Solid Waste Management in S. Korea

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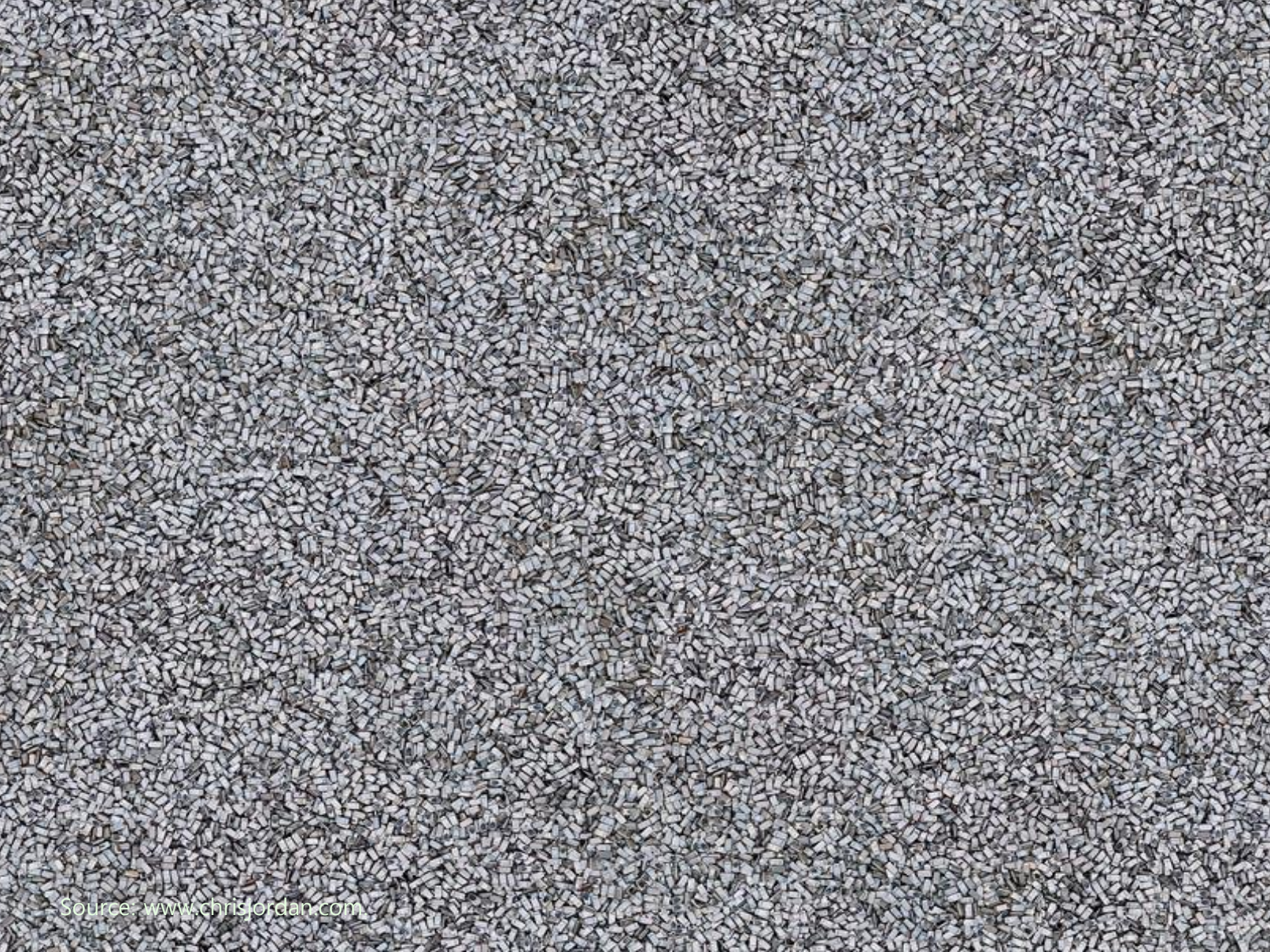

