ADB-KSP Join Consulting

Waste-to-fuel history and implementation in Korea

Global Transport Academy
Korea Transport Institute

Knowledge Sharing Program

MINISTRY OF STRATEGY AND FINANCE

ADB

Korea Eximbank

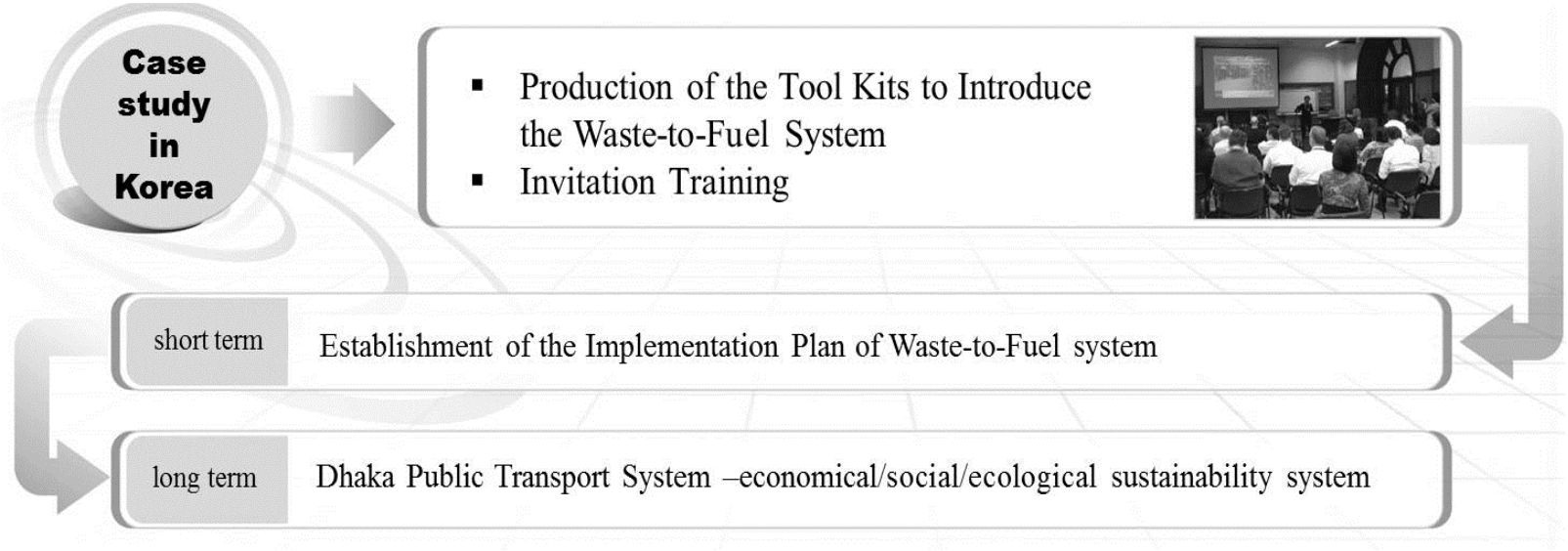
CONTENTS

I

Introduction of Project

1. Project Overview

Name	**Support for the establishment of waste-to-fuel technology in the transport sector in Bangladesh**
Implemented by	The government of Republic of Korea and The Export–Import Bank of Korea
Features	A joint consulting project with Asian Development Bank (ADB) as a part of the Knowledge Sharing Program (KSP)



2. Project Contents

- Analysis of the public transport system of Dhaka
- The case study of the waste-to-fuel system in Wonju city and finding implications
- The production of the introduction tool kits for the construction of a waste-to-fuel system
- Workshops for performance improvement
- Establishment of the implementation plan of a waste-to-fuel project

3. Waste-to-fuel System in Korea

Introduce Waste-to Fuel system in Korea

Case Study of The Waste-to-fuel system in Wonju

- Focus on : Basic information, Project costs including fixed and operating expenses, Financial structure analysis, Operating method and status, Success factors of the establishment and operation of the system, Development and improvement directions
- The system diagram, photos and video materials of the system are produced to ensure more effective understanding.

