

Negotiation works are also facilitated to finalize the contract between the proponent and the Procuring Entity.

E. Contract Awarding

After settling the contract, the Procuring Entity and the proponent undertake the contract. A Notice to Proceed (NTP) is sent to the proponent to officially signal the commencement of the service.

4) Contract with Waste Treatment Consultants

[43] Section 33.2.1.1, Government Procurement Reform Act Implementing Rules and Regulations, Jul2002
[44] Section 3 Part 1 Step 7, GPPB Manual of Procedures for the Procurement of Consulting Services, Nov2015
[45] Section 3 Part 1 Step 7, of the same

Contracts with waste treatment consultants are mostly made with only a single company; However, in case the scale of the assignment is too large such as emergency earthquake disaster restoration, the assignment might be shared among multiple waste treatment consultants. Further, some LGs contract comprehensively with a waste treatment consultant for multiple assignments such as environment assessment, facility basic plan, topographical and geological survey, etc. to reduce project period, to increase quality of achievement, and to reduce the cost.

7.2 APPENDIX B: Applications/Notifications to the Governments (EXAMPLE IN JAPAN)

The example of the application procedures to various government agencies concerning the WTF design in Japan is shown in Table 7-3 . It should be noted that some of the name of applications, notifications and the base laws and regulations, etc. shown in the table are abbreviated. The application procedures shown here may be revised to the situation in the Philippines. So, the latest laws and regulations must always be checked while proceeding with the design.

Table 7-3 Reference example of application procedure to government agencies concerning the development of a WTE-ACC in Japan (other than the Waste Cleansing and Treatment Act)

Application & Notification			Where to submit	When to submit	Remarks
Urban Planning decision			Governor, municipality	Before construction	Urban Planning Act, Article 11,3, Building Standards Act, Article 51
Road	1	Application for road occupancy permit	Road administrator	Before construction	Burial of structures, etc. (installation of signs and markings)
Road	2	Application for exemption from occupancy fee	Road administrator	Before construction	Projects done by local public body
Road	3	Application for recognition of self-financed construction work	Road administrator	Before construction	Construction done by other than road administrator
Road	4	Road and roadside excavation requests	Road administrator	Before construction	Excavation in the roadside area (within 20m per side of the road) as specified by law and ordinance (signs, markings, etc.)
Road	5	Application for road use permit	chief of police	Before construction	Construction that uses roads
River	1	Application for permit	River administrator	Before construction	When constructing, reconstructing or removing structures on land within the river area
River	2	Application for permit	River administrator	Before construction	When excavating, filling, cutting or making other changes to the shape of the land within the river area
River	3	Application for permit	River administrator	Before construction	Excavation, filling, cutting, or other changes to the shape of the land, new construction or reconstruction of structures in the river conservation area.
River	4	Application for recognition	River administrator	Before construction	Dredging for river construction or maintenance at own expense
River	5	Application for completion inspection of construction	River administrator	After completion	Dams, structures that serve as river management facilities, and structures that are installed by excavating embankments on land within the river area.
River	6	Application for partial use of structure	River administrator	After partial completion	When there are special circumstances
Architecture	1	Notification of plan (building)	Chief building official	Before construction	Submit an application for new construction, expansion, renovation, relocation, and for non-wooden buildings with two or more floors and a total floor area exceeding 200m2. Or in municipality where the chief building official is located.
Architecture	2	Outline of architectural planning	Chief building official	Before construction	Attached to the above
Architecture	3	Building construction notification	Governor	Before construction	Attached to the above
Architecture	4	Construction report	Chief building official	Before construction	When having a workshop, attach to notification of plan

Application & Notification			Where to submit	When to submit	Remarks
	5	Notification of plan (structure)	Chief building official	Before construction	When constructing structures such as chimney
	6	Ministerial approval application	Minister of Land, Infrastructure and Transport	Before submitting notification of plan	When constructing structures over 60m high such as chimney
	7	Application for permit (related to Building Standards Act)	Governor	Before construction	When the ban is lifted and permission is granted
	8	Application for permit (related to urban planning)	Governor	Before construction	When building in the area of a urban planning facility
	9	Application for permit (related to urban planning)	Governor	Before construction	Construction in urban redevelopment and land readjustment zones, and in scenic areas
	10	Notification of withdrawal of building (permit, notification of plan) application	Governor or Chief building official	When it occurs	When withdrawing the notifications and applications
	11	Notification of removal of building	Governor	Before construction	When removing building
	12	Application for approval of temporary use	Governor	After partial completion	Partial use of buildings prior to issuance of planning notice facility inspection certificate
	13	Notification of construction completion	Chief building official	Within 4 days after completion	When construction work for which the plan notice was submitted is completed
	14	Notification of use (change) of fireproof object	Fire station chief	7 days prior to use	
	15	Notification of Installation of Aviation Obstruction Lights and Daytime Obstruction Signs	Regional director of aviation	Before construction	When structures such as chimney is over 60m high
	16	Notification of high-rise building construction	Minister of Internal Affairs and Communications	Before construction	When the building is constructed in an area to prevent radio wave propagation interference and has a height of 31m or more
	17	Plan of planting	Governor, mayor	Before construction	Greening of public facilities
Water supply facility	1	Application for waterway works and construction recognition	Water utility manager	Before construction	New construction, renovation, removal of waterway pipes
	2	Application for water supply	Water utility manager	Before completion	Ditto
	3	Application for water supply for construction	Water utility manager	Before construction	
	4	Application for construction of water supply facility	Water utility manager	Before construction	Application for construction of water supply facility for construction
	5	Request of water supply start date	Water utility manager	Before completion	water supply in line with waterway construction
	6	Notification of plan (structure)	Chief building official	Before construction	Installation of elevated water tank (over 8m high)
	7	Notification of construction completion	Chief building official	Within 4 days after completion	When construction work for which the plan notice was submitted is completed
Drainage	1	Notification of drainage facilities plan	Sewerage business manager	7 days prior to construction	New construction, extension, renovation of drainage facilities

Application & Notification			Where to submit	When to submit	Remarks
	2	Notification of specified facility installation	Sewerage business manager	60 days prior to construction	In the case where sewage is continuously discharged from a factory or workplace and uses the public sewage system, and specified facilities (general waste treatment facilities) are installed (automatic vehicle washing facilities, etc.)
	3	Notification of new construction and change of use of detoxification facilities	Sewerage business manager	60 days prior to construction	Installation of detoxification facilities to discharge into sewer system (water treatment facility)
	4	Notification of completion for construction of specified facility/detoxification facility	Sewerage business manager	Within 5 days after completion	Notification for specified facility/detoxification facility
	5	Notification to start (change) using public sewerage	Sewerage business manager	Before start using	When continuously discharging sewage of a quantity or quality specified by a cabinet order and using a public sewage system
	6	Notification to start using public sewerage	Sewerage business manager	Before start using	When discharging from specified facility (general waste treatment facilities are applicable)
	7	Notification to use public sewerage	Sewerage business manager	Before start using	
Heating and hot water facility	1	Notification of boiler installation	Director of labor standards inspection office	30 days prior to construction	When installing steam boiler, hot water boiler, and once-through boiler
	2	Application for boiler completion inspection	Director of labor standards inspection office	After completion	Ditto
	3	Report on small boiler installation	Director of labor standards inspection office	After completion	When installing small boiler
	4	Notification of establishment of Class 1 pressure vessel	Director of labor standards inspection office	30 days prior to construction	When installing heat exchanger condensate system
	5	Application for completion inspection of Class 1 pressure vessel	Director of labor standards inspection office	After completion	When installing the above equipment
Combustion equipment	1	Application for hazardous material storage facility permit	Fire station chief, mayor	Before construction	Hazardous material in excess of the specified quantity
	2	Application for completion inspection for hazardous material storage facility	Fire station chief, mayor	After completion	Ditto
	3	Notification of security supervisor for hazardous materials	Fire station chief, mayor	After completion	Ditto
	4	Notification of storage and handling of small quantities of (semi-) hazardous materials	Fire station chief	Before start using	Hazardous material of more than a half of the specified quantity and less than the specified quantity
	5	Notification to install	Fire station chief	7 days prior to	Furnaces and stoves with a footprint of

Application & Notification			Where to submit	When to submit	Remarks
		equipment that uses fire		construction	1m2 or more, hot-air heaters, etc.
Fire suppression equipment	1	Notification of installation of firefighting equipment	Fire station chief	Within 4 days after completion	Fire prevention objects with a total area of more than 300m2
	2	Notification of commencement of construction of facilities subject to construction and maintenance	Fire station chief	10 days prior to construction	Installation of indoor fire hydrant system, sprinkler system etc
	3	Notification of commencement of using fire prevention objects	Fire station chief	7 days prior to start using	When using fire prevention objects
Elevator and crane	1	Notification of plan (elevator)	Chief building official	Before construction	Installation of elevator etc
	2	Notification of construction completion	Chief building official	Within 4 days after completion	Ditto
	3	Notification of installation of crane	Director of labor standards inspection office	30 days prior to construction	Installation of hanging load with more than 3t
	4	Application for completion inspection of crane	Director of labor standards inspection office	After completion	Ditto
	5	Report on installation of crane	Director of labor standards inspection office	Before construction	Installation of hanging load with more than 0.5t and less than 3t
High-pressure gas facility	1	Application for high-pressure gas production license	Governor	20 days prior to construction	When producing compressed gas more than 100m3 per day
	2	Application for completion inspection for high-pressure gas production facility	Governor	After completion	Ditto
	3	Notification of hazard prevention regulations	Governor	30 days prior to construction	Ditto
	4	Notification of high-pressure gas security coordinator	Governor	After completion	Ditto, appointment of security manager, technical manager etc.
	5	Notification of commencement of high-pressure gas production	Governor	After completion	When producing compressed gas more than 100m3 per day
	6	Notification of high-pressure gas production	Governor	20 days prior to start using	When producing compressed gas less than 100m3 per day
	7	Application for permission to set up Class 1 storage facility	Governor	30 days prior to construction	Installation of high-pressure gas storage for compressed gas (more than 300m3), etc. for pressurization of high-temperature water (nitrogen cylinders), Co2 fire extinguishing equipment (carbon dioxide cylinders), and storage when boilers are idle
	8	Application for completion inspection for Class 1 storage facility	Governor	After completion	Ditto
	9	Notification of specific high-pressure gas consumption	Governor	20 days prior to start using	When using specific high-pressure gas (compressed hydrogen, compressed natural gas, liquefied oxygen, liquefied ammonia, liquefied petroleum gas, and

Application & Notification			Where to submit	When to submit	Remarks
					liquefied chlorine) in compressed gas more than 300m3, and liquefied gas more than 3,000kg
Pollution control	1	Environmental Impact Assessment	Governor	When planning the project	Waste treatment facility (assessment against exhaust gas, drainage, noise, vibration, odor, factors such as transport vehicle)
	2	Application for factory establishment permit	Mayor	60 days prior to construction	
	3	Application for factory change permit	Mayor	60 days prior to construction	
	4	Notification of factory completion	Mayor	Within 15 days after completion	
	5	Notification of (establishment/change) of designated work area	Mayor	30 days prior to construction	
	6	Notification of establishment (change) of soot and smoke generating facilities	Governor	60 days prior to construction	Boiler electric heating area more than 10m2, Grate area more than 2m2, more than 200kg/h
	7	Notification of establishment of designated facility	Governor	60 days prior to construction	Applicable to waste treatment facility, water quality regulation (car wash facility etc.)
	8	Notification of establishment of designated facility	Mayor	30 days prior to construction	Noise regulation, air compressor and ventilator (over 7.5kW) etc.
	9	Notification of establishment of designated facility	Mayor	30 days prior to construction	vibration regulation, compressor (over 7.5kW) etc.
Other facility	1	Notification of plan (facility other than elevator)	Chief building official	Prior to construction	When constructing structures such as chimney and lightning rod
	2	Notification of construction completion	Chief building official	Within 4 days after completion	Ditto
	3	Notification of designated building	Governor	Within 1 month after start using	Office with total floor of more than 3,000m2
	4	Notification of installation of office ventilation system	Director of labor standards inspection office	30 days prior to construction	Air conditioning and mechanical ventilation equipment with central control system
	5	Notification of installation of designated chemical equipment	Director of labor standards inspection office	30 days prior to construction	Handling of sulfuric acid, nitric acid, etc. (hydrochloric acid in wastewater treatment, sulfuric acid in boiler pure water equipment)
	6	Application for new gas installation	Supplier	When designing	
Electric workpiece for home use	1	Application for use of electricity for private use	Supplier	Prior to construction	New application or partial change
	2	Electricity supply and demand contract	Supplier	After approval of use	In principal more than 500kW and receiving power at a special rate
	3	Notification of completion of electrical workpiece for home use	Supplier	30 days prior to receiving power	More than 500 kW
	4	Notification of work plan	Director General, Bureau of Economy, Trade and Industry	30 days prior to construction	Installation of demand equipment with more than 10,000V
	5	Notification of safety regulations	Director General, Bureau of Economy,		When installing, transferring, or borrowing electric facilities