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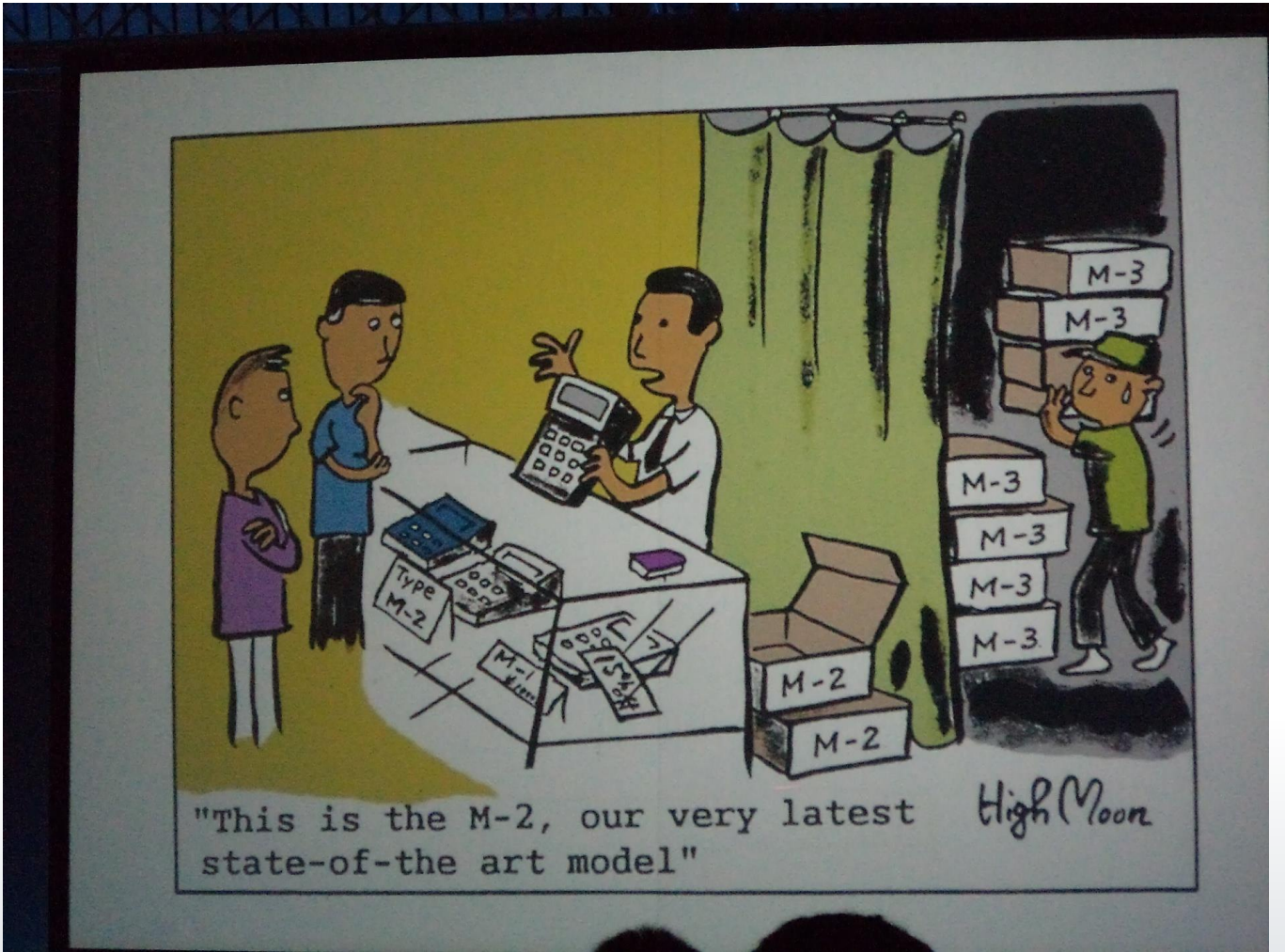
426,000 Cell Phones are Retired in the US Every Day!

New Model?


M-3
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Type
M-2
"This is the M-2, our very latest state-of-the art model"
High Moon

Desire bring about Wastes

Note: Our lifestyle filled with many desire brought an increase in waste.

Evolution of Humans

Wastes?

- *Waste is any object whose owner does not want to take responsibility for it. (**Palmer, P., 1992**.* Green Product by Design 4, Washington D.C. U.S. Congress, Office of Technology Assessment)
- *A newspaper on a desk is a publication to be read; it becomes a historical reference when archived in the library; and turns into "rubbish" only when it is thrown into a trash bin! What is called rubbish is, in fact, a resource that has been misplaced at the dumpsite. (*Community Museum Project, 2010. From trash to treasure: Designing upcycling systems. Hong Kong Institute of Contemporary Culture Limited)
- Who are the owner? person, community, nation., etc.
- The idea of reuse, recycle, and upcycle

CONTENTS

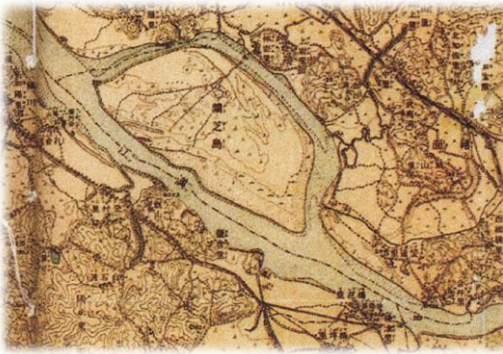
1. Overview and Current Status
2. Policies on Waste Reduction and Recycling
3. Safe Waste Treatments
4. Conclusion

Republic of Korea

- Population: 51.6 million (2016)
- Area: 99,720 km^2
- Population density: 511 cap/km^2 (2012) e.g., U.S. 32 cap/km^2 (2014)
- The heaviest pollution per unit area among Organization for Economic Cooperation and Development (OECD) countries
- Economic structure: Service-centered industrial structure

