Sustainable Practice of Waste Management towards a Circular Economy – The Korean Experience –

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I. Introduction

Republic of Korea imported 93.7% of primary energy ($145.9 billion) due to minimal natural energy and resources in 2018\(^1\).

Total cost of imports in Korea is $535.2 billion, of which imported raw material is $279.0 billion (52.0%) in 2018\(^2\).

The generation amount of waste in Korea increased from 346,669 ton/d in 2007 to 446,102 ton/d in 2018\(^3,4\). (CAGR : 2.32%)

The Framework act on resources circulation was enforced to promote recycling in 2018. It is desirable to realize resource circulation after safe treatment of hazardous wastes.

In Circular Economy society, manufacturers design products to be reusable and sustainable practices of 3R are key issues.

* CAGR : Compounded Annual Growth Rate (%)

II. Concept of Circular Economy

- **(Concept)**
  - The circular economy is a model of production and consumption, which involves reducing, reusing, and recycling (3R).

- **(Necessity)**
  - Increasing demand for raw materials.
  - The supply of crucial raw materials is limited.

- **(Benefit)**
  - Save raw materials
  - Reducing total annual greenhouse gas emissions.

## The 7 key elements of the Circular Economy

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<tr>
<th>Type</th>
<th>Content</th>
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<tr>
<td>Design for the future</td>
<td>○ To use the right materials, to design for appropriate lifetime and to design for extended future use.</td>
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<td>Incorporate digital technology</td>
<td>○ Track and optimize resource use and strengthen connections between supply chain actors through digital, online platforms.</td>
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<tr>
<td>Preserve &amp; Extend What’s Already made</td>
<td>○ While resources are in-use, maintain, repair and upgrade them to maximize their lifetime and give them a second life through take back strategies when applicable.</td>
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<td>Prioritize regenerative resources</td>
<td>○ Ensure renewable, reusable, non-toxic resources are utilized as materials and energy in an efficient way.</td>
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<td>Use waste as a resource</td>
<td>○ Utilize waste streams as a source of secondary resources and recover waste for reuse and recycling.</td>
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<td>Rethink the business model</td>
<td>○ Consider opportunities to create greater value and align incentives through business models that build on the interaction between products and services.</td>
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<td>Collaborate to create joint value</td>
<td>○ Work together throughout the supply chain, internally within organizations and with the public sector to increase transparency and create joint value.</td>
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Circular Economy with SDGs in Waste Management

7 AFFORDABLE AND CLEAN ENERGY
- The production of biogas from waste, purification and use as an energy source of LFG contributes to this goal.

8 DECENT WORK AND ECONOMIC GROWTH
- Introduce a new circular business models
- Increasing resource effectiveness and efficiency,
- Creating green jobs.

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
- Activities including the use of clean energy and waste management contribute to industrial transformation.

11 SUSTAINABLE CITIES AND COMMUNITIES
- Urban planning that can reduce consumption
- Extending the life of buildings and others by material selection in construction

12 RESPONSIBLE CONSUMPTION AND PRODUCTION
- Reducing consumption by better design or material selection
- Reduction of virgin material use by reuse and recycling

13 CLIMATE ACTION
- Reducing GHG emission by resources circulation and prevention on waste generation

Source: Schroeder et al., The relevance of circular economy practices to the sustainable development goals, J. of Industrial Ecology, 23(1), 2018
Min et al. Studies on the implementation plan for introduction of circular economy, NIER, 2018
III. Waste management in Korea
Classification of Wastes in Korea

- **Waste**
  - Household waste
  - Industrial waste
    - General industrial waste
    - Construction waste
    - Designated waste
  - Household waste from industrial sector
  - Industrial waste from facilities

**Specific Wastes**

- **91-01-00** Wastes from garbage bag
  - 91-01-00 Others
- **51-01-01** Sludge from water purification facilities
  - 51-01-01 Others
- **01-01-01** Waste polyethylene
  - 01-01-01 Others
- **10-13-00** General medical waste
Generation of Wastes in Korea

Source: Ministry of Environment, Status of waste generation & treatment (2021)
Unit Generation Rate in Household Waste