Application & Notification			Where to submit	When to submit	Remarks
			Trade and Industry		
	6	Notification of appointing (dismissing) chief engineer	Director General, Bureau of Economy, Trade and Industry	Prior to construction	Appointing electricity chief engineer for electric facilities with less than 170,000V
	7	Application for use approval	Minister, Director General, Bureau of Economy, Trade and Industry	Before use	Use for testing in connection with the partial completion of facilities for which construction plan approval has been applied for
	8	Application for inspection before use	Minister, Director General, Bureau of Economy, Trade and Industry	Before use	Construction inspection for facility for which application or notification has been submitted
	9	Notification of installation (change) of electrical equipment	Fire station chief	3 days prior to construction	Power receiving equipment for high voltage and specific high voltage, internal combustion engine power generation equipment, storage battery facilities (high-voltage power receiving, emergency generator, and battery are applicable)
	10	Application for safety management audit before use	Minister of Economy, Trade and Industry	Before use	
	11	Application for hazardous material storage (handling) facility permit (change)	Fire station chief Mayor	Prior to construction	Hazardous material in excess of the specified quantity
	12	Application for completion inspection of hazardous material storage (handling) facility	Fire station chief Mayor	After completion	Ditto
	13	Notification of security supervisor for hazardous materials	Fire station chief Mayor	After completion	Ditto
	14	Notification of storage and handling of small quantities of (semi-) hazardous materials	Fire station chief	Before start using	Hazardous material of more than a half of the specified quantity and less than the specified quantity
	15	Notification to install (change) equipment that uses fire	Fire station chief	7 days prior to construction	Furnaces and stoves with a footprint of 1m2 or more, hot-air heaters, etc.
Radio rebroadcasting equipment	1	Application for consent to rebroadcast	Broadcasting stations	Prior to construction	When retransmitting TV broadcasts
	2	Application for permission to install wired TV broadcasting facilities	Minister of Internal Affairs and Communications	Prior to construction	When the number of pull-in terminals exceeds 500.
	3	Notification of installation of wired TV broadcasting facilities	Minister of Internal Affairs and Communications	After completion	Ditto
	4	Notification of installation of wired TV broadcasting facilities and start of business	Minister of Internal Affairs and Communications	Before start using	Ditto
	5	Notification of installation of wired TV broadcasting facilities and start of business	Minister of Internal Affairs and Communications	2 weeks prior to construction	When the number of pull-in terminals is more than 51and less than 500

Application & Notification			Where to submit	When to submit	Remarks
	6	Notification of installation of cable communications equipment	Minister of Internal Affairs and Communications	2 weeks prior to construction	When the number of pull-in terminals is less than 50

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

7.3 Appendix C: General Structure of WTE/WTF

1) Outline of items

The following outlines the items that the designer needs to check sufficiently when designing a facility.

(1) Load of the facility self-weight

The load to be used in structural planning includes the weight of equipment such as the furnace bodies, filtration-type dust collector, induction fan, steam condenser, etc. apart from the weight of pillars, beams, floors, roofs, walls, foundations etc. In addition, dynamic loads such as cranes need to be considered.

(2) Load capacity

In addition to human loads such as machine operators and visitors, temporary loads such as tools, equipment, parts and vehicles during maintenance and overhaul are also included. In the case of axial direction load calculation of a pillar and a foundation by vertical load, reduction by the number of floor supports may be performed.

(3) Water pressure, earth pressure

Basement, pits, retaining walls, etc. should be determined in consideration of groundwater pressure and earth pressure. Depending on the area, the groundwater level may change significantly with the season, thus structural design and construction plan should be made in consideration of regional characteristics.

(4) Wind pressure

Wind pressure is short-term load applied to the roof and wall due to strong wind during a typhoon. The calculation of wind pressure is carried out based on the Building Standard Law, the enforcement order, etc. The chimney and the water tank of the roof equipment must be planned with similar calculations.

(5) Seismic force

Seismic force is a short-term load applied to a structure at the time of an earthquake. The calculation of the seismic force of the above ground part and below ground part of the building is carried out according to the "Guidance of Technical Standards for the Building Structure" based on the Japanese Building Standard Law and its IRR. The chimney and the water tank of the roof equipment must be planned with similar calculations. As structural calculation of buildings, calculation method of lateral bearing load may be applied regardless of the specification of structure type and height.

Although many experimental studies have been conducted on the earth pressure during earthquakes, no definitive conclusions have yet been obtained. Conventional methods for calculating earth pressure during earthquakes are always based on calculation of earth pressure in regular time, and it is hard to say such a method is sufficient, but right now current design are being carried out with reference to some qualitative properties obtained from many research results. Regarding these, it might be necessary to consider the Japanese building load guideline 2015 (Architectural Society of Japan). It is necessary to consider also about the increase of the water pressure at the time of the earthquake which applies to walls in the underground tank etc.

(6) Temperature stress

In designing indeterminate structure such as rigid frame or arch, it is necessary to design while bearing in the thermal stress due to temperature change.

(7) Geological Survey

For the civil engineering works, there are considerable differences in foundation work costs and underground structure work costs depending on the ground conditions, and it is difficult to grasp an appropriate budget without conducting preliminary surveys. Types of geological survey methods include boring, test drilling, physical underground exploration, and penetration tests, and prior to placing an order, these ground surveys should be conducted at the planned construction site, and the survey results should be one of the design conditions. Judgment as to whether a pile foundation is to be a friction pile or a support pile is determined by geological survey, and the type and length of the pile are decided on it also. Therefore, when a building and a plant are ordered collectively, it is at least necessary to fill in the order specifications with the standard penetration test (at N value) of several points in the site, and the ground water level in the vicinity.

The Soil Contamination Countermeasures Act of Japan (May 2002) stipulates that for (a) land that was the site of a factory or workplace related to a specified facility using hazardous substances whose use has been discontinued, or (b) land where health damage may occur due to soil contamination, geological surveys must been carried out to determine the presence of harmful substance such as cadmium or lead when conducting plant abolition or retirement, and land modification. Specifically, it depends much on the prefectural or local regulations, but developing a new, or renovating an existing WTF might be subject to laws, so prior consultation with the person in charge is necessary. When the specific harmful substance exceeding the standard is detected, it is stipulated that the soil pollution diffusion prevention measures such as replacement of the soil be taken.

(8) Other structural considerations in civil engineering and architecture

A. If there is a possibility that the concrete floor will be worn by the claws of a crane bucket, shovel loader, etc., it is necessary to increase the rebar protective cover thickness.
B. For concrete and reinforced concrete structures, etc., expansion joints might be installed if needed with consideration of the shape, height of the building.
C. In cold regions, it is necessary to consider the repeated freezing and thawing on the concrete surface, and the underground structure should be designed considering the freezing and frosting of the ground.

2) Machinery and Equipment

In WTFs, there are many devices exposed to various severe environments associated with the burning, crushing, fermentation of waste, so in designing, it is necessary to take sufficient consideration according to the situation. In particular studies on wear resistance, corrosion resistance, and heat resistance are fundamental for maintaining the initial functions of the equipment until the required service life.
Therefore, the structure should be easy to partially repair or replace and should have versatility. Materials should be designed with due consideration to economics, compatibility, versatility, etc.

(1) Wear resistance

Apart from selecting materials that might resist wear caused by waste, waste incineration residue, molten slags, etc., the necessary wear protection plates and wear allowance shall be secured, and the structure shall be easy to repair or replace. The main parts that require wear resistance include claws of a crane bucket, grate of a stoker furnace, air outlet of a fluidized bed furnace, and a contact surface accompanying movement of waste and incineration residues in a waste incineration facility. At gasification and melting facilities and incineration ash melting facilities, the parts that require wear resistance are refractory at the outlet of molten slag, internal heat exchange tube and gas seal of kiln type gasification furnace. For waste to fueling facilities such as RDF, the parts that require wear resistance are compression molding dies etc.

(2) Corrosion resistance

The structure of the WTE-ACC must be free from leakage or scattering of combustion gas or dust; in addition, steel products should be designed to avoid high temperature corrosion and low temperature corrosion.
The main equipment and machinery that should be considered for corrosion resistance in WTE-ACCs include grates, refractory parts in high temperature zone, combustion gas cooling equipment, heat recovery equipment, flue gas ducts, exhaust gas treatment equipment, wastewater treatment equipment, and chimneys. Other WTFs shall also comply with the standards of WTE-ACCs, however, for bio-methanation facilities, because corrosion by condensation of humid gas from the fermenter is considered, corrosion resistance should be considered for buildings and equipment that come in contact with gas.

(3) Heat resistance

A lot of equipment in WTE-ACCs is affected by heat, so appropriate material selection and sufficient structural consideration are required. In other words, in addition to the examination of material selection for combustion chambers, combustion gas cooling facilities, exhaust gas treatment facilities, etc., there are still many points that must be taken into consideration in terms of structural aspects such as how to escape thermal expansion. For WTE-ACC, the following are examples of points:

a. Thermal expansion of steel frame supports for furnaces, boilers, and steel outer cylinder of chimneys, etc.
b. Connection with the building when the furnace steel frame is integral with the building steel frame, etc.
c. Flue gas ducts, support method of steam piping, expansion joint, etc.

For equipment that is thermally affected at other WTFs, it is necessary to design according to the WTE-ACCs.

(4) Noise

In the WTFs, equipment is generally stored in a factory building, and equipment with particularly high noise is installed in a partitioned room, and noise countermeasures such as attaching a sound absorbing material to a wall or a ceiling are required.

When installing a filtration type dust collector and a steam condenser, etc. outdoors, it is desirable to secure a separation distance to the site boundary by providing a green zone around to reduce noise. However, there are many cases where site constraints are severe, and measures such as surrounding with a soundproof wall are considered as necessary.

Depending on the shape, size, exhaust gas flow rate, etc. of the flue gas, resonance noise and low frequency noise may sometimes be generated. Such a phenomenon may not be predicted at the time of design, and if it occurs, measures such as installing an enclosure wall outside or installing a silencer in the flue gas ducts will be taken.

For crushing equipment, the intensity of noise differs depending on the type of crushing machine, so as a measure against noise, it is necessary to install in a partitioned room and attach a sound absorbing material to the inner wall of a building in consideration of the type of crusher.

(5) Workability in rainy weather

In Japan, most of the equipment has been housed inside the building in consideration of inspection and maintenance of the equipment. Also, there are many cases where dust collection equipment and wastewater treatment equipment are also housed in the building to facilitate operation management and repair work.

(6) Others

In facilities that handle heat like WTE-ACCs, there is heat radiation from furnaces, gas cooling facilities such as boilers, dust collectors, fans, etc. and room temperature rises, so sufficient ventilation should be planned to secure a good working environment.