History of Waste Management of S. Korea (1/4)

Period 1 : Period of No Preparation (1980's and Before)



Nanjido landfill (1978-1993)

- Seoul's official landfill
- Two piles of refuse – 98 m high, occupying 2,715,900 m^2 of land, composed of 91,972,000 m^3 of garbage (equivalent of continuous dumping by 13 million 8.5-ton trucks)
- The tallest waste dumpsite in the nation
- Nicknamed as "Samdado," meaning a island with three common things, i.e., dust, odor and flies

History of Waste Management of S. Korea (2/4)

Period 2 : Period of Expedient Measures (1990's)

MSW generation

- Rapid decline in the amount of MSW generation down to 1.0 kg/cap·d
- Composition : Rapid decline of coal ash to nearly zero
  Decreasing non-combustibles and constant combustibles
  Food waste rapidly decreased

MSW treatment/processing

- Increasing number of well-equipped transfer stations and incineration plants

MSW disposal/reuse

- Introduction of sanitary landfills in the nation
- Decreasing landfilling and increasing reuse/recycle
- Significant increase in MSW reduction by incineration

History of Waste Management of S. Korea (3/4)

Period 3 : Period of Comprehensive Measures (after 2000) (1/2)

MSW generation

- Constant MSW generation around 1.0 kg/cap·d
- Composition : Both non-combustibles and combustibles significantly decreased
  Constant food waste generation

MSW treatment/processing

- Increasing number of well-equipped transfer stations and processing units due to rapid increase in reuse/recycle
- Continuous increasing number of incineration plants
- The first RDF production plant in operation at Wonju since 2007

MSW disposal

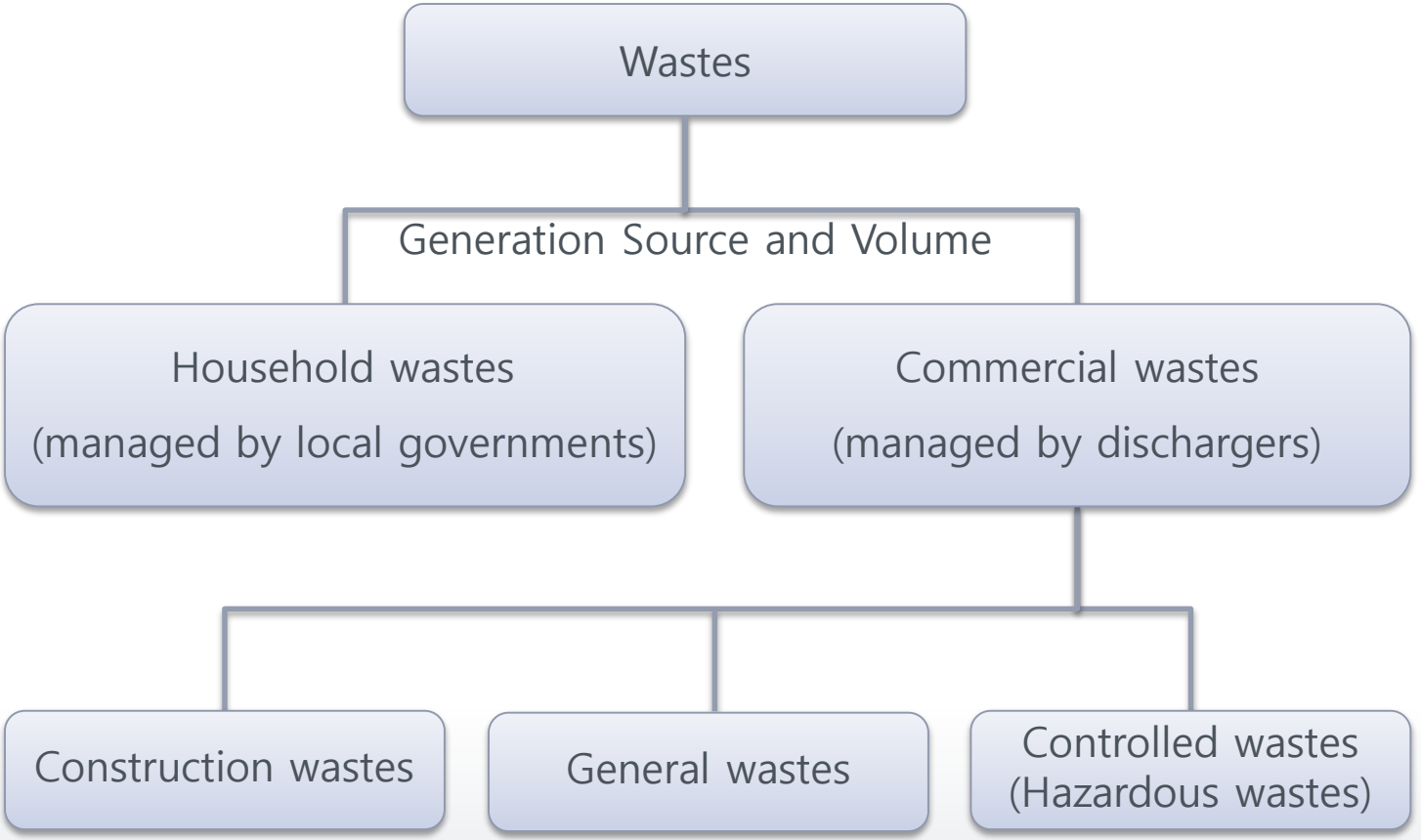
- Rapid decrease in landfilling and rapid increase in reuse/recycle
- Landfill of food waste and sludge banned since 2005

