

An aerial photograph of a city, likely Seoul, South Korea. The image shows a dense urban area with a large green park area in the center. A prominent feature is a large, circular stadium with a green field and a white roof, located in the lower right quadrant. The city is surrounded by a body of water on the left and a highway interchange at the bottom. The text "Waste Management in KOREA" is overlaid in white, bold, sans-serif font across the center of the image.

Waste Management in KOREA

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-Doctor, Master and Bachelor :

Department of Environmental Engineering, University of Seoul

<Recent Research>

-Seoul Waste Management Plan for 2022(2019)

-Waste Management in Seoul : A to Z(2014)

-Basic Plan for Seoul Upcycle Plaza(2016)

-Modulation of Korea's Development Experience : Nanjido Eco Park Restoration from Waste Dumping Site(2014)

-Preliminary Study on Surplus Building Materials Bank(2014)

<Research Field>

-Municipal Waste Management

-Non-preference Facilities Siting

Content

1. Evolution of Solid Waste Management Policies and Acts
2. Roles and Responsibilities of Central & Local Governments and the Private Sector
3. Financing Structure of Solid Waste Management

1. Evolution of SWM Policies and Acts in Korea

1.1 Legislation of SWM

Acts on SWM in Korea

- SWM has evolved through four phases, from Era of Waste Cleaning to Era of Waste-Zero
- In era of waste cleaning, 2 acts including Waste Cleaning Act were legislated
- In era of framing WM Infrastructure, WM Act and 2 additional acts were legislated
- In era of waste to resources, Recycling Acts on construction and demolition(C&D) debris and electrical and electronic(EE) waste were legislated
- In era of waste-zero, resource circulation act was launched

Seoul City's codes for SWM as regional government

- Incinerators O/M and residents aids programs in the affected area
- Permission of private waste haulers
- Financial aids for recycling market

Local governments' code for SWM

- Ways to separate, put out and collect waste
- Waste fee system
- Performance evaluation of private waste haulers

1. Evolution of SWM Policies and Acts in Korea

1.1 Legislation of SWM ... Continued

Phases	Regulations
Era of Waste Cleaning (until late 1980s)	<p>Waste Cleaning Act(1961)</p> <ul style="list-style-type: none"> · Cleaning of residential waste <p>Environment Protection Act(1978)</p> <ul style="list-style-type: none"> · Management of industrial waste <p>EPA Established(1980)</p>
Era of Framing Waste Management Infrastructure (from late 1980s to late 1990s)	<p>Waste Management Act(1986)</p> <ul style="list-style-type: none"> · Integrated waste management concept including recycling · Waste fee system(1995) · Food waste landfill ban(2005) <p>Resource Conservation and Recycling Act(1992)</p> <ul style="list-style-type: none"> · Restriction of packing materials and one-way products · Designating recyclables · Encouraging recycling industries · EPR system on packing materials <p>Waste Treatment Facility Construction Encouragement Act(1995)</p> <ul style="list-style-type: none"> · Landfill site and incinerator
Era of Waste to Resources (late 1990s to early 2010s)	<p>C&D Debris Recycling Act(2003)</p> <ul style="list-style-type: none"> · Encouraging consumption of recycled aggregates <p>Electrical and Electronic Equipment and Vehicles Recycling Act(2008)</p> <ul style="list-style-type: none"> · EPR system on used electrical and electronic equipment
Era of Waste-Zero (late 2000s to now)	<p>Resource Circulation Act(2018)</p> <ul style="list-style-type: none"> · Waste disposal charge to local government · Central government monitor whether provincial meets its SWM target · Creation of recycling culture

1. Evolution of SWM Policies and Acts in Korea

1.2 Classification of SW

- In Korea, all wastes fall into two groups, **Residential waste** and **Business waste**.
- **Business waste** is further divided into four categories.... residential waste in large amounts, industrial waste, C&D debris and hazardous waste.
- **Local governments** are responsible for treatment of **residential waste**, whereas **business waste** are treated by **their generators**.