In consideration of the properties of the waste to be treated, it is desirable to provide a structure in which dust does not leak easily and install a dust collection device or the like for preventing scattering at a place where dust is generated.

7.4 APPENDIX D: AN EXAMPLE OF WASTE TREATMENT TECHNOLOGY SELECTIONS IN JAPAN

Following shows Waste Technology Selection of MSW Facility Development Plan (LGU's FS) for an LGU in Japan

1) Procedure for Selection of Treatment Methods

The procedure for selecting a waste treatment system is shown below.

First Selection

1 Identification of waste treatment methods to be covered by the project

↓

2 Exclusion of treatment methods that are not appropriate for this project

↓

3 Extraction of waste treatment methods

⇩

Second selection

1 Draft evaluation items and criteria

↓

2 Conduct manufacturer surveys based on established evaluation items and evaluation criteria

↓

3 Selection of an appropriate waste treatment method for the project based on a comprehensive evaluation

⇩

Determination of Waste Treatment Method

Figure 7-5 Procedure for Selection of Treatment Methods

2) First selection

(1) Extraction of waste treatment systems to be covered by the project

MSW treatment methods can be roughly classified into two categories: incineration and methane fermentation. Treatment by incineration includes incineration, incineration plus ash melting, and gasification and melting. Each method is classified as follows.

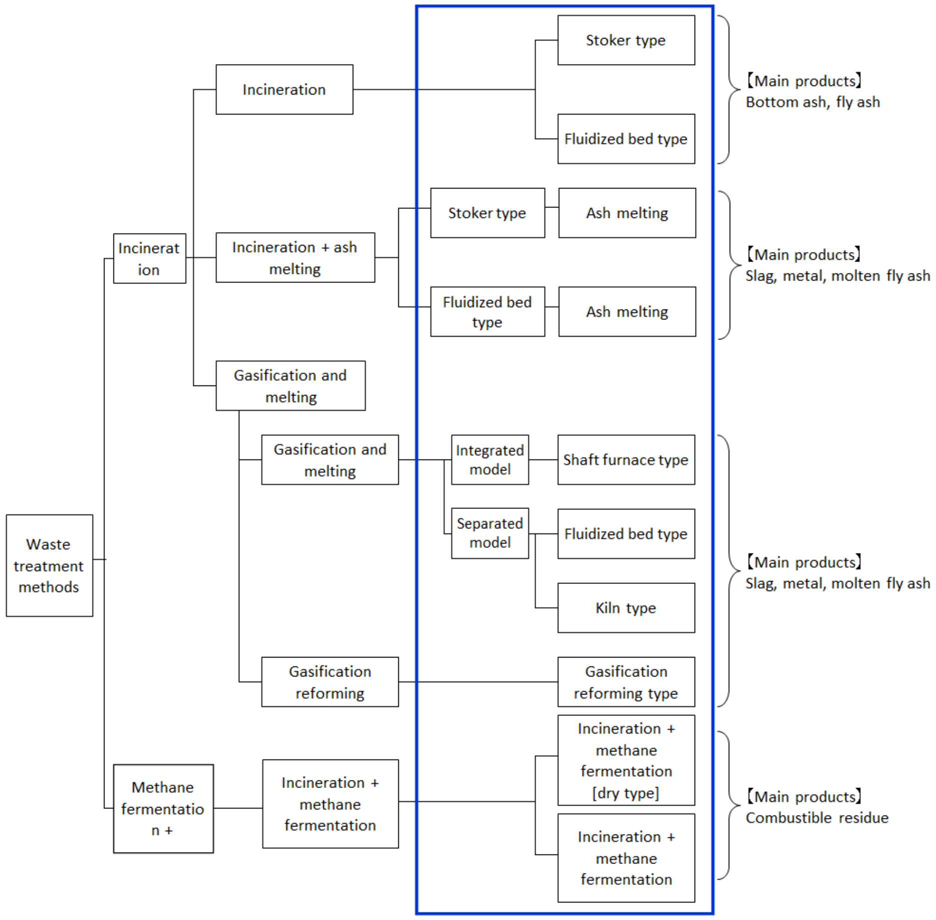


Figure 7-6　Classification of Waste Treatment Methods

(2) Exclusion of treatment methods that are not appropriate for this project
(Omitted)

A. Summary

Table 7-4 shows the waste treatment methods that are not appropriate for this project and the reasons for their exclusion.

Table 7-4 Waste treatment methods to be excluded and reasons for exclusion

<table>
<tr><th>Processing method</th><th>Reasons for exclusion</th></tr>
<tr><td>Stoker type + ash melting</td><td rowspan="2">▪ High maintenance costs because ash melting causes severe damage to refractory materials and requires periodic repairs.
▪ The ash melting process uses thermal energy, which lowers the energy recovery rate.
▪ Lack of reliability due to the occurrence of many problems.
▪ In recent years, there have been few cases of construction of new intermediate treatment facilities with ash melting facilities.
▪ The government subsidy system does not actively encourage the introduction of ash melting.
▪ Plant manufacturers have not actively recommended this trend in recent years.</td></tr>
<tr><td>Fluidized bed + ash melting</td></tr>
<tr><td>Gasification and melting
(Shaft furnace type)</td><td>▪ There are issues of fuel cost and environmental impact due to the constant use of coke, a resource energy, as a secondary material.
▪ In recent years, there have been almost no gasification and melting facilities constructed with a capacity of 50 tons/day or less.</td></tr>
<tr><td>Gasification and melting
(Fluidized bed type)</td><td>▪ In recent years, there have been almost no gasification and melting facilities constructed with a capacity of 50 t/day or less.
▪ When the lower calorific value is less than 6,000 kJ/kg, auxiliary combustion is required, resulting in fuel cost and environmental impact concerns.
▪ The risk of deterioration of the work environment is higher than with other methods.
▪ There is a limitation that pretreatment with a crusher is required.</td></tr>
<tr><td>Gasification and melting
(Kiln type)</td><td>▪ There are approximately 15 facilities nationwide. A wide range of facilities are in operation, from relatively small facilities to large ones. The latest facility was completed in July 2012 by the XXXX Regional Wide-Area Municipalities Association. However, the periodic maintenance and repair costs for the operation and maintenance of the facility, as well as the service costs, are high, and the gasification and melting method (kiln) has been used. Plant manufacturers with gasification and melting (kiln-type) technology are not actively introducing new facilities.</td></tr>
<tr><td>Gasification reforming</td><td>▪ There is the little track record and almost no corresponding plant manufacturer.</td></tr>
<tr><td>Methane fermentation
[Wet type]</td><td>▪ There are no plans for the segregated collection of food waste. The number of actual cases of the combined incineration (stoker type) + methane fermentation (wet type) method is small, and there are almost no plant manufacturers that support this method.</td></tr>
</table>

(3) Extraction of waste treatment methods

A. Results of selection

B. The following waste treatment methods were selected after eliminating those that were not appropriate for this project. The following is a summary of each waste treatment method.

＜Selection Results＞ ・Incineration (stoker type) ・Incineration (fluidized bed) ・Incineration (stoker type) + methane fermentation [dry type] ※Incineration (fluidized bed) + methane fermentation [dry type] is excluded because there is no track record in Japan.

3) Second selection

(1) Second Selection

With regard to the waste treatment system selected in the first round of selection, an appropriate waste treatment system for this project will be selected in accordance with the contents indicated in the basic policy.

(2) Evaluation items, evaluation criteria

The evaluation items were set according to the contents indicated in the following basic policy. Among them, "facilities that serve as a base for environmental education and information dissemination" and "landscape-friendly facilities" were excluded from the evaluation items because they have no relevance to the treatment method.

A. Facilities designed to reduce environmental impact

In order to reduce the environmental impact of intermediate treatment of discharged combustible waste, recyclable waste, and human waste, we will promote energy conservation and effective use of thermal energy to contribute to the reduction of fossil fuel consumption and carbon dioxide emissions, based on thorough operation management and strict compliance with various laws and regulations.

B. Resource-circulation-conscious facilities

Aiming for advanced recycling, it will be considered a heat recovery (residual heat utilization) system through the effective use of thermal energy. In addition, resource recycling and the reduction of final treatment volume in the recycling process.

C. Economy-friendly facilities

Reduce life cycle costs including construction, operation, and maintenance costs.

D. Facilities designed for stability and safety

Introduce a highly reliable treatment system that excels in stable operation to protect the living environment.

E. Facilities to serve as a base for environmental education and information dissemination

Aiming to create facilities that will be familiar to local residents as a place for the local community and as a base for environmental education and information dissemination, the center will provide "a place to learn about environmental issues in a hands-on manner," "a place to disseminate and exchange information," and "a base for residents' groups and local activities.”

F. Landscape-friendly facilities

Harmony with the landscape of the XXXXX area is essential, and consideration will be given to the landscape of the facility.

The evaluation items and evaluation criteria are shown in Table 7-5 .

Table 7-5 Evaluation Items and Criteria for Waste Disposal Methods

<table>
<tr><th>Main items</th><th colspan="2">Items</th><th>Focus of evaluation</th><th>Evaluation criterion</th></tr>
<tr><td rowspan="4">Facilities designed to reduce environmental</td><td colspan="2" rowspan="2">Pollution Prevention</td><td>Can it meet pollution control standards?</td><td>Criterion achievable: ◎
Criterion not achievable: ×</td></tr>
<tr><td>Can it achieve a “no waste water emission system”?</td><td>Feasible: ◎
Unfeasible: ×</td></tr>
<tr><td colspan="2">Global Warming Impact</td><td>What are carbon dioxide emissions?</td><td>Evaluation based on incineration facilities (stoker type)</td></tr>
<tr><td colspan="2">Final treatment load</td><td>What is the final treatment volume?</td><td>Evaluated by the amount of final treatment materials</td></tr>
<tr><td rowspan="2">Resourc e-circulati</td><td colspan="2">Energy-saving</td><td>What is the amount of auxiliary fuel used, electricity used, etc.?</td><td>Evaluation based on incineration facilities (stoker type)</td></tr>
<tr><td colspan="2">Energy recovery</td><td>Is an energy recovery rate of 10% or more satisfactory?</td><td>Satisfied: ◎
Not satisfied: ×</td></tr>
<tr><td rowspan="2">Economy-friendly facilities</td><td rowspan="2">Expenditure cost</td><td>Facility construction costs</td><td>What are the facility construction costs?</td><td>Evaluation based on incineration facilities (stoker type)</td></tr>
<tr><td>Maintenance costs (20 years)</td><td>What are the costs for labor, inspection and repair, and utilities?
What are the costs for the final treatment of residuals?</td><td>Evaluation based on incineration facilities (stoker type)</td></tr>
<tr><td rowspan="4">Facilities designed for stability and safety</td><td rowspan="2">Safety</td><td>Accidents and problems</td><td>Have there been any accidents or problems in the past 10 years?</td><td>No accidents or problems during the operation of the facility: ◎
Accidents and problems have occurred during the operation of the facility, and there have been no explosions, deaths, or injuries: ○
Accidents and problems during facility operation, resulting in explosions or death or injury: △</td></tr>
<tr><td>Operating results</td><td>What has been the operating performance over the past 10 years?</td><td>Evaluation based on incineration facilities (stoker type)</td></tr>
<tr><td colspan="2" rowspan="2">Stable operation</td><td>Can it handle a wide range of waste types?</td><td>Compatible: ◎
Standard: ○
Difficult to handle: △</td></tr>
<tr><td>Dealing with unsuitable materials</td><td>A small variety of unsuitable materials: ◎
Typical types of unsuitable materials: ○
Many kinds of unsuitable materials: △</td></tr>
<tr><td colspan="3">Facilities that serve as a base for environmental education and information dissemination</td><td colspan="2">Excluded from evaluation due to irrelevance to treatment method.</td></tr>
<tr><td colspan="3">Landscape-friendly facilities</td><td colspan="2">Excluded from evaluation due to irrelevance to treatment method.</td></tr>
</table>

(3) Evaluation methods

A. Assumptions for comparison and evaluation （Omitted）

B. Valuation methods （Omitted）

C. Evaluation methods （Omitted）

D. Weighting of evaluation items

The weighting of evaluation items is based on the importance and number of items to be evaluated, as shown in Table 7-6 , with a total score of 100.