History of Waste Management of S. Korea (4/4)

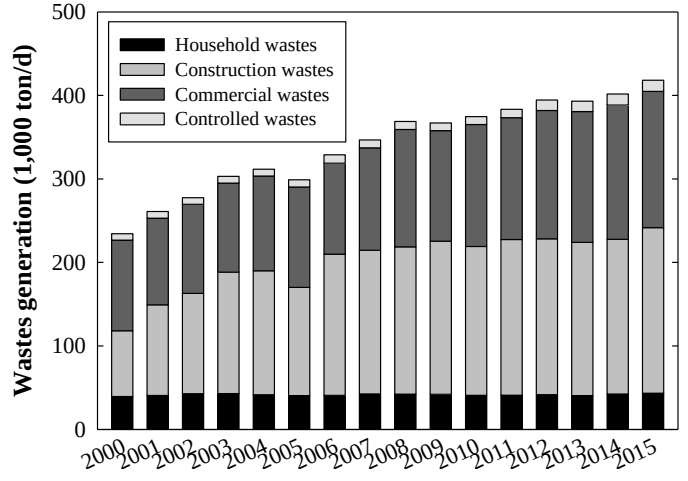
Period 3 : Period of Comprehensive Measures (after 2000) (2/2)

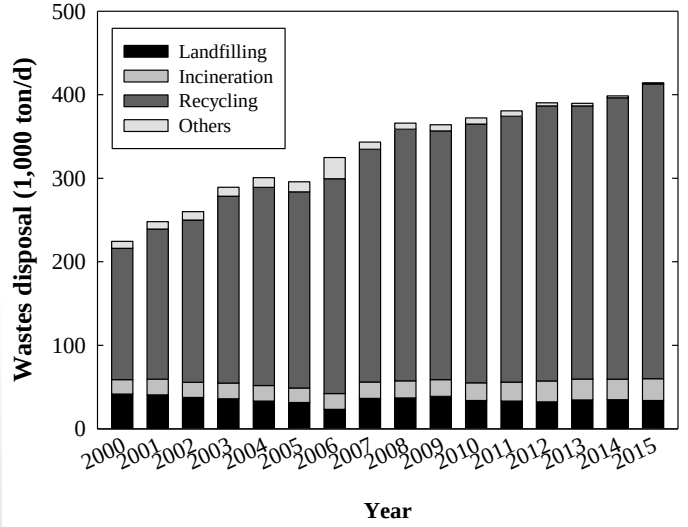
Sudokwon Landfill as a representative sanitary landfill in the nation

Waste Management Criteria in S. Korea



Trends in waste generation and treatments





- ✓ Total waste generation is steadily increasing
- ✓ Household wastes is gradually reduced
- ✓ Commercial wastes inevitably increased due to …
  Expansion of economic activities
  energy-intensive industrial structures
  rise in construction

- ✓ High Recycling is due to citizen's participation on the segregated discharge
- ✓ Landfiling continued to decline