Ⅱ Waste-to-Fuel Technology

1. Comparison of organic waste treatment technology

Criteria	Principle	Economics
Waste-to-fuel	Technology that adds an adjuvant or employs the drying process to use the calorific potential of organic wastes and convert it into a fuel product	· While construction and installation costs are cheap, the use of calorific adjuvant and additives results in slightly high operation cost · If no markets are found for the fuel product, it is considered waste requiring additional treatment cost
Anaerobic digestion	Technology that breaks down biodegradable organic matters in organic waste under stable anaerobic conditions	· High initial installation cost but requires not much power; produced gas can be used as fuel to bring down the operation cost
Composting	Technology that stably decomposes the biologically decomposable organic matters in organic waste under aerobic condition	· Installation cost of 80 million won/ton for a treatment facility with a capacity of 30 tons under automated system · Installation cost of 50 million won/ton to treat 30 tons using the existing food waste-to-resource and reduction facility · Lower installation and operating costs compared to other treatment methods
Incineration	Technology that reduces the volume, detoxifies and stabilizes by combusting combustible components in organic waste during a short period	· High installation and treatment costs as an integrated treatment facility encompassing an incinerator, construction, and civil engineering · Costs to treat odor near the insert hopper and dryer and to treat incinerated ash · Increased operation costs due to the use of supplementary fuel to secure heating source
Carbonization	Technology where organic waste is heated in a no or low oxygen environment to produce water and flammable gas, leading to pyrolysis that leaves carbonized inorganic matters behind	· Drying and decomposition using the cracked gas of the carbonization facility are possible · Costs for the facility to prevent secondary pollution · High installation costs as an integrated treatment facility
Solidification	Technology where a physical barrier is created around a single unit with high structural strength to trap organic waste and minimize the likelihood of harmful pollutants to dissolve	· Low initial investment costs compared to other technology · Increased operation costs due to the frequent use of chemicals · When unable to be used as a landfill cover material, additional costs incur since waste treatment is required

Source: Sudokwon Landfill Site Management Corporation. (December, 2005). A Study on the Improvement of Organic Sludge Treatment Systems. *Sudokwon Landfill Site Management Corporation*, p406.

2. Utilization of natural gas in advanced countries

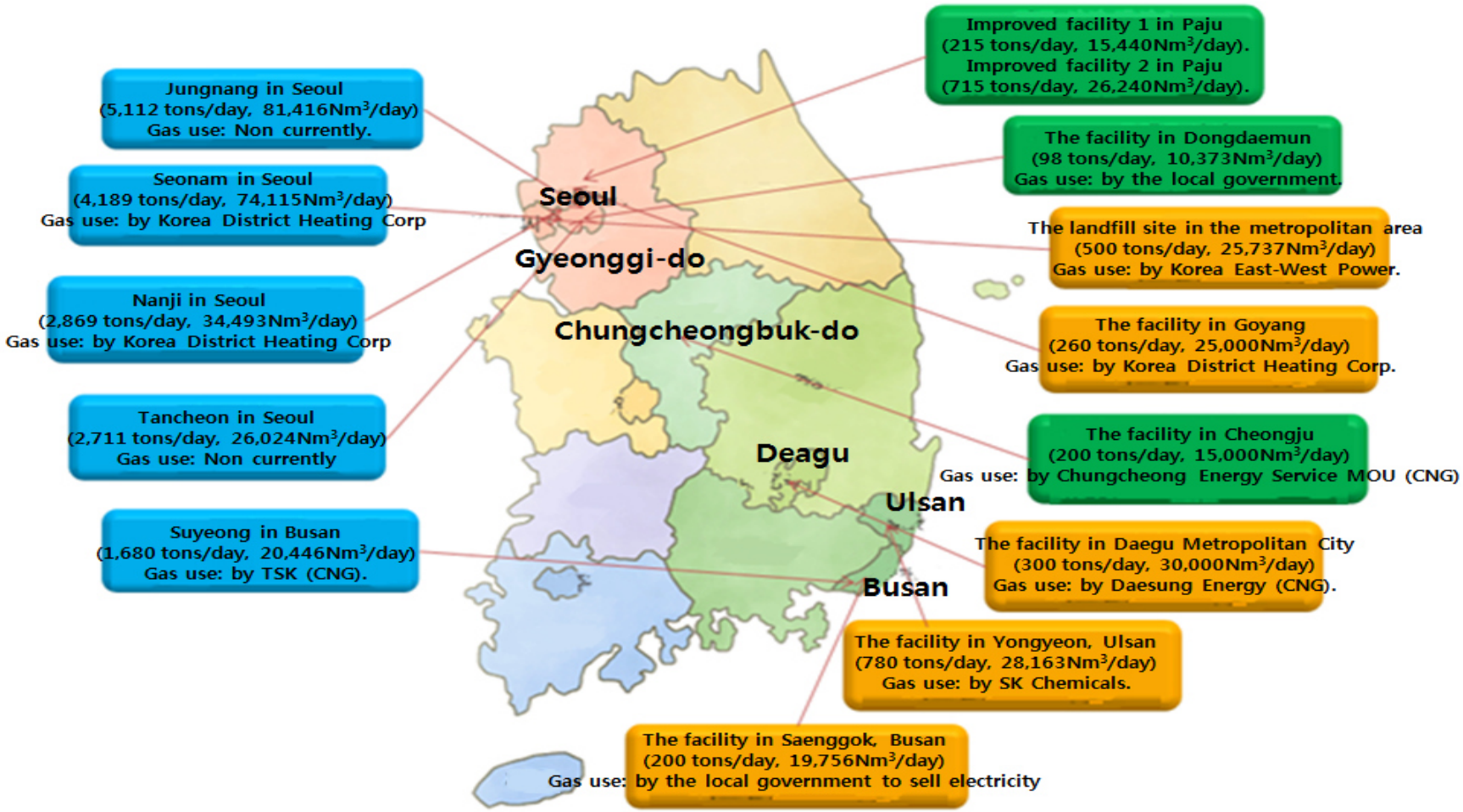
	Vehicle fuel	Provision via natural gas lines
Sweden	50% of vehicles fueled by natural gas	Gothenborg region 1,500㎥/hr (after quality improvement) Laholm region 500㎥/hr (after quality improvement)
France	35% of the entire buses	
Germany	8% of vehicles (estimation)	Substitution rate of natural gas will be 6% by 2020.