Classification		Criteria for classification
Residential waste(RW)		<ul style="list-style-type: none">- All waste not include in business waste- Waste less than 300 kg a day from one waste source- Subdivided into several types, such as discards, recyclables, food scraps, bulky items, street cleaning waste and so on, to manage wastes properly
	RW in large amount	<ul style="list-style-type: none">- Residential waste more than 300 kg a day from one waste source- C&D debris less than 5 tons from a C&D work
Business waste	Industrial waste	<ul style="list-style-type: none">- Waste generated from work places emitting environmental pollutants or running environmental protection facilities- Residuals from public environmental infra structures, eg sewage treatment facilities, excreta treatment facilities, water treatment plants and so on
	C&D debris	<ul style="list-style-type: none">- C&D debris more than 5 tons from a C&D work
	Hazardous waste	<ul style="list-style-type: none">- Products or package containing harmful or toxic materials, like oils, acidic liquid, heavy metals, etc.- Infectious waste, such as medical waste

1. Evolution of SWM Policies and Acts in Korea

1.3 Break down of Residential Waste

Items	Sub-items	Treatment methods
Discards	All mixed waste not classified into below	Incineration, landfill, refuse derived fuel (RDF)...
Food wastes	Abandoned foodstuff, uneatable parts, leftover	Feedstuff, composting, anaerobic fermentation...
Recyclables	Papers, glass bottles, plastics, ferrous metals	Material recovery, energy recovery...
Bulky wastes	Furniture, larger electric home appliances, larger household items	Material recovery, energy recovery, incineration, landfill...
Smaller electric home appliances	Fans, telephones, vacuum cleaners, mobile phones...	Material recovery, energy recovery, incineration, landfill...
C&D debris	C&D debris less than 5 tons from a C&D work	Material recovery of inert materials, incineration of combustibles, landfill of residuals...
Briquette ash	Used coal briquette	Cover soil in landfill, soil conditioner of farmland...
Street cleaning wastes	Fallen leaves, vacuum dusts, rubbish in wastebin	Incineration, landfill, RDF, composting...
Used fluorescent lamps	Used fluorescent lamps	Material recovery, hazardous waste treatment...




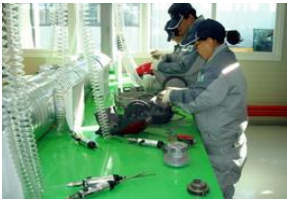



1. Evolution of SWM Policies and Acts in Korea

1.4 Changes of SWM in Seoul

- Municipal waste management in Seoul has reached to the Era of Waste-Zero nowadays through the Era of Waste Cleaning, the Era of Framing Waste Management Infrastructures, and the Era of Waste to Resources.
- **The Era of Waste Cleaning** was featured by taking away wastes from downtown area as soon as possible. In this Era, recycling was driven by market mechanism.
- **Volume based fee system** is recommendable as a representative project of the **Era of Framing Waste Management Infrastructures**. Construction of incinerators was initiated in the Era as well.
- Introducing **Expanded Producer Responsibility scheme**(EPRs) and **banning food waste landfill** were remarkable events in the **Era of Waste to Resources**, which have led expansion of waste recycling so much.
- In the **era of Waste-Zero** nowadays, the center of waste management gravity has shifted to activities to reduce waste generation at waste sources or in the phase of consumption. Expansion of flea markets for used goods and encouraging **up-cycling** actors can come first as waste source reduction activities.