Municipal Solid Waste (MSW) Generations

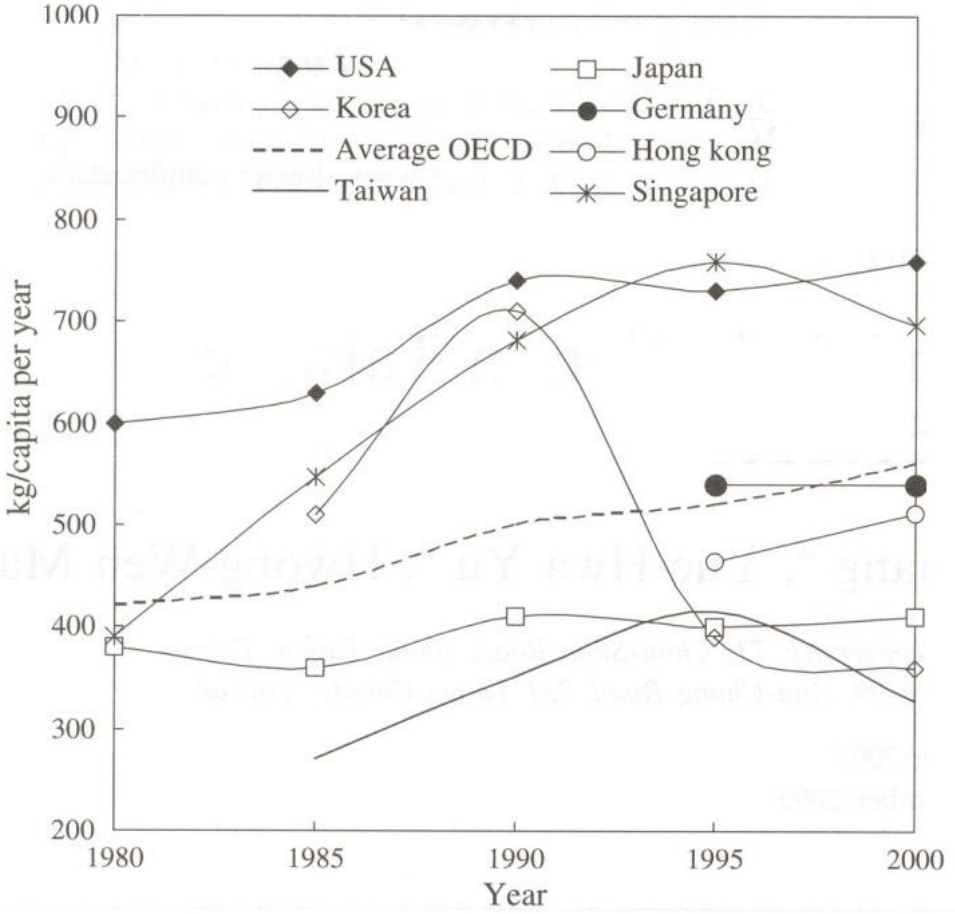


Fig. 1. Comparison of MSW generation in some countries from 1980 to 2000 (OECD, 2002).

Waste generation

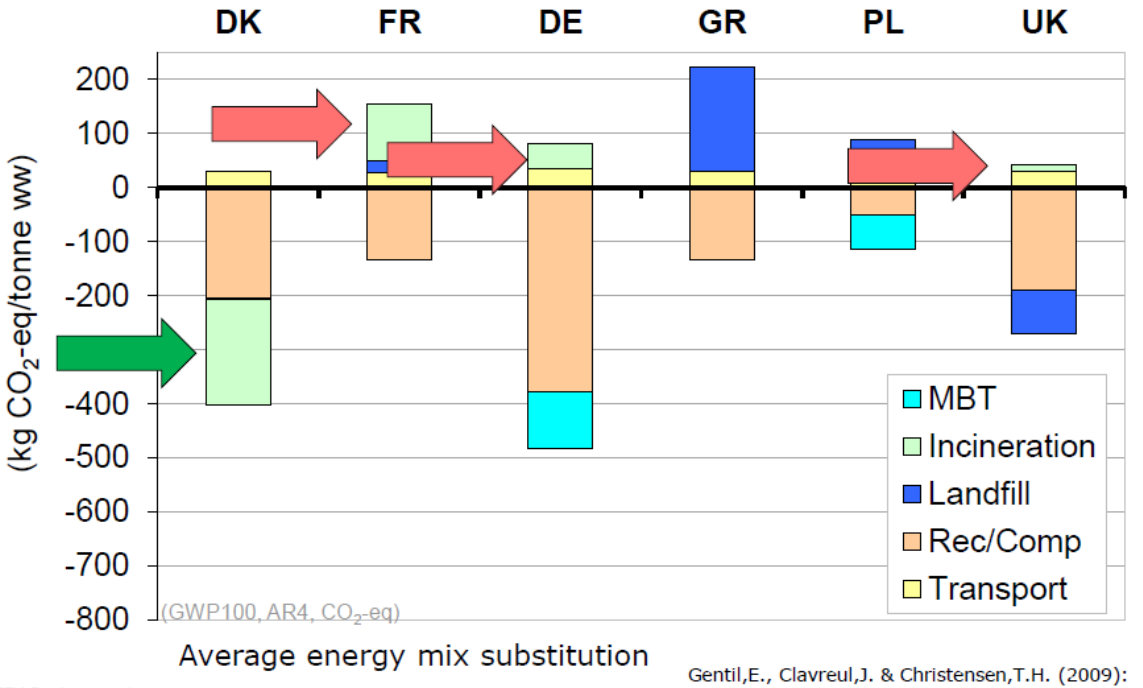
- Income
- Culture
- industrial structure
- civic awareness
- etc.

What we have to be careful to compare the waste statistics?

- Country specific regulations and definitions of MSW
- Generation rates are estimated using collected wastes
- Accuracy of estimation methods

Greenhouse Gas and Waste Treatments

Performance of one tonne of waste



DTU Environment
Department of Environmental Engineering

Gentil,E., Clavreul,J. & Christensen,T.H. (2009): Global warming factor of municipal solid waste management in Europe. *Waste Management and Research*, 27, 850-860.