Ⅲ Implementation in Korea

1. Waste-to-fuel system in Korea

1.1 Mass bio-gas production facilities in Korea

Source: Eco Energy Holdings



1.2 Implementation Plan

■ **Review on the commercialization of waste-to-fuel (including local and overseas cases)**

• Overseas anaerobic digestion process

- Mostly wet digestion or dry digestion technologies are used for processing organic wastes in other countries. In case of Korea, the digestion days (HRT) of dry method are shorter (14 to 21 days) and the organic loading rates, gas and methane generation rates are faster than those of wet digestion.

Process title	Application site	Methane generation	Remarks
Dranco Process (Belgium OWS)	Salzburg in Austria Brecht in Belgium	140 ㎥/ton	Organic urban waste
Valorga Process (France Gaz de France)	Amiens in France Tilburg in Netherlands	60 ㎥/ton	60% Combined waste + 40% Organic waste
Vegger Process	Vegger and Herning in Demark	80 ㎥/ton	75% Human waste + 25% Industrial waste
Mobius System (Finland)	Various sites including the demonstration facility in Minamiashigara	100-120㎥/ton	Food waste
Rem System (Austria)	Various sites including organic waste treatment facility in Nigata Prefecture	115㎥/ton	Food waste
Lietson System (Germany)	The demonstration facility in Aichi Prefecture	100-120㎥/ton	Food waste

1.2 Implementation Plan

■ Investigation of organic waste-to-fuel technologies and Enhancement Cases

- Basic researches on domestic technologies
  - Researches on waste-to-fuel in Korea started from 1997
  - Researches in Korea on technologies to produce bio energy using organic wastes and bio-gas purification have been actively conducted since the introduction of new renewable policies and green growth strategies in 2000 (Green growth technology in environment, 2009).

Local methods for anaerobic digestion of organic wastes

Type	Company name	Technology	Ownership	Targe waste	Site	Treatment volume (ton/d)
Exclusive digestion	Halla E&C	MSWAS	Korea	Food waste	4	100
	Seohee Construction	DRANCO	Belgium	Food waste	2	298
	Daewoo E&C	DBS	Korea	Livestock excretions and food waste	3	230
	Samsung Engineering	BTA	Germany	Food waste	1	10
	Taeyeong	-	Japan	Food waste	-	-
	GLE&G	-	Korea	Food waste	2	70
	Unison	-	Germany	Livestock excretions	1	20
	Ecodays	ECOPAD	Korea	Livestock excretions and food waste	3	130
Combined with sewage	Hyosung Ebara Engineering	-	Korea	Food waste	3	340
	Halla E&C	-	Korea	Food waste	2	40
Combined digestion	Halla E&C	-	Korea	Livestock excretions and food waste	1	80