Source: Ministry of Environment, Status of waste generation & treatment (2021)
Sustainable Practice of waste management towards a circular economy
- The Korean Experience

Generation of Wastes in 2019

- Construction waste: 221,102 ton/day (44.5%)
- General Industrial waste: 202,619 ton/day (40.7%)
- Household waste: 57,961 ton/day (11.7%)
- Designated waste (3.1%): 15,556 ton/day

Source: Ministry of Environment, Status of waste generation & treatment (2021)
Treatment of Household Waste in 2019

- Recycling: 34,613 ton/day (59.7%)
- Incineration: 14,919 ton/day (25.7%)
- Landfill: 7,336 ton/day (12.7%)
- Others: 1,093 ton/day

Source: Ministry of Environment, Status of waste generation & treatment (2021)
IV. Sustainable Practices of waste towards a Circular Economy
Sustainable Practice of waste management towards a circular economy - The case study in Korea

Resource Circulation in 3R

**Reduce**
- Restriction on the single-use goods: disposable cups, containers, shopping bags and others (18 items)
- Restriction on the overpacking: Food & beverage, cosmetics and others (7 items)
- Waste Charge System: Containers for biocide, Disposable diapers, Cigarettes and others (6 items)

**Reuse**
- Beverage container deposit system: Cleaning and Reusing

**Recycle**
- EPR: Metal can, Glass bottle, Paper pack, Synthetic resin, Fluorescent lamp, Battery and others (16 items)
- Eco-AS: Refrigerator, Washing machine, TV, others (50 items) & End-of-Life vehicles
- Support on recycling facilities: National treasury support for sorting, storage and other facility
- Fostering Recycling Industry: Promoting use of recycled materials

Volume-base waste fee system: Standard bag, Sticker of large waste (Reduction of waste generation per capita)
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Practice of resource circulation in waste stream

- **Volume Base Waste Fee (VBWF) system**
  - MSW (mixed)
  - Food waste (using standard bag or RFID)

- **Separate discharge of 6 type of MSW**
  - Glass, Ferrous, Plastics, Paper, Textile, EPS

- **Specific waste**
  - Battery, Fluorescent lamp, other waste (using collection box)
  - E-waste (Takeback, Door to Door)

- **Operation of public waste treatment facility (Local government)**
  - Food waste recycling facility

- **Nation-wide WEEE recycling facility (Producer Responsibility Organization)**
Separated Collection of Household Wastes


RFID System—Food waste (2010)

RFID: Radio Frequency Identification
Methods for RFID Food Waste Management System

1. Issue the RFID food waste discharge management card by household

2. The discharge port will open when you touch the card to the collection container.

3. The amount of food waste will be automatically weighted when you dump food waste into the discharge port. (Voice command will run in parallel)

4. Information on the discharge will be sent to the central server. (Environment Corporation)

5. Levy the disposal fee by household (maintenance fee, etc.)

Food waste discharge management card

103-403
E-waste Collection

Consumer

Door to Door

Take-back

1599-0903

Collection by PRO (or Producer directly)

Local government

Logistics Center

Public Depository

Local Depository

Recycling center

Collection by Local government

Ref. http://www.kerc.or.kr/recycle/info
Food waste recycling Facility

- Recycled to animal feed
- Recycled to compost
- Anaerobic digestion

Nation-wide E-waste recycling center

Recycling center in Metropolitan area (eastern side)

Recycling center in Jeju

- Mainly recycle the large home appliances (Refrigerator, Washing machine, etc.)

Ref. http://www.k-erc.or.kr/recycle/center
V. Summary

In Korea, regulation and laws that induce resources circulation are being implemented to realize a circular economy.

- Based on resource circulation in 3R, volume based waste fee system (1995) and restriction on single-use goods and over-packaging are working fine.
- EPR system (Packaging and product) and ECO-AS (E-waste)

For sustainable practice of resource circulation, waste flow programs such as separate discharge, collection and recycling are conducted by local government and producer (manufacture).

- Segregation of Household Waste and E-waste is one of the most important measure.
- Recycling of Household Waste and E-waste is carried out by Local government and Producer, respectively.

A long-term master plan and the technical roadmap have been established and promoted to convert towards a circular economy society through resource circulation.
Thank you for Your Attention

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