1. Evolution of SWM Policies and Acts in Korea

1.4 Changes of SWM in Seoul...continued

~ 1969yr	1970yrs	1980yrs	1990yrs	2000yrs	2010yr ~	
<p><u>Era of Waste Cleaning</u></p> <ul style="list-style-type: none"> •Waste recycling is led by private sector •Inert materials used for building housing site and Han-river's bed •No separation of waste and disposed at landfill together •Nanjido landfill in use/a Metropolitan landfill under construction 						
			<p><u>Era of Framing Waste Management Infrastructures</u></p> <ul style="list-style-type: none"> •Public sector joins in recycling •Enacts volume-based fee system •Construct waste incinerators •Nanjido landfill closed/a Metropolitan landfill in use •Partially initiate food waste management 			
				<p><u>Era of Waste to Resources</u></p> <ul style="list-style-type: none"> •Introduce EPR system •Expand separation of all food waste •Regional use of incinerators to their capacities •Construction of a SR center for smaller electric home appliances 		
			<p><u>Era of Waste-Zero</u></p> <ul style="list-style-type: none"> •Expand markets for used goods •Food waste reduction •Encourage up-cycling •Initiate waste to fuel 			

1. Evolution of SWM Policies and Acts in Korea

1.5 Policy Direction of SWM in Seoul

Weakness at the point of WM

- Lack of land to construct waste treatment facilities
- Waste generation beyond accommodation within border of Seoul

Strength

- Financial condition and technical options to secure infrastructures
- Citizen's positive attitude to waste recycling of governments

Policy direction

- **Securing infrastructures** within Seoul as much as possible
- **Minimizing social conflicts** surrounding treatment facilities by reduction and recycling
- Comprehensive **role sharing of all stake-holders** to do waste management effectively



Sky view of Seoul in 1956



Sky view of Seoul in 1997

1. Evolution of SWM Policies and Acts in Korea

1.6 Policy Direction Reflected in SWM Plans

- **Recycling** will be enhanced from 61% in 2015 to 72% in 2021
- **Landfill** will be lessened to 5.4% until 2021

Environmental Conservation Plan (2006~2015)	Basic Plan for Waste Treatment (2012~2021)
<ul style="list-style-type: none">· Principle : comfortable living base· Strategies : waste to resources· Programs :<ul style="list-style-type: none">- building infrastructures- expanding street washing· Goals :<ul style="list-style-type: none">- recycling 61%(2015yr)- incineration with heat recovery 25%(2015yr)	<ul style="list-style-type: none">· Principle :<ul style="list-style-type: none">- avoiding waste landfill- building infra for resources recovery· Programs :<ul style="list-style-type: none">- strengthening waste reduction/recycling- building waste treatment facilities· Goals :<ul style="list-style-type: none">- recycling 72%(2021yr)- landfill 5.4%(2021yr)