Street Containers for Segregation

Sri Lanka (2012)

Singapore (2015)

Frankfurt (2012)

Singapore (2011)

Brussel (2012)

Policies on Waste Reduction and Recycling

1. Volume based rate system
2. Segregated discharge system
3. Policies for disposable products and packing materials
4. Extended Producer Responsibility (EPR)
5. Other policies

Volume Based Rate System (Household wastes)

- Imposing a charge to the public by applying the Producer Pays Principle - Pay as you throw!
- Rates depend on volume of produced wastes and treatment costs of the local authorities (e.g., 2-3 cents/L)
- There is a synergic effect of the segregated discharge system and the volume based rate system

These are not simple plastic bags but cash!

Segregated Discharge Systems (Household wastes)

- Stationary system for residential area – Drop off
- Temporal system for apartments – e.g., every Monday and Wednesday by resident themselves

Volume Based Rate System (Food wastes)

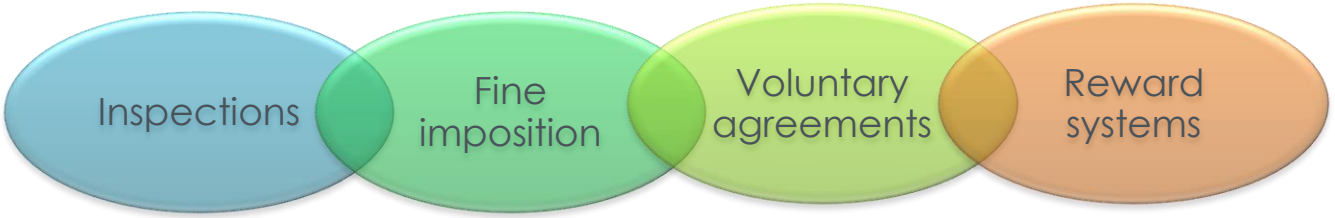
- Imposing a charge to the public by applying the Producer Pays Principle - Pay as you throw!
- Rates depend on volume of produced wastes and treatment costs of the local authorities (e.g., 5-10 cents/L)
- There is a synergic effect of the segregated discharge system and the volume based rate system

Segregated Discharge Systems (Food wastes)

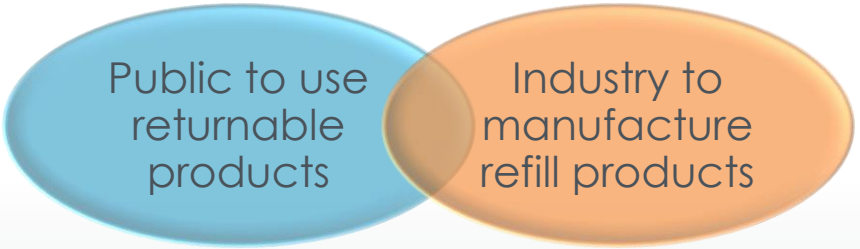
- Stationary system
- Drop off

Policies for Disposable Products and Packing Materials

- Means of policies for disposable products



- Via this policies, the government intends to induce …



EPR, Extended Producer Responsibility

- Manufacturers take responsibility for their products and packing materials by recycling a quota (A deposit-refund system)
- In 2003, EPR started and the object items are TV, refrigerators, washing machines, tires, glass bottles, etc.
- EPR is being expanded to 32 items including fluorescent lamps, packing films, mobile phones, audios, air conditioners, PCs, batteries, etc.
- The target recycling rates are set by the negotiation between producers and government every year. The lowest and the highest are manganese and alkaline batteries (20%) and PET, metal cans, and tires (80%)

Waste Charge System

- To charge the manufacturer or importers the cost for disposing hazardous/unrecyclable wastes
- To reduce production and consumption of goods by the increased prices
- To promote efficient disposal

Eco-assurance System (EcoAS)

- Requiring environmental considerations in the design stage of products
- Easiness in repair, easiness of detaching recyclable materials, utilization of recycled materials, etc.
- e.g., electronics and automobiles