Table 7-6 Weighting of evaluation items

Main items	Items		Importance
Facilities designed to reduce environmental impact	Pollution Prevention	Standards for pollution control	5
		Closed system	5
	Global warming impact		5
	Final treatment load		5
	Subtotal		20
Resource-circulation-conscious facilities	Energy-saving		10
	Energy recovery		10
	Subtotal		20
Economy-friendly facilities	Expenditure cost	Facility construction costs	15
		Maintenance cost （20 years）	15
	Subtotal		30
Facilities designed for stability and safety	Safety	Accidents and Problems	10
		Operating Results	10
	Stable operation	Compatible with a wide range of waste types	5
		Dealing with unsuitable materials	5
	Subtotal		30
Total amount			100

(4) Overall Evaluation

Overall Evaluation

The overall ratings are shown in Table 7-7 , and Table 7-8 . In addition, the scores for ◎, 〇, and △ are as follows:

◎: 3points

〇: 2points

△: 1point

Score of evaluation points = weighting (middle item) x number of evaluation points

Example: Weighting (middle item): 5 points, Evaluation◎: 3 points, score = 5 x 3 = 15

Table 7-7 Overall Evaluation (Part 1)

Main items	Items	Focus of evaluation	Reference No.	Importance（Main items）	Importance（Items）	Features Evaluation	Incineration facilities (stoker type)	Incineration facilities (fluidized bed type)	Incineration facilities (stoker type)+ Methane fermentation facilities (dry type)	Evaluation Criteria
Facilities designed to reduce environmental impact	Pollution Prevention	Is it possible to achieve pollution control standards?	1	20	5	Features	Standard achievable	Standard achievable	Standard achievable	Standard achievable: ◎ Standard not achievable: ×
						Evaluation	◎	◎	◎	
						Score	15	15	15	
		Can we achieve a closed system?	2		5	Features	Feasible	Feasible	Difficult to determine since no responses were received in the survey.	Feasible: ◎ Unfeasible: ×
						Evaluation	◎	◎	—	
						Score	15	15	—	
	Global warming impact	What are the carbon dioxide emissions?	3		5	Amount of discharge	88,857t-CO_2/20 years	Comparable to incineration facilities (stoker type).	Comparable to incineration facilities (stoker type). Since both the incineration facilities (stoker type) and the methane fermentation facilities (dry type) use electricity, they consume more electricity and emit more carbon dioxide, but the amount of carbon dioxide emissions is the same as that of the incineration facilities (stoker type) because of the possibility of reducing carbon dioxide emissions through methane recovery.	Evaluation based on incineration facilities (stoker type)
						Evaluation	○	○	○	
						Score	10	10	10	
	Final disposition load	What is the final disposal volume?	4		5	Amount generated	15,883ｔ/20 years	Comparable to incineration facilities (stoker type).	Comparable to incineration facilities (stoker type).	Evaluation based on incineration facilities (stoker type)
						Evaluation	○	○	○	
						Score	10	10	10	
	Subtotal						**50**	**50**	**35**	
Resource-circulation-conscious facilities	Energy conservation	What is the amount of auxiliary fuel used, electricity used, etc.?	5	20	10	Amount used	Electricity usage: 37 GWh/20 years Auxiliary fuel consumption is standard. (Manufacturer's average for A fuel oil use: 1,800 kL/20 years Manufacturer's average for kerosene use: 3,000 kL/20 years)	Comparable to incineration facilities (stoker type).	Comparable to incineration facilities (stoker type). The power consumption is high because both the incineration facility (stoker type) and the methane fermentation facility (dry type) use electricity, but it is comparable to that of the incineration facility (stoker type) because power can be generated by methane recovery.	Evaluation based on incineration facilities (stoker type)
						Evaluation	○	○	○	
						Score	20	20	20	
	Energy recovery	Does the heat recovery rate satisfy either 10% or more of the heat requirement, or grant conditions?	6		10	Rating	Satisfied	Satisfied	Satisfied	Satisfied: ◎ Unsatisfied.: ×
						Evaluation	◎	◎	◎	
						Score	30	30	30	
	Subtotal						**50**	**50**	**50**	

Table 7-8 Overall Evaluation (Part 2)

Main items	Items		Focus of evaluation	Reference No.	Importance (Main items)	Importance (Items)	Features Evaluation	Incineration facilities (stoker type)	Incineration facilities (fluidized bed type)	Incineration facilities (stoker type)+ Methane fermentation facilities (dry type)	Evaluation Criteria
Economy-friendly facilities	Expenditure costs	Facility construction costs	What are the facility construction costs?	7	30	15	Amount of money	Incineration facilities: approx. X.XX billion yen (including tax)	Comparable to incineration facilities (stoker type).	Construction costs are high because of both incineration facilities (stoker type) and methane fermentation facilities (dry type).	Evaluation based on incineration facilities (stoker type)
							Evaluation	○	○	△	
							Score	30	30	15	
		Maintenance and management costs (for 20 years)	What are the costs for labor, inspection and repair, and utilities? What are the costs for the final disposal of the residuals?	8		15	Amount of money	Personnel, inspection and repair, and utility costs: incineration facility: approx. X.XX billion yen/20 years (incl. tax) Final disposal of treatment residue: incineration facility: approx. XXX million yen/20 years (including tax)	Comparable to incineration facilities (stoker type).	Labor, inspection and repair, and utility costs are high due to the presence of both incineration facilities (stoker type) and methane fermentation facilities (dry type). The final disposal cost of the treated residue is almost the same.	Evaluation based on incineration facilities (stoker type)
							Evaluation	○	○	△	Evaluation based on incineration facilities (stoker type)
							Score	30	30	15	
	15							60	60	30	
Facilities designed for stability and safety	Safety	Accident and problems	Have there been any accidents or problems in the past 10 years?	9	30	10	Features	There have been no cases of accidents or problems that could affect the operation.	There have been no cases of accidents or problems that could affect the operation.	There have been no cases of accidents or problems that could affect the operation.	No accidents or problems during the operation of the facility: ◎ Accidents and problems have occurred during the operation of the facility, and there have been no explosions, deaths, or injuries: ○ Accidents and problems during facility operation, resulting in explosions or death or injury: △
							Evaluation	◎	◎	◎	
							Score	30	30	30	
		Operating results	What has been the operating performance over the past 10 years?	10		10	Features	There are over 100 in operation.	There are three operating records.	There are six operating records.	Evaluated by number of operating results
							Evaluation	◎	○	○	
							Score	30	20	20	
	Stable operation		Can they handle a wide range of waste types?	11		5	Features	Capable of handling a wide range of waste types.	When the lower heating value of the refuse material is lower, an auxiliary combustion agent is needed.	Capable of handling a wide range of waste types.	Feasible: ◎ Standard: ○ Difficult to deal with: △
							Evaluation	◎	○	◎	
							Score	15	10	15	
			Dealing with unsuitable materials	12		5	Features	Since combustible waste of approximately 800 m2 or less is targeted for treatment, the types of non-processable materials are standard.	Since combustible waste of approximately 150 m2 or less is targeted for disposal, there are many types of unsuitable materials.	The types of unsuitable material are standard.	Small variety of unsuitable materials: ◎ Standard types of unsuitable materials: ○ Many kinds of unsuitable materials: △
							Evaluation	○	△	○	
							Score	10	5	10	
	Subtotal							**85**	**65**	**75**	
Comprehensive evaluation							**Features**	**Highest overall evaluation score. Excellent evaluation of all items.**	**The evaluation of the incineration facility (stoker type) is almost the same as the evaluation of the incineration facility (stoker type), but there are concerns about the low operating record of the facility over the past 10 years (there is no record of a facility of the same size) and the handling of unsuitable materials for treatment.**	**Concerns about the feasibility of closed systems, high construction and maintenance costs, and low operating results, as they generate more wastewater than incineration facilities (stoker type) and incineration facilities (fluidized bed type).**	-
							Comprehensive evaluation	**◎ : 6 ○ : 6 △ : 0**	**◎ : 4 ○ : 7 △ : 1**	**◎ : 4 ○ : 5 △ : 2 — : 1**	-
							Score (out of 300 points)	**245**	**225**	**190**	-
							Score (out of 100 points)	**82**	**75**	**63**	-

After a comprehensive evaluation, an incineration facility (stoker type) was selected. Summary of selection of “treatment method “is shown in Table 7-9 .

Table 7-9 Selection result of waste disposal Method

Processing system	Result	Reasons
Incineration facilities (stoker type)	Adopted	The stoker type has a long history, is technologically established, has been adopted in large numbers, has not caused any serious problems, and has an excellent evaluation in terms of "facilities with consideration for reducing environmental load," "facilities with consideration for resource recycling," "facilities with consideration for economic efficiency," and "facilities with consideration for stability and safety. Additionally, several plant manufacturers have expressed their willingness to participate in the project, and all of them prefer the "stoker type," so we will adopt this method as the most suitable for our waste treatment.
Incineration facilities (fluidized bed type)	Not adopted	The "facility with consideration for environmental load reduction," "facility with consideration for resource recycling," and "facility with consideration for economic efficiency" are equivalent to the incineration facility (stoker type), but the "facility with consideration for stability and safety" has not been in operation for the past 10 years, especially since there is no record of the operation of a facility of the same size. In addition, the plant manufacturers who responded to the questionnaire have no intention of participating in the project. Furthermore, the "facility with consideration for stability and safety" was not adopted because it is not recognized as a method compatible with the Municipal Solid Waste Management Association.
Incineration facilities (stoker type) + Methane fermentation facilities (dry type)	Not adopted	The system is rejected because it is not recognized as a method compatible with the Municipality's waste treatment, due to the high wastewater volume, concerns about the feasibility of a closed system, the high construction and maintenance costs, the limited operating records, and the fact that plant manufacturers who responded to the questionnaire survey have not indicated their intention to participate in the system.

7.5 Appendix E: WTE-ACC as a Stable Power Source Cases in Japan

Surplus electricity generated from WTE facilities (WTE-ACCs, Methanation Facilities, etc.) has normally been sold to local electric grid companies, but with power retail liberalization from 2000 to 2016 in Japan, the option for electricity business has been expanding such as competitive auction, LGU establishing their own electricity retail company, etc.

A series of power system reforms such as the full liberalization of power retailing and the establishment of wider grid organization has brought about reforms in handling the surplus of power in WTEs. In addition, by the renewable energy fixed price purchase system (Feed-in Tariff, FIT) was established in July 2012, combined with the effects of power retail liberalization, the sale of surplus electricity from WTEs has been a valuable source of revenue for the local areas where the WTEs are placed.

This section introduces the outline of power retail liberalization, FIT system, and the widening of power generation business in Japan that contributes to the stable supply of power. LGUs planning the development of a new WTE are encouraged to refer to the manual and the latest information provided by the government and make effective use of them in their planning.

1) Power Retail Sales Liberalization

Regarding power liberalization, after the special high voltage sector was deregulated in March 2000 by the revised Electricity Business Act, the high voltage sector was also gradually deregulated; and in April 2016, all fields were completely liberalized including low voltage sector for household. Electricity system reform in Japan is configured and planned with total 3 stages: the first stage established a wide area grid operation institutions (2015); the second stage was the full liberalization of electricity retailing business (2016), and in the third stage, the transmission and distribution division will be legally separated in 2020.