1. Evolution of SWM Policies and Acts in Korea

1.7 Achievement of SWM in Seoul

Waste generation

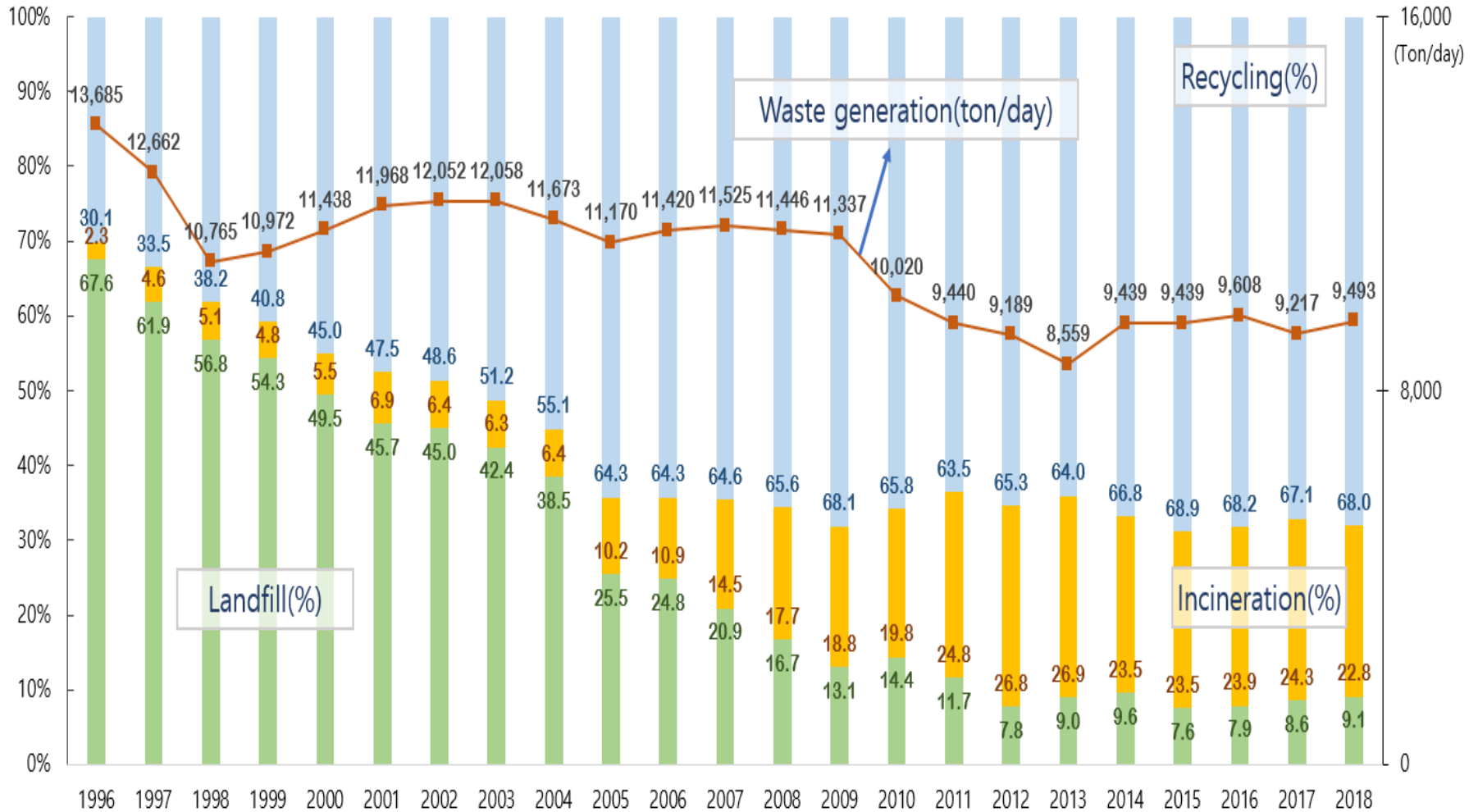
- About 9 thousand tons of municipal waste in a day are generated from various sources like ;
 - 3.5 million families and 10 million citizens as source of household waste
 - 700 thousand buildings and 80 thousand business units as source of commercial and institutional waste
 - 8,000 kilometers road as source of street cleaning waste

Ways to manage waste

- Waste generation has been restricted from 13,685 tons per day in 1996 to 9,493 tons in 2018
- Waste recycling, mainly collecting both recyclables and food waste, has been up 60~70% since 2005
- Waste incineration with energy recovery has also risen up to 23% in 2017
- Dramatic change has happened to waste landfill by dropping from 68% in 1996 to 9.1% in 2018

1. Evolution of SWM Policies and Acts in Korea

1.7 Achievement of SWM in Seoul...continued



2. Roles and Responsibilities of Governments and the Privates

2.1 Roles and Responsibilities of Governments

- All level of governments are doing roles and responsibilities with their own organizations to manage SW
- **Central government** owns administrative sections to establish technical standards, and support regional governments like Seoul city or local governments like 25 local districts of Seoul city technically or financially.
- Seoul city government as a **regional government** has administrative sections to aid 25 local districts' responsibilities by running waste treatment facilities that are jointly used by 25 local districts and by supporting local districts technically or financially.
- 25 local districts as a **local government** run administrative sections to commit their responsibility to collect and treat MSW generated from their territories