Food waste management and Waste-to-Energy policies

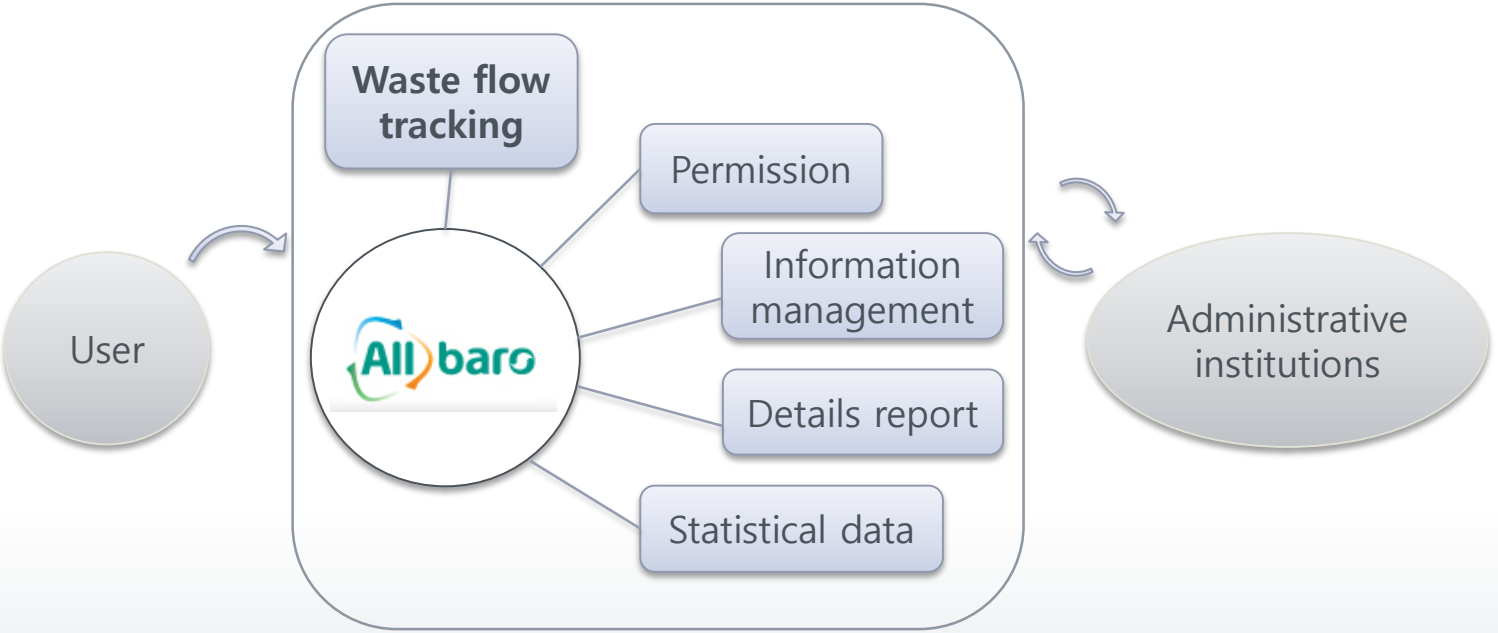
- To reduce import of fossil fuel and greenhouse gas emission
- For example, volume based rate system for food wastes, no direct landfilling of organic wastes including food wastes and sludge, etc.

Safe Waste Treatments

1. Waste Manifest System
2. Importing and Exporting Wastes
3. Recycling Facilities

Waste Manifest System (Allbaro System)

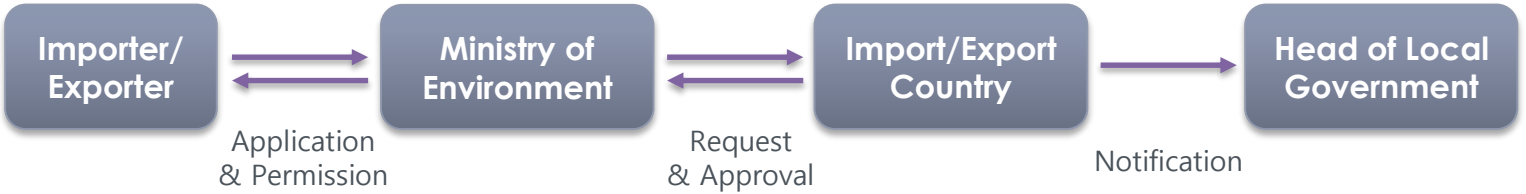
- To prevent illegal waste disposal and apply transparent waste treatment process based on information technology
  - from generation to transport and disposal



- "Allbaro" means "Honestly and Rightly" in Korean

Importing and Exporting Wastes

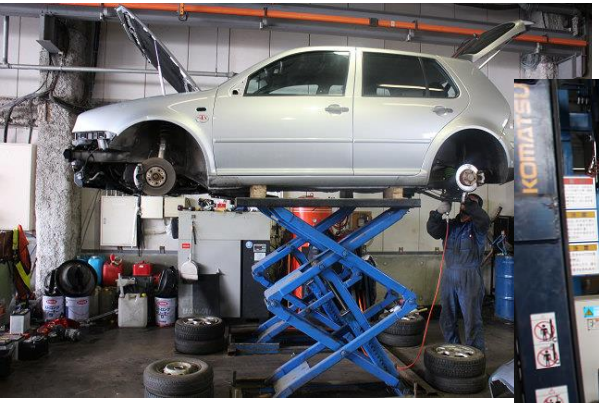
- Republic of Korea joined the Basel Convention
- The Ministry of Environment operates an approval system of importing and exporting wastes
- Importing and exporting of 86 types of hazardous wastes controlled by this system