2) Feed-in Tariff (FIT) system

The FIT is a system under which the government promises that power companies purchase electric power generated by renewable energy source at a certain procurement price (FIT price) for procurement period. The purpose of the FIT scheme is to encourage the introduction of renewable energy, which currently has a high cost of electricity generation, by setting a favorable procurement power tariff against general electricity prices. The cost required to purchase power at the FIT price is covered by the renewable energy charge that the power consumers bear on the electricity charge.

Renewable energy power targeted for the FIT system are five types: solar, wind, mini-hydro, geothermal and biomass power generation; WTE-ACCs and methanation facilities fall under the category of biomass power generation (See Table 7-10).

Table 7-10 Procurement price and period for Waste to Energy Facilities (as of 2016)

Types of biomass	Examples of biomass	Procurement price Per 1kWh	Procurement period
Methanation gas (Biomass-derived)	Methane gas from sewerage, livestock manure, food residue and paper etc.	JPY39 + VAT (39 UScent)	For 20 years
General waste and other biomass	Pruned branches, wood waste, paper, food residue, waste cooking oil, black liquor	JPY17 + VAT (17 UScent)	

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

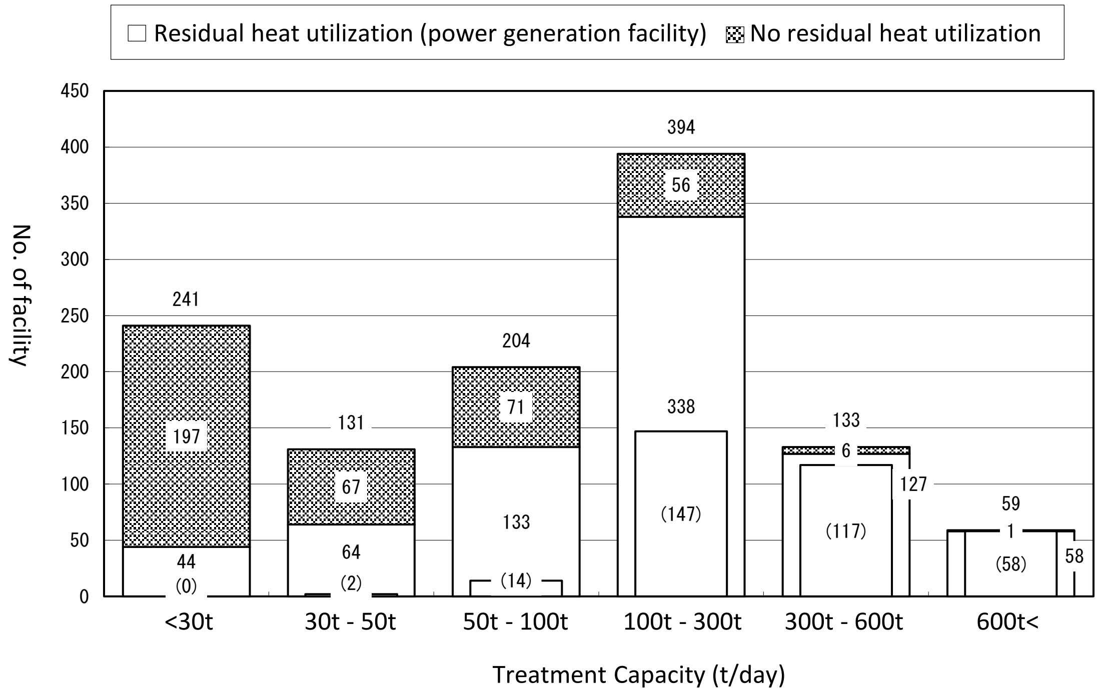
3) Stable supply by widening the WTE-ACCs networking

In terms of advanced utilization of waste energy obtained from MSW treatment, networking the multiple facilities and expanding the networking area are important issues to be considered in order to ensure stable supply to meet demand in addition to improving the efficiency of power generation of individual WTE-ACCs. Furthermore if MSW is considered as resource of a local area, then supplying electric power generated from WTE-ACCs to local community (Local consumption of locally produced low carbon waste energy) are also be paid attention in terms of political judgement and environmental education.

(1) Benefits of networking and widening the area of WTE-ACCs

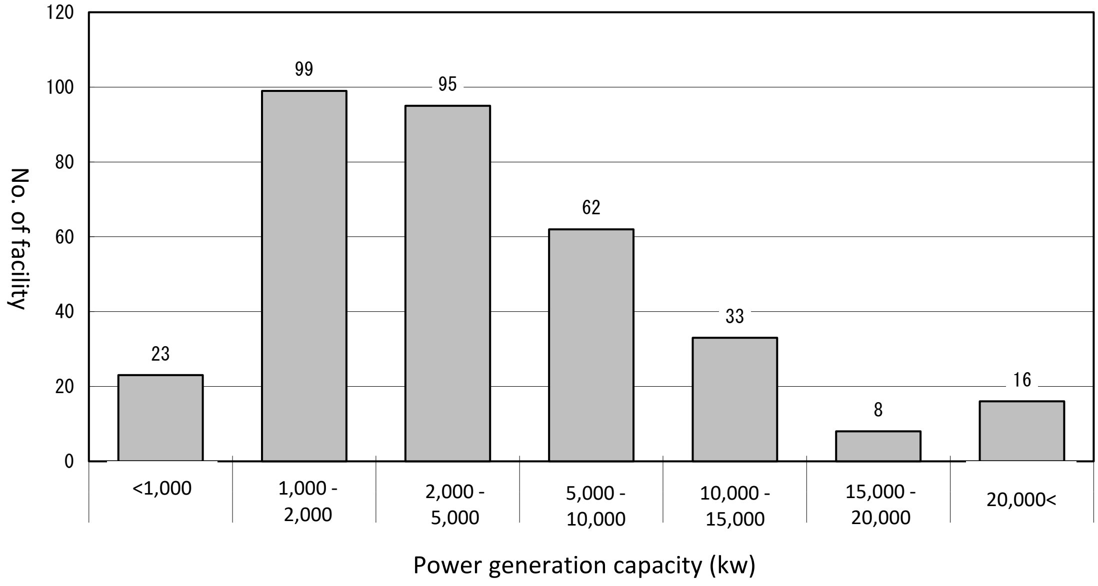
WTE-ACC that stably treats local MSW is considered as a stable power source comparable to other renewable energy source such as solar. On the other hand, there is also unavoidable temporary drop in the amount of power transmission due to unplanned shutdown caused by sudden mechanical failure, etc. In addition, in many cases, the size of the WTE-ACC is proportional to the population size of the city, therefore the power generation capacity of facilities located in small and medium cities in rural areas is relatively small, and there may be facilities that might not be able to supply stable surplus power. Figure 7-7 surplus heat usage by capacity of WTE-ACCs in Japan, and Figure 7-8 shows the number of WTE-ACCs by power generation capacity.

Therefore owing to the following points: i) the realization of stable power supply according to power demand (leveling and stabilization of surplus power), ii) responding to the same-time same-quantity system, and iii) power purchase restraint by inter-facility electricity interchange, the need for networking of power generation projects with multiple facilities and wide-area networking (widening) among different municipalities has been pointed out.



Source: Japan Waste Treatment 2014 (MOEJ, March 2016)

Figure 7-7 Situation of residual heat usage by waste incineration facilities (record of 2014)



Source: Japan Waste Treatment 2014 (MOEJ, March 2016)

Figure 7-8 Number of WTE-ACCs by power generation capacity (record of 2014)

(2) Case example of WTE-ACCs networking

As an example of networking WTE-ACCs utilizing liberalized retailer system in which LGs are involved, a case of Tokyo Eco Service Co., Ltd. is introduced.

Tokyo Eco Service Co., Ltd., established in October 2006 by joint investment of Clean Authority of Tokyo (A special purpose municipal body established by 23 Tokyo Metropolitan Cities in order to deal with joint intermediate treatment (hereinafter "CAT") and Tokyo Gas Co., Ltd., aims at the more efficient operation of the WTE-ACCs and the effective sales of surplus electricity.

Table 7-11 Profile of Tokyo Eco Service Co., Ltd.

Company name	Tokyo Eco Service Co., Ltd.
Establishment	October 24, 2006
Capital stock	200 million yen
Investment ratio	CAT 59.8% Tokyo Gas Co., Ltd. 40.2%
Business	Operation & Management for WTE-ACCs Electricity sales Consulting work pertaining to the Waste Treatment Staffing work Other related to the above

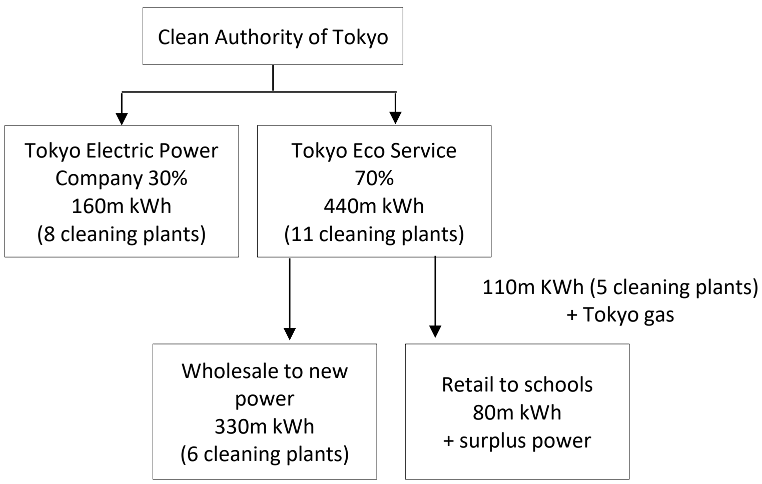
Source: Tokyo Eco Service Co., Ltd. webpage

Table 7-11 shows where the surplus electricity of CAT is sold to in 2015.

Out of total surplus electricity (600 million kWh/year) of CAT, CAT sold 70% (440 million kWh/year from 11 WTE-ACCs) to Tokyo Eco Service Co., Ltd. and the rest 30% (160 million kWh from 8 WTE-ACCs) to Tokyo Electric Power Company, Inc (Tepco). Tokyo Eco Service Co., Ltd. wholesales 70% of purchased power to the retailers, and retails another 30% to the consumers which are primary and secondary school in Tokyo 23 wards.

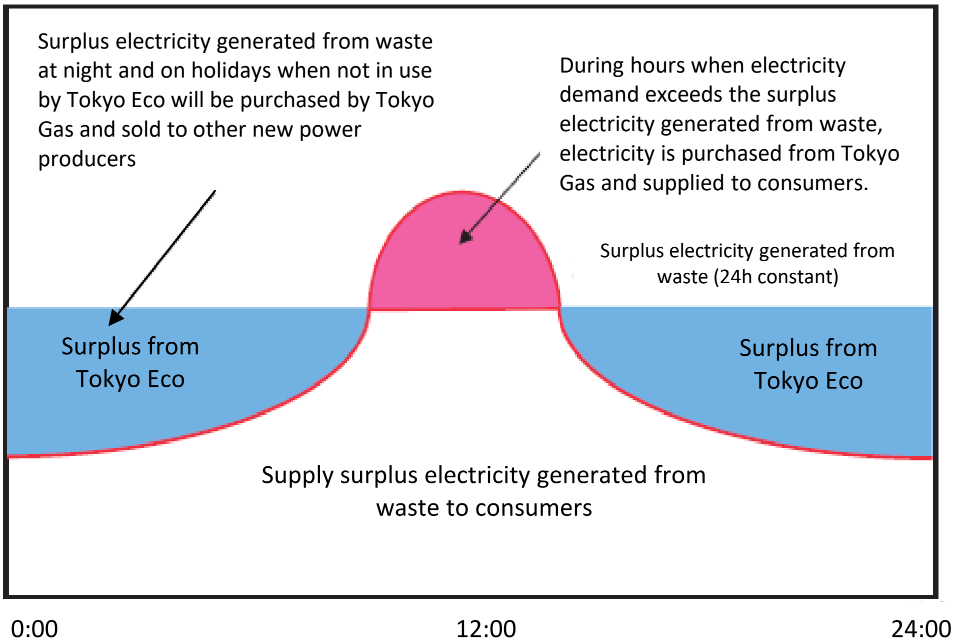
On the other hand, the power from the WTE-ACCs can be a base power which can be constant for 24 hours. Therefore, regarding the power supply and demand adjustment scheme in the retail power business at Tokyo Eco Service Co., Ltd., when electricity runs short during the daytime hours when electricity demand is high, they receive supply of supplemental electricity from a co-investor Tokyo Gas's power plant, and on the contrary, at night and on holidays, when surplus power is generated, surplus power is sold to Tokyo Gas Co., Ltd. to adjust the overall supply and demand in order to respond to the power demand. (See Figure 7-10)

Table 7-12 shows CO2 emission coefficients of Tokyo Eco Service Co., Ltd. and other electric companies. As at the end of September 2015, Tokyo Eco Service Co., Ltd. supplies power to 421 places (343 local elementary and junior high schools, 78 other facilities, 45,000 kW of contracted power), and they supply to about 30% of the municipal elementary and junior high schools in the 23 wards on a number basis. This can be referred as a form of local production for local consumption of biomass energy that supplies / returns power with low CO2 emissions to the area through a power retailing business that utilizes a low carbon energy power source that contains a large amount of biomass.