2. Roles and Responsibilities of Governments and the Privates

2.1 Roles and Responsibilities of Governments...continued

Items	Central government	Seoul city government	25 local districts
Roles	<ul style="list-style-type: none"> •Set/implement waste management plan •Encourage technology development •Support local governments technically and financially •Adjust regional waste treatment •Manage hazardous waste •Revise legislation at governmental level 	<ul style="list-style-type: none"> •Set/implement waste management plan •Run regional waste treatment facilities •Level up efficiency of waste management <ul style="list-style-type: none"> -Develop human resources -Educate waste sources •Support 25 local districts technically and financially •Adjust 25 local districts' waste treatment •Revise legislation at regional level 	<ul style="list-style-type: none"> •Set/implement waste management plan •Collect/treat municipal waste •Run own waste treatment facilities •Level up efficiency of waste management <ul style="list-style-type: none"> -Develop human resources -Educate waste sources •Revise legislation, especially on waste source separation and collection
Administrative sections	<ul style="list-style-type: none"> •Resource recirculation division •Waste resource management division •Resource recycling division •Waste-to-energy division 	<ul style="list-style-type: none"> •Resource recirculation division •Neighborhood environment division 	<ul style="list-style-type: none"> •Waste cleaning divisions
Affiliated organization	<ul style="list-style-type: none"> •Korea Environment Co. •Sodokwon Landfill Site Management Co. •Korea Environmental Industry & Technology Institute 	<ul style="list-style-type: none"> •Seoul SR center •Waste incinerators 	<ul style="list-style-type: none"> •Waste collection forces •Food waste facilities •Material recovery facilities •Transfer stations

2. Roles and Responsibilities of Governments and the Privates

2.2 Seoul's Infrastructure for SWM

Major waste treatment facilities

- 1 landfill site, 5 incinerators, 5 food waste treatment facilities, 15 material recovery facilities, 46 transfer stations

Additional waste treatment facilities

- Small-sized home appliances facility, Voluminous home appliances facility, Wood treatment facility, C&D debris facility, Fluorescent lamps/Dry cells treatment facility

Facilities	Details	Remarks
Landfill site	<ul style="list-style-type: none"> · Total area : 20 km² · Landfill area : 9km² · Landfill capacity : 228 million tons of waste · Location : reclaimed land in the west of Seoul · Operation : a public corporation 	<ul style="list-style-type: none"> · Group purchase of EPA and Seoul city government · Seoul, Incheon and Gyeonggi jointly use · The public corporation is under control of EPA
Incinerators with energy recovery	<ul style="list-style-type: none"> · Number : 5 facilities · Design capacity : totally 2,900 tons/day (50~900) · Location : in Seoul · Owner : Seoul city government · Operation : qualified private companies 	<ul style="list-style-type: none"> · Several incinerators in Gyeonggi-do are jointly used with Seoul · Qualified private companies are running facilities under contract-out

2. Roles and Responsibilities of Governments and the Privates

2.2 Seoul's Infrastructure for SWM ...continued

Facilities	Details	Remarks
Food waste treatment facility	<ul style="list-style-type: none"> · Number : 5 facilities · Design capacity : totally 1,238 tons/day (100~450) · Location : in Seoul · Owner : 5 local districts · Operation : qualified private companies 	<ul style="list-style-type: none"> · Five facilities cover one third of food waste generated from Seoul · Remaining food waste are treated by facilities scattering in Gyeonggi-do · Partial capital investment companies have a right to run the facility for 10~15 years in general
Material recovery facility	<ul style="list-style-type: none"> · Number : 15 facilities · Design capacity : totally 650 tons/day(20~70) · Location : in Seoul · Owner : 15 local districts · Operation : contracted private companies 	<ul style="list-style-type: none"> · 10~15% of recyclables are collected by 25 local districts, the remaining are done by merchants · 15 MRFs just cover recyclables collected by 16 local districts · Private companies operate 15 MRFs under the contracts with local districts
Transfer station	<ul style="list-style-type: none"> · Number : 46 facilities · Location : almost in Seoul, but several ones in Gyeonggi-do · Owner and operation : 25 local districts, but a few stations by permitted private haulers 	<ul style="list-style-type: none"> · Transferring of wastes in bulky, especially mixed waste and food waste · Storage & transferring of waste in small quantity, eg home appliance, street cleaning waste · parking lots or car washing booths are optionally prepared
small-sized home appliances facility	<ul style="list-style-type: none"> · Number : 1 facility · Location : in Seoul · Owner : Seoul city government · Operation : qualified private companies 	<ul style="list-style-type: none"> · Decomposition of small-sized home appliances into materials to encourage material recovery · Employing disadvantaged groups and donating profits to charity