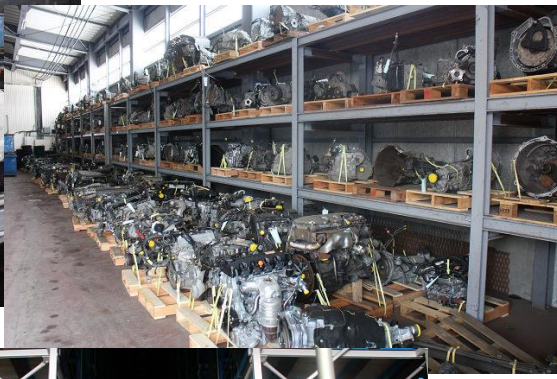


Integrated Solid Waste Management Complex

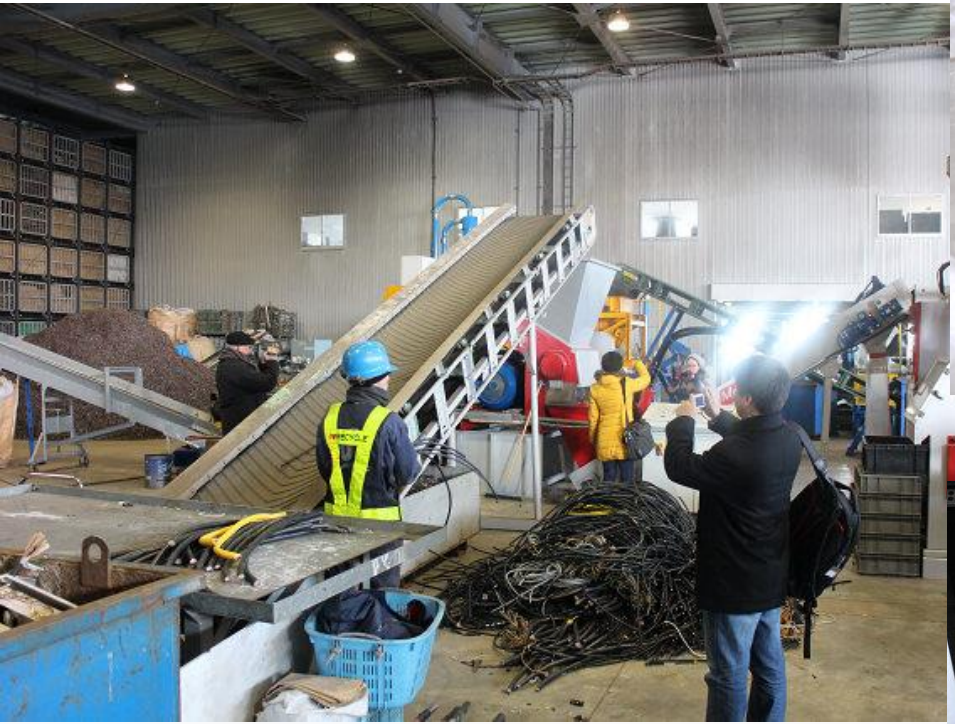
- located in Pusan (3 million of residents)
- based on the concept of Industrial Ecology
- consist of (1) Material recovery facilities, (2) Solid refuse fuel plant, (3) Oil recovery plant from plastics, (4) SRF power plants, (5) Anaerobic digester for food wastes, and (6) landfill.

Automobile Recycling (S. Korea)





WEE Recycling (S. Korea)



WEEE Collection Centers in Italy - Stationary

Stationary WEEE collection bin (Bologna, Italy)

Stationary WEEE collection bin equipped w/ an autonomous power supply with solar panels (Bologna, Italy)

WEEE Collection Centers in Italy - Mobile

Prototype WEEE Mobile, a Mobile WEEE collection centre in Bologna

Prototype mobile WEEE collection bin (Bologna, Italy)

The prototype collection bins actively collect a wide range of data about both users and the items they deposit to optimise collection efficiency

Modified mobile WEEE collection bin w/ a data collection system (Bologna, Italy)

Store for Reuse of Furniture and Electronics (S. Korea)

Completion of Recycling

- The most important thing for successful and efficient recycling system is PURITY of recycled materials.
- Non-recyclables mixed with recyclables enhance the collection and transportation cost significantly because recyclables are not well compacted.
- A good recycling system for a society can be established not only by seting up efficient separation systems but also buying and using the goods made of recycled materials.

Conclusions

Summary

- Korea has succeeded in achieving a sustainable structure in which waste reduction and recycling are prevailed

Further improvements

- Management on whole life-cycle of wastes (i.e., production, consumption and disposal)
  → Material flow analysis (MFA) will be introduced
- Examination on statistical information of wastes
  → Enhancement of administration transparency is crucial
- International cooperation
  → Transboundary movement of waste getting more important for beneficial use of wastes

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National
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THANK YOU FOR LISTENING

ANY QUESTIONS

WML-SNU

Laboratory of
Waste Management
& Resource Recirculation

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