Source: 37th National Urban Cleaning Research and Conference Presentation 2016.1

Figure 7-9 Surplus power buyers of clean authority of Tokyo (2015)



Source: 37th National Urban cleaning Research and Conference Presentation 2016.1

Figure 7-10 Outline of power supply and demand of Tokyo Eco Service Co., Ltd.

Table 7-12 CO_2 emission coefficients by electric power company (record of 2014, announced October 2015)

Electrical Company name	Actual emission factor (t-CO_2 / kWh)	Adjusted emission factor (t-CO_2 / kWh)
Hokkaido Electric Power Co., Ltd.	0.000683	0.000688
Tohoku Electric Power Co., Ltd.	0.000571	0.000573
Tokyo Electric Power Co., Ltd.	0.000505	0.000496
Chubu Electric Power Co., Ltd.	0.000497	0.000494
Hokuriku Electric Power Co., Ltd.	0.000647	0.000640
Kansai Electric Power Co., Ltd.	0.000531	0.000523
Chugoku Electric Power Co., Ltd.	0.000706	0.000709
Shikoku Electric Power Co., Ltd.	0.000676	0.000688
Kyushu Electric Power Co., Ltd.	0.000584	0.000598
Okinawa Electric Power Co., Ltd.	0.000816	0.000816
Tokyo Eco Service Co., Ltd.	**0.000071**	**0.000149**

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

7.6 APPENDIX F: SAFETY MEASURES

1) Accident at WTFs

In WTFs, since the property of waste is not uniform and it is difficult to grasp all the contents, an unexpected accident may occur. In some cases, the accident might affect not only the facility but also the surrounding people and the environment.

(1) Occurrence conditions of the accident

The MOEJ summarized in March 2009 the accidents at WTFs across the country occurred from FY 2004 to FY 2007. According to this, among the WTFs, the occurrence of accidents in the bulky waste treatment facility is the largest, followed by those in waste incineration facility and in the recycling facility. In the bulky waste treatment facility, it is considered that explosives such as cylinders get mixed in the waste and the explosion or ignition is caused by the spark generated by the impact of the crusher. In addition, cotton-like combustibles generated from crushing are also estimated to cause fire. In the waste incineration facility, some kind of fire is carried in, and accidents such as burning up in the waste pit are reported. Table 7-13 shows the number of occupational accidents and property damage accidents by facilities.

Table 7-13 Number of occupational accidents and property damage accidents by facilities

Facility Types		Total No. of facilities (FY2007)	4 yrs (FY2004-FY2007)		
			Work-related injury or death	Property damage incidents	Total
Waste incineration facility	Conventional incineration facility	1,285	248	130	378
	Gasification pyrolysis melting furnace		21	34	55
Recycling facility	Recycling facility	1,211	97	11	108
	RDF producing facility etc		6	13	19
Oversize waste treatment facility		676	150	324	474
Sewage treatment facility	Sludge reclamation treatment facility	1,041	11	5	16
	Sewage treatment facility		23	10	33
Final disposal site		1,831	12	20	32
Total		6,044	568	547	1,115

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

Note: If the explosion causes damage to the facility as well as injuries to the workers, it was counted as both a property damage incident and a work-related injury or death.
Personal injury in the collection works covers accidents with four or more days of absence from work, and although many reports were received on fires and traffic accidents, these were not included in the total.
The number of questionnaires sent to LGUs via prefectures was 2,454 and the number of responses by mail or e-mail was 1,352, for a collection rate of 55.1%.

(2) Example of accidents

Examples of serious personal injury accidents in WTFs include i) burns from hot ash, hot water, etc., ii) caught in machines, iii) fall from a high place, and iv) lack of oxygen. In terms of the number of incidents, there are many accidents involving cuts, flying objects and falls.

Specific examples of recent accidents at WTE-ACCs are shown in Table 7-14 .

Table 7-14 Accident in WTE-ACC

Type of accident	Status of accident
Fall	While moving during inspection work around the furnace, a worker fell through a machine hatch that had been opened for the work to the first floor, 5 meters below.
Flying objects	A clinker (a lump of ash with a diameter of about 30 cm) near the spraying nozzle at the top of the cooling tower fell on the worker's back while he was making a hole in the ash accumulated in the refuse hopper at the incineration plant.
Tumbling	While working with a 10-ton truck and a vacuum truck to lift sludge from a sludge storage tank at a drainage facility, he was injured when he fell.
Entanglement	While opening the inspection port of the molten fly ash conveyor to check the status of the molten fly ash, he dropped the measuring cup he was holding for ash sampling into the conveyor. When he quickly tried to remove it, his right arm was caught in the conveyor.
Lack of oxygen	During the construction of the facility, a subcontractor went under the floor to check on the completion and cleaning of the water piping for firefighting and the first person collapsed. After the first person collapsed, the second person also went under the floor to check on the situation and collapsed. A nearby worker noticed the abnormality and used a work fan to ventilate the subfloor.
Pinch	At around midnight, the tension of the conveyor chain was adjusted and he was caught between the flight and the padding plate when he tried to check the tension during the inspection.
Cut	A worker received instructions for inspection by radio communication, but misheard them and went to another piece of equipment. He thought he had stopped the gas-cooled rotary valve of the fly ash conveyor system of the other equipment, but he had not, and the tips of the three fingers of his right hand, which he inserted through the inspection port, were cut off.
Burn	When the worker noticed water leaking from the inspection port at the bottom of the gas cooling tower, he opened the door of the lower inspection port and found ashes had accumulated, so he scraped them out with an iron bar. When he opened the door of the upper inspection port and was scraping out the ashes, he was exposed to boiling water that came out of the inspection port and was burned on his hands and feet.

Source: Planning and Design Guidelines for WTF Development (2017, JWMA)

2) Facility Safety Measures

Accidents are said to occur due to the combination of "insecure state of equipment" and "insecure behavior of people". In the development of a waste treatment facility, we must first work to eliminate the "equipment" factor. Specifically, it is to carry out "fail-safe" and "fool-proof" of equipment.

"Fail-safe" refers to "a mechanism or structure that ensures a safe state even if the equipment fails." For example, redundant design such as having a spare unit for major equipment or turning off the power at the time of failure of the equipment. “Fool proofing” is "a mechanism or systems that does not cause an accident even if a person makes a mistake in operation". A good example of fool-proofing is the mechanism that stops the machine when you try to open the lid of the washing machine spinner in rotation and put your hand inside. In addition, there is also "defense of equipment" to make equipment intrinsically safe. Specific examples of "defense of equipment" include a cover of a coupling that connects a pump and a motor, and a safety net of a crane gear.

Along with the improvement of the unsafe condition of the facilities, there are also cases where measures are taken from the viewpoint of "human defense"; if it is difficult to secure defense of equipment, measures will be taken to protect people. "Human defense" refers to so-called protective equipment such as helmets, safety belts, or dust masks.

Specific safety measures in gasification melting facilities, incineration residue melting facilities, waste crushing and sorting facilities, waste fueling facilities, waste high-speed composting facilities, etc. are described in each chapter as safety measures for each facility. It is necessary to carry out construction that makes use of past lessons at the time of implementation design and construction, along with securely executing those safety measures, since information such as accident cases of waste treatment facilities throughout the country can be obtained relatively easily via the Internet.

The laws and regulations pertaining to safety measures regarding the construction and operation of waste treatment facilities, and notifications include the following.

a. Occupational Safety and Health Act (1972 .6.8 Law No. 57)
b. Labor Safety and Health Act Enforcement Order (1972 .8.19 Decree No. 318)
c. Occupational Safety and Health Regulations (1972 .9.30 Ministry of Labor Ordinance No. 32)
d. Crane Safety Regulations (1972 .9.30 Ministry of Labor Ordinance No. 34)
e. Boilers and pressure vessels safety regulations (1972 .9.30 Labor Ordinance No. 33)
f. Prevention Regulations against Hypoxia (1972 .9.30 Labor Ordinance No. 42)
g. About the improvement of the occupational safety and health measures in the waste disposal business (1982.8.26 notice No. 123, Ministry of Health and Welfare, Health and Sanitation Bureau, Ministry of Health

and Welfare, Water Environment Department, Environmental Improvement Division manager)

h. About reinforcement of occupational safety and health measures in waste disposal business (1993.3.2 Notice No. 56 Ministry of Health and Welfare life Health Water Environment Department, Environmental Improvement Division)
i. About prevention of labor accident in cleaning business (1993.3.2 123rd notice of the Ministry of Labor) and supplement "Safety and health management outline in cleaning business" after revision.
j. About thorough prevention measures against explosion in waste disposal business (1995.9.25 Notice No. 201 Ministry of Health and Welfare, Ministry of Health and Welfare, Bureau of Health and Environment, Water Environment Department Environmental Management Division)
k. About measures of dioxins in refuse incineration facility (1998.7.21 Notice No. 18, Ministry of Labor Labor Standards Bureau Safety and Health Division)
l. About prevention measures for dioxins exposure in work in waste incineration facility (2001.4.25 Notice No. 183 Ministry of the Environment Minister's Secretariat, Waste Management and Recycling Department Waste Management Division) and another served as an attachment "waste dioxin exposure prevention guidelines in things incineration facility in the work."

In addition, if necessary, specific chemical substance hazard prevention regulations (1972.9.30 Ministry of Labor Ordinance No. 39) shall be taken to prevent occupational accidents.

3) Formulating Accident Response Manual

(1) Accident response manual

In recent years, waste treatment facilities are strongly required to realize safe and secure operation both from environmental measures and from accident measures. With regard to environmental measures, the strengthening of laws and regulations and the technological improvement of facilities themselves have progressed, achieving higher than a certain level. However, once a serious accident occurs, the organization not only suffers great human and material damage, its social responsibility is also strongly questioned. In waste treatment facilities, there have been some accidents that have had a great social impact, and facilities that cannot ensure the safety of facility operation may cause difficulties in the survival of the facilities themselves.

Against this background, due to the amendments to the Waste Disposal Act in April 2004, Article 21 (2) of the Act stipulates that when a waste treatment facility causes or is likely to cause a hindrance to the preservation of the living environment, the situation of the accident should be promptly reported to the prefectural governor.

The Ministry of the Environment compiled the “Waste treatment facility accident response manual preparation guidelines” (hereinafter referred to as “the guidelines”) in 2006 following the revision of the law in the preceding paragraph. The guidelines presume an accident that might occur in the waste treatment facility and take basic directions for preparation of a manual such as appropriate preventive measures and measures for the accident, reporting to relevant organizations, and post-accident response.