2. Roles and Responsibilities of Governments and the Privates

2.2 Seoul's Infrastructure for SWM ...continued

Facilities	Details	Remarks
Voluminous home appliances facility	<ul style="list-style-type: none"> · Number : 9 facility · Location : nationwide · Owner and operation: major home appliances producers 	<ul style="list-style-type: none"> · Decomposition of voluminous home appliances into small pieces of same materials to encourage material recovery
Wood treatment facility	<ul style="list-style-type: none"> · Number : hard to count · Location : nationwide · Owner and operation : wood recycling companies 	<ul style="list-style-type: none"> · Preliminary crush of wooden products in local districts' transfer stations to help efficient transportation
C&D debris facility	<ul style="list-style-type: none"> · Number : hard to count · Location : nationwide · Owner and operation : permitted private companies 	<ul style="list-style-type: none"> · Preliminary sorting and storage of C&D debris in local districts' transfer stations to help efficient transportation
Fluorescent lamps/Dry cells treatment facility	<ul style="list-style-type: none"> · Number : not well-known · Location : nationwide · Owner and operation: major producers 	<ul style="list-style-type: none"> · Preliminary sorting and storage of Fluorescent lamps/Dry cells in local districts' transfer stations to help efficient transportation

2. Roles and Responsibilities of Governments and the Privates

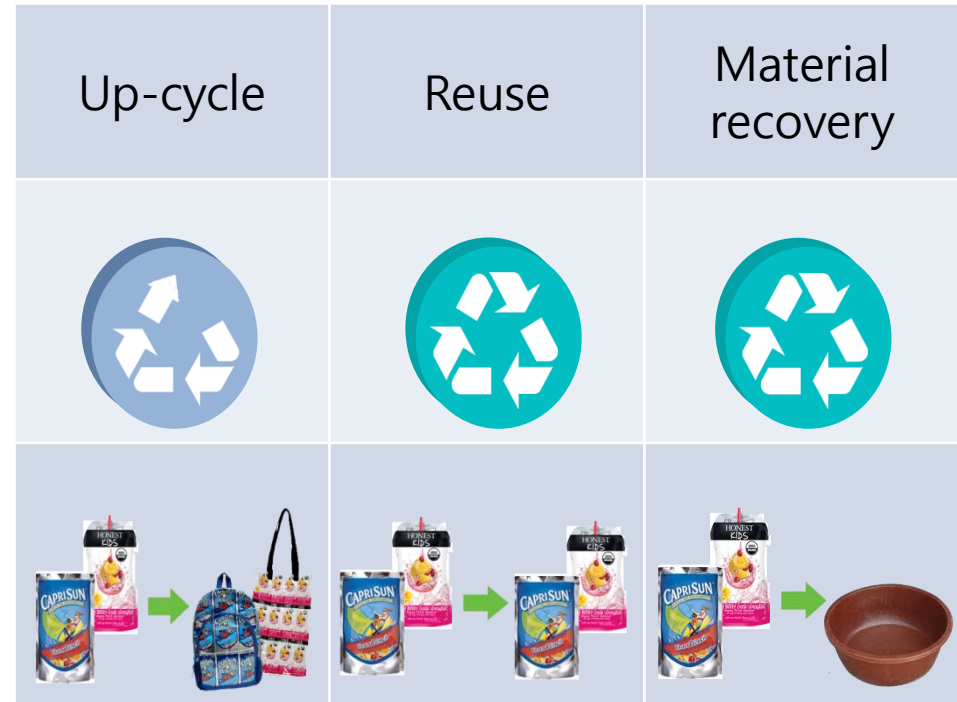
2.3 Up-cycle Plaza, Seoul's Latest Infrastructure for SWM