2. The Waste-to-fuel system in Wonju and Its Implications

2.1 Overview

■ Organic waste-to-resource project in Wonju

- Supervising office: Gangwon Provincial Office
- Ordered by: Gangwondo Bioenergy
- Constructed by: Ecoenergy Holdings and Halla Energy & Environment
- Title: Organic waste-to-resource project in Wonju
- Construction period: 24 months from the beginning of construction

  (including 6 months of test operation)
- Period: 20 years from the date of operation (Dec. 2012~Nov. 2032)
- Equipment and capacity
  - Capacity: 600Nm3/hour
  - Purification technology: Simplex 600

Source: Eco Energy Holdings

2. The Waste-to-fuel system in Wonju and Its Implications

2.2 Project Background

- The ban on the ocean dumping of organic waste called for countermeasures
- Introduce the technology to convert waste resources to energy through new and renewable energy technology
- Secure alternative energy resources following the high value of a gas digester used in the existing sewage treatment center and high gas prices

2.3 Project Objective

- To lead the government's policy by converting biomethane to automotive fuel
- Develop and distribute new and renewable energy
- Boost the local economy by attracting private investment
- Reduce greenhouse gas emissions in the transport sector

2.4 Expected outcomes

Environmental aspects

- stable inland treatment of all organic waste can prevent environmental pollution in surrounding
- replacement of fossil fuel with biomethane can reduce greenhouse gas emissions and prevent global warming

Economical aspects

- by using part of biogas produced on-site, operation costs can be saved
- by linking with a project to reduce greenhouse gas, a new business model can be created
- the attraction of private investment will boost the local economy and create local jobs

Recycling

- reduce the total amount of waste
- new and renewable energy production can offer new measures to treat organic waste
- biomethane can replace fossil fuel as automotive fuel

2.7 Organic waste-to-resource project in Wonju

■ Project and facilities overview

- Intends to build a stable treatment facility for organic waste to energy and perform inland treatment of waste subject to ocean dumping

Facility name	Capacity	Composition
Incoming·supply facility	220 tons/day	• Weighbridge, incoming area • Storage hoppers, etc.
Pre-treatment facility		• Solid waste storage tank(2 kinds) • Selective crusher, fine crusher(2 kinds)
Anaerobic digestion facility		• Waste storage tank, heated mixing tank, sterilized storage tank, anaerobic digester (wet, mesophilic digestion) • Biogas storage tank/digested sludge holding tank
Anaerobic digested water treatment facility	250m3/day	• Digested sludge dehydrator (centrifugal dehydrator) • Wastewater treatment facility (SBR: sequencing batch reactors • Connected treatment water tank
Bio compost production facility	30 tons/day	• Digested sludge/subsidiary materials storage tank • Post-composting facility (shaft-free mixing) • Equipment to select foreign substances and packing facility
Bio methane production facility	600Nm3/hr (biogas)	• Biogas refining facility(water scrubbing) • Biomethane compression, storage, and measurement facilities
Odor reduction facility	1,200m3/min (deodorization capacity)	• Ventilator • Odor reduction facility (chemical cleaning+bio filter+wet cleaning)

2.8 Benefits analysis

Direct (quantitative) benefits	Indirect (qualitative) benefits
• Benefits from the on-site use of biogas • Benefits from the replacement of LNG with biomethane • CDM project effect benefits • Benefits from the sales of bio compost • Saving transport costs and environmental benefits from the inland treatment of waste originally subject to ocean dumping	• Reduced maritime pollution from the inland treatment of organic waste • Securing integrated management and stable treatment facilities of organic waste, resulting in the improvement of living conditions and the efficiency in Wonju's public administrative management. • Encouraging waste reduction • Establishment of resource-recycling society • Promotion of Wonju, Gangwon Province as a local government that leads low-carbon green growth and climate change adaptation.

Source: Ecoenergy Holdings Co., LTD. (2010). Using Organic Waste to Bio Methane Vehicle Fuel Facility Project Technical Report. *Ecoenergy Holdings Co., LTD*, p15.

THANK YOU!