Table 7-15 **Error! Reference source not found.**shows the provisions of Article 21 (2) of the Waste Disposal Act, and Table 7-16 shows the items to be determined in the accident response manual.

(2) Accident response manual and crisis management and safety assessment

It has been mentioned earlier that it is expected that serious accidents may occur and if the response is incorrect it will be difficult for the facility itself to survive. The guidelines indicate that the current accident response also requires response from the perspective of "crisis management".

In waste treatment facilities, unexpected accidents may occur from handling waste whose property and shape are not constant. In safety measures, it is generally important to predict in advance the accident and risk and take measures in advance, that is, "safety assessment". The guidelines call for “presuming possible accidents” as well as post-accident responses. Waste treatment facilities have experienced various accidents so far and using those experiences to predict possible accidents and hazards is an effective way to establish safe facility operation.

The main point of accident prevention is to assume a possible accident and reflect it on the facility construction and facility maintenance and to establish and maintain the action standard for securing the safe behavior of people in the operation of the facility.

Table 7-15 Provisions of Article 21-2 of the Waste Disposal Act

<Item 2, Article 21> The establisher of a general waste treatment facility or an industrial waste treatment facility specified by a Cabinet Order (hereinafter referred to as a "specified treatment facility" in this paragraph) shall, when damage or any other accident has occurred at said specified treatment facility and the general waste or industrial waste to be treated at said specified treatment facility, or the sewage or gas generated by the treatment of said general waste or industrial waste, has been dispersed, spilled, permeated into the ground, or scattered, and hinders or is likely to hinder the preservation of the living environment, immediately remove the hindrance or take emergency measures to prevent its occurrence, and promptly notify the prefectural governor of the status of the accident and the outline of the measures taken. 2 The prefectural governor may, when he/she finds that the person prescribed in the preceding paragraph has not taken emergency measures prescribed in the same paragraph, order that person to take emergency measures.

Table 7-16 Items to be determined in the accident response manual

1. Basic Items in Accident Response Manual
   - ✓ Objectives of manual, scope of application, definition of terms etc.
   - ✓ General action procedure in occurrence of accident
   - ✓ Structure of manual
2. Responsible System for Responding to Accidents
   - ✓ Basic flow of accident response
   - ✓ Phase of accident and response criteria
   - ✓ Accident response system, and each roles, responsibilities, and authority
   - ✓ Emergency contact network
3. What to Do When an Accident Occurs
   - ✓ Classification and organization of possible accidents
   - ✓ Basic items regarding report types and its timing
   - ✓ Response according to the type of accident
4. What to Do After an Accident
   - ✓ Investigation methods for determining the cause of the accident
   - ✓ How to consider measures to prevent recurrence
   - ✓ Survey items of the surrounding environment
   - ✓ How to record the accident
   - ✓ How to deal with local residents and the media
5. Education/Training
   - ✓ Objectives of education and training, scope of application etc.
   - ✓ Education/Training plan
   - ✓ Record of education/training
   - ✓ Evaluation method of education/training
6. Review of Manual
   - ✓ Approach to manual review
   - ✓ Responsible system of manual review, timing of review
7. Other Necessary Items
   - ✓ Necessary documents (list of disaster prevention equipment, list of documents and drawings, list of gas used and chemicals, evacuation route map, etc.)

7.7 APPENDIX G: RESPONSIVENESS TO DISASTER WASTE

The Philippines' geographical location on the "Pacific Ring of Fire" and along the Pacific typhoon belt makes the country prone to many forms of natural disasters such as typhoons, earthquakes, floods, volcanic eruptions, landslides, and fires.
Typhoon Haiyan/Yolanda in 2013, along with about 6,300 deaths, initially 3,631, (28,688 people had severe/minor injuries, 1,062 went missing, 16,078,181 were affected and 5,130,580 were forced to evacuate), generated 19 million tons of waste and required additional budgetary arrangement of USD301 million and foreign support, including the removal of debris by UN volunteers.

According to "Disaster Waste Management (DWM) in the Philippines" (2021, Maria Antonia N. Tanchuling, UP Diliman, jsmcwm.or.jp), waste management in the event of such a catastrophic disaster in the Philippines suggests that emergency waste is not separated and that most cities do not have pre-designated temporary storage for disaster waste. Therefore, there is an urgent need to "establish a disaster waste management economic plan that minimizes health and environmental risks."

This Appendix provides information on the handling of disaster waste for future waste treatment plans in the Philippines by giving an overview of disaster waste treatment in Japan.

In Japan, Provinces and LGs need to formulate a disaster waste treatment plan based on national disaster prevention work plan, the provincial regional disaster prevention plan, and the local disaster prevention plan based on Disaster Countermeasures Basic Act.
The disaster waste treatment plan prepared by the provinces and LGs needs to include disaster prevention, emergency measures to dispose disaster waste properly and quickly (including waste from evacuation centers), and recovery measures.
The points to be noted regarding maintenance of WTFs are shown as follows;

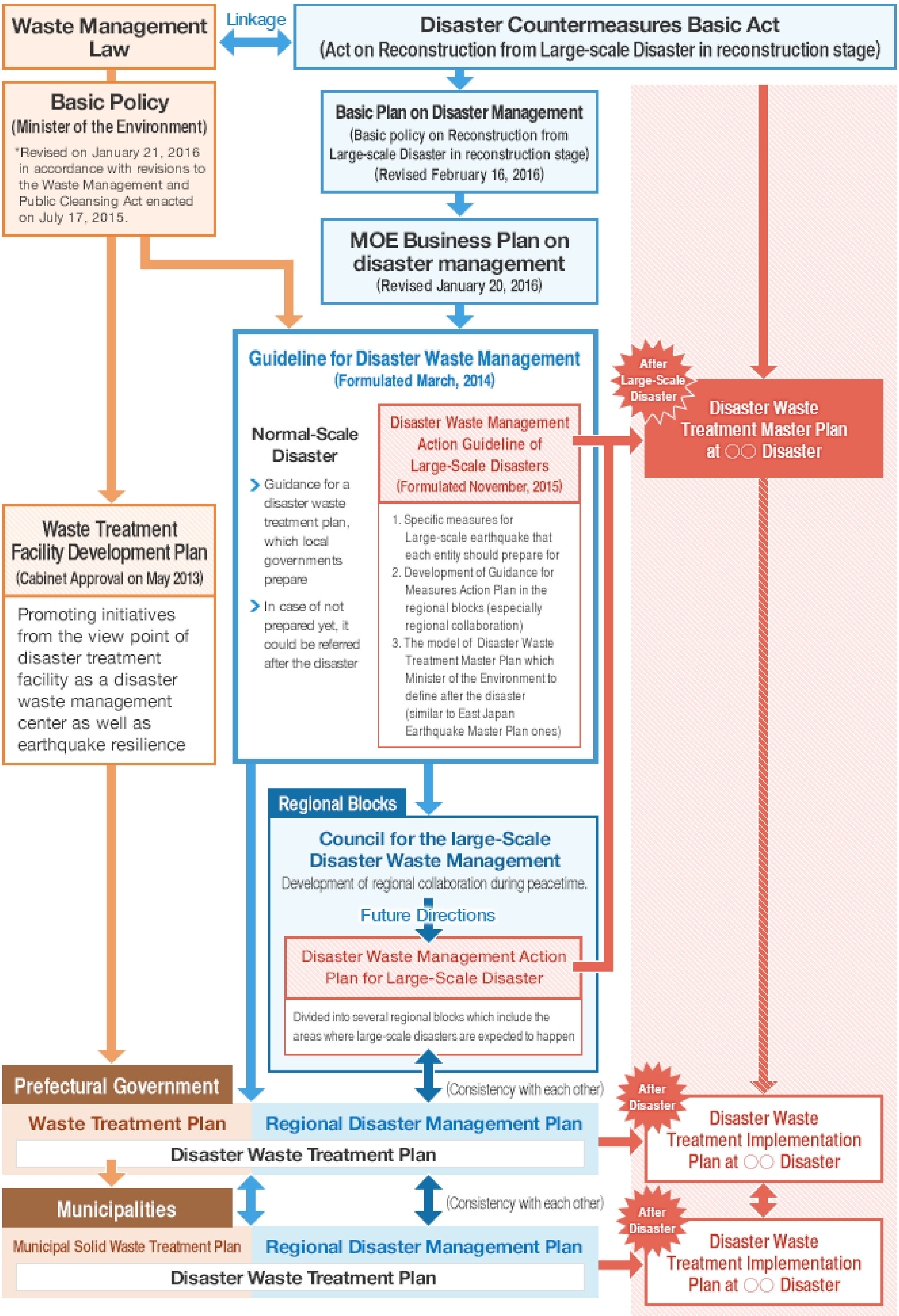
1) Positioning of disaster waste treatment plan

(1) Overview

In the past, treatment of wastes generated by disasters (hereinafter referred to as "disaster wastes") has been mainly conducted by LGs where disasters have occurred and has been treated based on the Waste Disposal Act. However, due to the experience of the Great East Japan Earthquake in 2011 and recent disasters, preparedness and measures became necessary to ensure smooth and prompt processing even in the event of a large-scale disaster while ensuring proper handling, and the Waste Disposal and Cleaning Act, and the Revised Disaster Countermeasures Basic Act (hereinafter referred to as "revised law") were enacted as of August 6, 2015.
This revised law requires that **<u>measures for waste treatment at the time of disaster be incorporated into the provincial MSW management plan and LG's MSW management master plan, and a seamless response is required</u>** from preparation for peacetime to measures for large-scale disasters.

(2) The relation between regional disaster prevention plan and MSW Management Master Plan

With the Disaster Countermeasures Basic Act as the background, provinces and LGs need to formulate regional disaster prevention plan and disaster waste treatment plan based on the national disaster prevention basic plan, the MOEJ disaster prevention work plan, and the disaster waste management guidelines as shown in Figure 7-11
Regional disaster prevention plans and disaster waste treatment plans created by provinces, and those created by LGs need to be coordinated so that there is no contradiction between them.
MOEJ formulated "Disaster Waste Management Action Guideline of Large-Scale Disaster" on November 16, 2015 in order to further promote disaster waste treatment measures at the time of a large-scale disaster. With the lessons learned from the Great East Japan Earthquake and relative large-scale disasters that occurred in recent years as well as the measures taken since then, the action guideline clarify the roles and responsibilities that stakeholders involved in disaster waste treatment should take during a large-scaled disaster, and by establishing a system of collaboration and cooperation among stakeholders, it aims to achieve "Response by all Japan."



Source: Disaster waste action guidelines for large-scale disaster occurrence (November 2015, MOEJ, Minister's Secretariat, Waste and Recycling Measures Department)[46]

Figure 7-11 Diagram of Planning and Guidelines related to Waste Treatment Measures in Case of Disasters

[46] http://kouikishori.env.go.jp/en/relationship_diagram/

(3) Roles of LGs in disaster waste treatment

LGs are the main in-charge of disaster waste treatment and must act in coordination with the disaster waste treatment plans formulated by provincial governments and must formulate a highly effective disaster waste treatment plan before the disaster. Depending on the scale of the disaster, affected LGs may not be able to handle the disaster waste alone, so it is necessary to establish a good cooperative relationship with provinces, other LGs, local businesses, etc. and to actively improve the ability to cope with disasters before the disaster. After the disaster, priority should be given to maintaining the health of local residents and preserving the living environment. Depending on the size of the disaster, it is required to make maximum use of advance preparation and handle disaster waste in accordance with the national treatment guidelines and provincial action plans.

In past disaster waste treatment cases, the role of private enterprise groups such as construction companies, dismantling companies, industrial waste processing companies is large, so they should consider signing agreement for support during peacetime. The LGs that support the affected areas should clarify the supportable contents and communication methods regarding disaster waste treatment, and at the time of disaster, communicate with the affected areas, and provide manpower and physical support. There are cases provincial government may carry out disaster waste treatment in response to administrative subcontracting and alternative execution of administrative work from LGs.