What up-cycle is

- Up-cycle = Reuse + Design
- Up-cycled product
= Used material + Design

Up-cycle plaza's roles

- Up-cyclers incubating
- Offering citizen to try up-cycling
- Information herb for recycling



2. Roles and Responsibilities of Governments and the Privates

2.3 Up-cycle Plaza, Seoul's Latest Infrastructure for SWM ...continued

Facility overview

- Lot area 6,931 m², Building area 16,530m²
- 50 billion KRW or 45 million dollars
- **Workrooms for Up-cyclers, Up-cycle materials bank,** Exhibition hall of Up-cycled products, **Retail shop** of Up-cycled products, Preprocess of reused items, Education room, Materials washing room Machine room, **Outdoor flea market**, and so on



2. Roles and Responsibilities of Governments and the Privates

2.3 Up-cycle Plaza, Seoul's Latest Infrastructure for SWM ...continued

Project schedule

- ~ 2012. 11. **Basic plan**
- ~ 2015. 12. Building design
- ~ 2017. 01. Building construction
- 2017. 09. **Opening ceremony**
- ~ 2018. 08. 32 Up-cyclers moved in



2. Roles and Responsibilities of Governments and the Privates

2.3 Up-cycle Plaza, Seoul's Latest Infrastructure for SWM ...continued

Example of up-cycle products



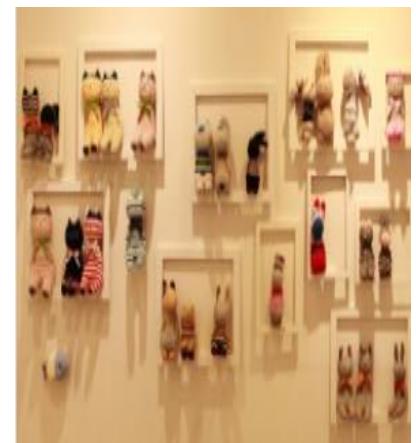
Bicycle parts ⇒ **Light fixture**



Umbrella ⇒ **Pouch bag**



Clothes ⇒ **Cellular phone cover**



Clothes ⇒ **Dolls**



Plastic bottle ⇒ **Block**



Pallet ⇒ **Interior accessories**



Coffee bag ⇒ **Fashion accessories**



Fire hose ⇒ **Wallet**

2. Roles and Responsibilities of Governments and the Privates

2.4 Collection Bodies for MSW in Seoul

- **Discards & food waste** : 113 private haulers licensed by 25 local districts under contract
- **Recyclables** : around 1,000 vendors, private haulers or own forces of 25 local districts
- Large WEE appliance : producers(distribution dealers, collection agents), private haulers or own forces of 25 local districts, vendors, reused items deals
- Smaller WEE appliance : producers(collection agents), private haulers or own forces of 25 local districts
- Wasted furniture : reused items deals, private haulers or own forces of 25 local districts
- Used fluorescent lamps : producers(collection agents), private haulers or own forces of 25 local districts
- Small amount C&D debris, Briquette ash, Street cleaning waste : private haulers or own forces of 25 local districts

2. Roles and Responsibilities of Governments and the Privates

2.5 Private Participation in SWM

In source reduction and reuse area

- Private company or volunteers collect used products, donate them to the poor, sell in low price or export to other countries
 - .ARUMDAUNGAGE(Beautiful shop) : mainly handle small items like clothes, books...
 - .NOKSECGAGE(Green shop) : same above
 - .Food bank : Foodstuffs or foods over prepared
 - .Recycling center : mainly handle large like whit goods, furniture

In recycling area

- Private companies collect valuable recyclables and sell them to next-step market after sorting into items
- There are about 750 scrap merchants in Seoul and 2,500 in Capital area
- Some companies operate public MRFs or food waste facilities under contract with local governments
- More than 60% of food waste from Seoul is treated by private companies

2. Roles and Responsibilities of Governments and the Privates

2.5 Private Participation in SWMcontinued

In collection and treatment area

- 114 private haulers of residential waste collect waste under the contract with local governments
- Neighbors on Waste to Energy Facility or landfill site can monitor status of facility operation whenever they want
- Operation of all Waste to Energy Facilities is done by qualified private companies under contract with Seoul city government
- SUDOKWON landfill site that Seoul, Kyonggi and Incheon jointly use is also managed by a public enterprise

3. Financing Structure of SWM

3.1 Waste Fee Covers 32% of all Expense of Local Governments

- All cost to manage **business wastes** are paid by **their generators**
- In management of **residential waste**, costs bearing bodies can be listed **waste generators, local government, regional government, central government and goods producers** under Expanded Producer Responsibility(EPR) scheme
- **Waste generators** of residential waste pay the cost of waste collection and treatment fully or partially as waste fee
- **Central government or Regional governments** supplement the capital cost of waste treatment facilities owned by local governments
- **Goods producers** are in charge of treatment of their packing materials and EE appliance under EPR scheme and pay for cost of those items treatment.
- In 2018 **waste fee** from waste generators **covered 32%** of all waste management **expense of local governments** in Korea, and 52% in Seoul.



Standardized plastic bag for discards



Weighing system for food waste



Vehicle with weighing system

3. Financing Structure of SWM

3.2 Cost Bearing Bodies for Residential Waste Management

Waste	Waste generator	Local government	Regional government	Central government	Producers under EPR system
Discards	·Collection cost ·Partial treatment cost	·Outsourcing treatment cost	·Partial capital & O/M cost of own facilities	·Partial capital cost of facilities	Not applicable(NA)
Food waste	·Collection cost ·Partial treatment cost	·partial capital & all O/M cost of facilities ·Outsourcing treatment cost	·Partial capital cost of facilities	·Partial capital cost of facilities	NA
Recyclables	NA	·partial capital & all O/M cost of facilities	·Partial capital cost of facilities	·Partial capital cost of facilities	·Outsourcing treatment cost
Bulky waste	·Collection cost ·Partial treatment cost	·Outsourcing treatment cost	NA	NA	NA
EE equipment	·Items collected by 25 local districts : partial collection cost	·Items collected by local districts : partial collection cost	·All capital & O/M cost of Seoul SR center		·Own collection cost ·All capital & O/M cost of facilities
Street cleaning waste	NA	·Collection cost ·Outsourcing treatment cost	NA	NA	NA

Note) Discards : waste disposed at incinerators or landfill sites

Recyclables : used packages or products which are recyclable or government designates as recyclable items

Bulky waste : embarrassing items that are not easy to put into standardized plastic bags like furniture

3. Financing Structure of SWM

3.3 Capital Cost Sharing for Public Residential Waste Facility(2020)

Type of Facilities	Facility Owner	Resource Sharing(%)		Remarks
		Central Government	Local Government	
<ul style="list-style-type: none"> ▶ Waste to Energy ▶ Organic Waste Bio-Gasification 	Seoul city	30	70	Only jointly used
<ul style="list-style-type: none"> ▶ Material Recovery facility for MSW 	Regional Government ex. Seoul	40	60	Only jointly used
<ul style="list-style-type: none"> ▶ Material Recovery facility for MSW of Construction site 	Local government	30 (50)	70 (50)	(Jointly used)
<ul style="list-style-type: none"> ▶ Landfill site ▶ Food Waste Treatment 	Island area	50 (30)	50 (70)	(Landfill)



Thank you.

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