Installation of materials necessary for repair and equipment, and stocking of items necessary for reoperation such as heavy machineries, generators, fuels, chemicals, etc. should be carried out in order to cope with cases where LGs' WTFs such as WTE-ACCs, Sewage Treatment Plants, and Sanitary Landfills are damaged. While predicting the content and the extent of the disaster in advance and creating an inspection guide to repair, each facility should establish a communication and cooperation system with the planned repair companies in preparation for inspection and repair.

2) Measures for disaster waste at the time of a huge disaster occurrence

The Nankai Trough Giant Earthquake and the Tokyo Metropolitan Earthquake, which are expected to occur in the future, are expected to generate more than the amount of disaster waste generated by the Great East Japan Earthquake, so only ordinary measures based on provincial and Local Governments cannot sufficiently cope with such massive disasters.

"Disaster Waste Management Guidelines (MOEJ, Mar2014)" intends for the support of the formulation of disposal plans for disaster waste in province and LGs. Although the basic content of the measures is covered, it might not be sufficient for great disasters that requires a wide-area response beyond provincial level.

After the Great East Japan Earthquake, various laws have been enacted such as the Basic Law on Strengthening the National Land (December 11, 2013, Law No. 95 in the National Assembly) and the National Land Resilience Policy Charter (December 17, 2013) was compiled in the government, which positioned disaster waste measures as an important issue.

When a huge disaster occurs, "a situation where recovery and reconstruction will be delayed significantly due to stagnant disposal of enormously generated disaster waste" must be avoided, so it is necessary to prepare in advance.

Based on these, the outline is shown below based on the guidelines of disaster waste measures at the time of a huge disaster occurrence in reference to the 'Grand Design of Disaster Waste Measures at the time of a huge Disaster Occurrence' (Ministry of Environment, disaster waste measures study committee at the time of a huge earthquake occurrence, March 2014).

(1) Ensuring smooth treatment of large amount of disaster waste

In order to reduce the temporary load of the WTFs (shredding and sorting facility, WTE-ACCs, Sanitary Landfills), and to treat large amount of disaster waste smoothly, temporary storage facilities should be established, and the thorough separation and recycling of disaster waste should be promoted.

It is extremely difficult to secure a sufficient final treatment capacity especially in the case of a huge disaster, so in order to reduce this as much as possible, thorough separation and recycling is the key. In addition since it will take more labor and time to sort out the disaster waste that has been mixed at the stage of dismantling and removal towards the temporary storage site later. From the viewpoint of speedy disposal, it is important to make sure that separating is done with recycling in mind as early as possible.

Existing WTFs should be restored early and operate to receive disaster waste as soon as possible, however in case the existing WTFs cannot handle the disaster waste, then the installation of temporary treatment facilities

(crushing and incineration) and the securing of the final disposal site should be carried out. At the same time, by establishing a cooperative system within the regional block, disaster waste disposal will be carried out within the block.
Furthermore, if treatment within a regional block is difficult, wide area treatment beyond the regional block should be carried out. It is important to deepen the public's understanding of the necessity of disaster waste measures to facilitate disaster waste treatment.

In order to secure a robust waste disposal system in preparation for the occurrence of a huge disaster, the disaster response capabilities of WTE-ACCs and Sanitary Landfills, which will be bases in regional blocks, should be strengthened to ensure the alternativeness and multiplicity of treatment and the robustness of the treatment facilities as disaster prevention bases.

(2) Securing backup functions with large-scale disasters in mind

Based on the lessons of the Great East Japan Earthquake, back-up functions should be secured such as infrastructure function, administrative function, and supply system of materials and equipment with large-scale wide area disaster in mind.

(i) Securing backup system in preparation for infrastructure outages

With the WTFs becoming base, secure alternative means and backup functions such as stockpiling in preparation for stopping supply of electricity, fuel, water, and supply chain of equipment when the lifeline function such as electricity and gas is interrupted and transportation network is cut off.

(ii) Securing a backup system for administrative functions

With a large-scale disaster in mind, work with relevant ministries, organizations, and private sector to standardize on arrangements for multi-faceted measures in advance and for work related to wide-area support. In the event that staff, facilities, etc. of LGs are injured and damaged, secure alternative bases so that the central functions of LGs are not lost.

(iii) Securing the supply system of vehicles, temporary treatment facilities and machinery

Confirm the supply system of private business operators who supply vehicles, heavy equipment, temporary processing facilities, materials and equipment necessary for disaster waste disposal and the impact of disasters, and secure a supply system that can be backed up in the event of a disaster even if the supplier is affected.
If it is expected that the rapid increase in demand will make it difficult to secure vehicles, heavy equipment, temporary processing facilities, and materials and equipment nationwide, consider measures including procurement from overseas.

3) Application for financial subsidy

The generation of disaster waste and damage to WTFs have a serious impact on the stability of people's lives and socioeconomics, and it is the responsibility of the government to reverse the disaster effect as soon as possible. However, the costs involved are enormous and often exceed the financial capacity of the LG. Therefore the MOEJ provides financial support in the form of Waste Treatment and Disaster Recovery Projects, and aims for early recovery from disasters.

The details for how to apply for disaster waste treatment project expenses and WTF disaster recovery project expenses, and other know-how are described in "Manual for Administrative Work in Disaster (for use of LG in-charge)" (MOEJ, June 2014). With reference to the manual, this paper describes the outlines of "Financial Support for Disaster Waste Treatment Expenses" regarding the expense for LGs to collect, transport, and treat disaster wastes, and "Financial Support for WTF Recovery" regarding restoring WTFs affected by the disaster.

(1) Disaster waste treatment project

The financial subsidy of disaster waste treatment is a project to financially support the affected LGs in terms of the costs related to the treatment of disaster wastes due to storms, floods, storm surges, earthquakes, and other unusual natural phenomena and the large amounts of wastes deposited on the coast outside the coastal protection area, etc. The outline is shown below.

Table 7-17 Outline of disaster waste treatment projects

a. Business entities	LGs (including some administrative unions, regional alliances and special wards)
b. Target project	Project pertaining to the collection, transportation and disposal of waste that is particularly required for the maintenance of living environment, and collection, transportation and disposal of sewage that has flowed into the toilet tank due to disaster that LGs carry out due to disasters or other reasons. Particularly projects related to collection, transport and treatment of human waste from temporary toilets and group shelters.
c. Subsidy rate	1/2
d. Basis for Support	Waste Disposal and Cleaning Law (1970 Act No. 137) Article 22 The State, as stipulated by Cabinet Order, may assist the municipalities with some of the costs required to dispose of waste, which has become particularly necessary due to disasters and other reasons. Law Enforcement Order on Waste Disposal and Cleaning (1971 Ordinance No. 300) Article 25 Subsidies of the state to the municipalities under the provisions of Article 22 of the Act shall be made within a half of the expenses required for the treatment of wastes which were required particularly by disasters and other reasons.
e. Others	Measures will be taken for the special grant tax up to 80% for the local expenses (subsidy) of this subsidy, and the burden on LG will be around 10%.

(2) WTF disaster recovery project

This is a project related to restoring the WTF damaged by the disaster to its original form. The outline is shown as below.

Table 7-18 Outline of WTF disaster recovery project

a. Business entities	LGs (including provinces, municipalities, special wards, some administrative unions, wide-area alliances), waste treatment centers, PFI selected companies, wide-area waterfront environment improvement centers, Japan environmental safety business corporation
b. Target project	Project to restore WTF damaged by disaster to original form, and emergency restoration project
c. Subsidy rate	1/2
d. Support basis	Budget Assistance The Act on Special Financial Assistance and Subsidies to Address the Great East Japan Earthquake" (Law No. 40, 2011)
e. Others	General allocation tax measures for principal and interest repayment money (47.5% of principal and interest redemption money (up to 85.5% by financial strength correction)) if debt issue measures are taken for the local share

4) Business continuity plan (BCP)

(1) BCP Overview

A. The need for formulating a BCP

BCP is a strategy of business and crisis management to protect organization from the damage to customers and the resulting loss of reputation and trust in the organization that would result from an interruption of business in the event of a natural disaster by not interrupting important operations, and even if there is an interruption, resuming operations as quickly as possible.

"National land resilience" is one of the important policies of the government, and is based on the "Basic Act on Land Revitalization that Contributes to Disaster Prevention and Mitigation to Realize a Strong and Flexible National Life" (hereinafter referred to as "Basic Act") which was enacted in December 2013 based on the lessons learned from the Great East Japan Earthquake. In response to the establishment of the Basic Act, the government made a cabinet decision on the "Basic Plan for Strengthening National Land" (hereinafter referred to as “Basic Plan”) in June 2014, and also published the "National Land Revitalization Regional Planning Guidelines" (hereinafter referred to as “Guideline”) to guide prefectures and municipalities to formulate plans to strengthen national land.

An action plan of national resilience is published annually, and in the action plan BCP is adopted in many KPI (Key Performance Indicator) of vulnerability assessment. In the plan published in 2015, the "standby rate at disaster for incineration facilities" will be "50%" in 2018.

(2) Characteristics of BCP in general waste incineration facilities

While BCPs of private companies are often formulated with the aim of resuming normal operations as soon as possible, BCP of administrative organizations (LGs) are often formulated with the purpose of “starting disaster-specific operations, which does not take place during usual operation (for example, setting up shelters, treatment of disaster waste, etc.) as soon as possible.

WTE-ACC has a characteristics that, although it is a division in an administrative organization, it is required to resume normal work (waste incineration) as soon as possible, instead of interrupting normal work and performing specific work during disasters. As such, the BCP of WTE-ACC needs to be grasped from the idea similar to BCP of a private company with a factory.

Incineration facilities that will treat disaster waste are expected to be put into operation early after the disaster, thus it is necessary to secure business resources such as fuel, electricity, water, chemicals and materials in addition to human resources.

BCP is then understood as a method (preparation) for that purpose, and should be prepared in each individual facility, and the items should be organized well before the disaster.

(3) Expected issues and points of BCP

If no measures in normal times are taken and response come only after a large-scale disaster occurs, it will be difficult to respond promptly. Therefore, it is the biggest feature of BCP that makes it possible to restart immediately after the occurrence of a disaster by assuming the problems that occur when a large-scale disaster occurs and taking measures against it well before a disaster.

The BCP of a WTE-ACC aims to grasp the issues for resuming incineration by the target recovery time, and to organize measures to solve problems if any. The resumption of incineration means making the whole facility function almost like normal, so in considering a BCP, it is important to understand what processes are used in normal business operations and what business resources are required in each process.

Specifically, i) organize regular work according to the implementation process (1. starting-up preparation, 2. reception and weighing, 3. input and storage of waste, 4. waste supply (cranes, etc.), 5. Incineration and air supply, 6. Exhaust gas emission (chimney), 7. Ash removal, 8. waste water treatment), ii) have a “Target Start Time” for each process with the assumption that a post-disaster target recovery time (resumption of incineration) of the facility has been secured, iii) list up "business resources" necessary for the implementation of each task (people, buildings, goods (facilities, equipment, tools, raw materials, fuel, chemicals, infrastructure and lifeline, system data, internal and external coordination and correspondence)), and iv) evaluate the corresponding priority of each business resource, create a list of countermeasures (alternative measures) organized according to business resource categories, focusing on those that may not be secured at the time of the disaster, and it is important to consider these measures well before the disaster.

In line with this, “disaster response work”, which occurs only at the time of disaster, is also an important matter in order to reliably resume incineration by the target recovery time, so it will be necessary to check if there are any issues or problems in the implementation. The contents of the disaster response work include the following.

1. Emergency stop of the facility,
2. Confirmation of staff safety,
3. Confirmation of facility damage,
4. Confirmation of restoration time with lifeline business operators,
5. Confirmation of supply time with equipment providers,
6. Coordination with disaster response headquarters,
7. Examination of operation policy,
8. Response to inquiries from citizens