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Technological Interventions for Managing E-Waste

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KERC

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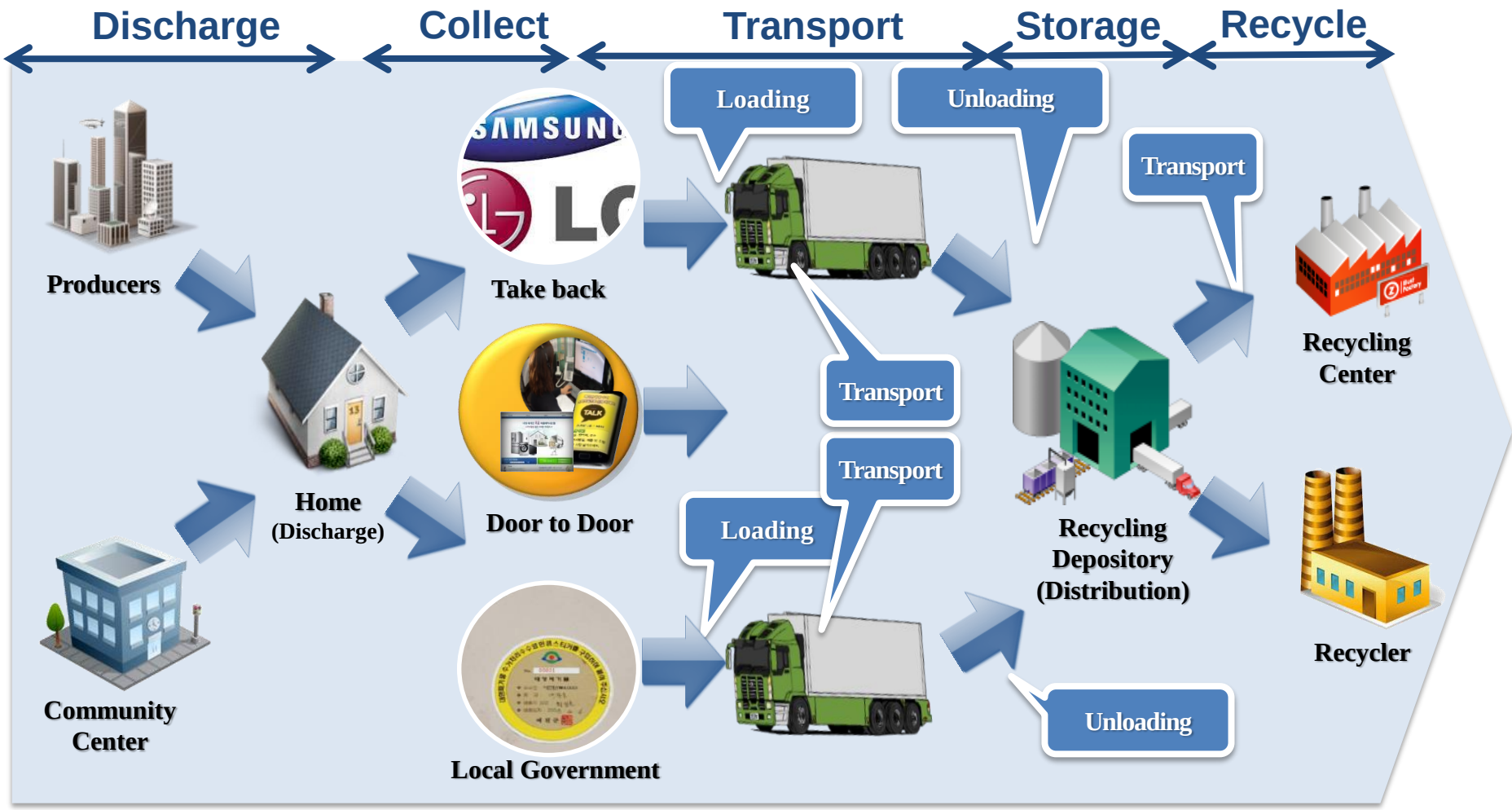
Content

- Systematic (legal) Approaches for E-waste Recycling
- Polyurethane(PU) to Solid Refuse Fuel(SRF) for Energy
- Recycling of refrigerants
- Handling of small size E-Waste (WEEE)
- Conclusions

System(legal) for E-waste(WEEE) recycling

- E-waste collection and recycle process



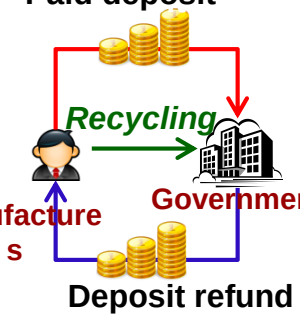
System(legal) for E-waste(WEEE) recycling

▪ Chronological change in recycling system in Korea

1991

Separate garbage System

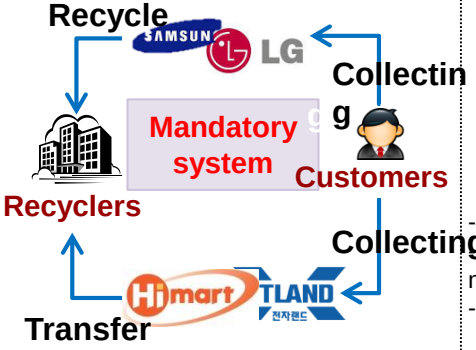
- Cleaning managed by local gov. office



1993

Deposit System

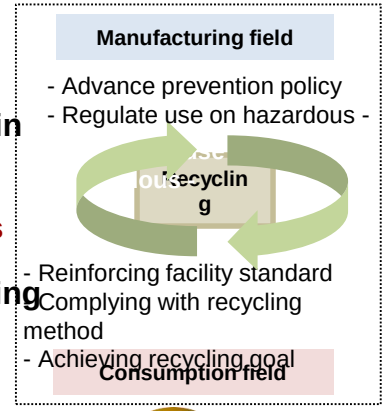
- Designation of recycling business operator



2003

Extended Producer-Responsibility system

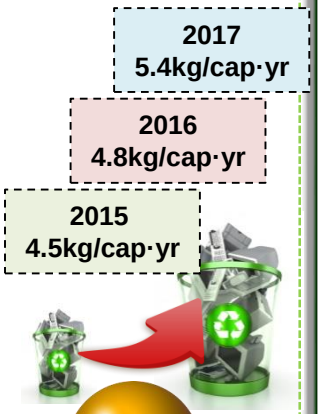
- Expansion Obligations to producers(Sellers)



2008

Eco-Assurance System

- Based on EPR, Strong regulations appearance



2014

Target-amount System

- Expand list of Items [10 → 27 items]

Source: Waste resources management, University of Seoul

System(legal) for E-waste(WEEE) recycling in Korea

- **E-waste recycling system with regulations**

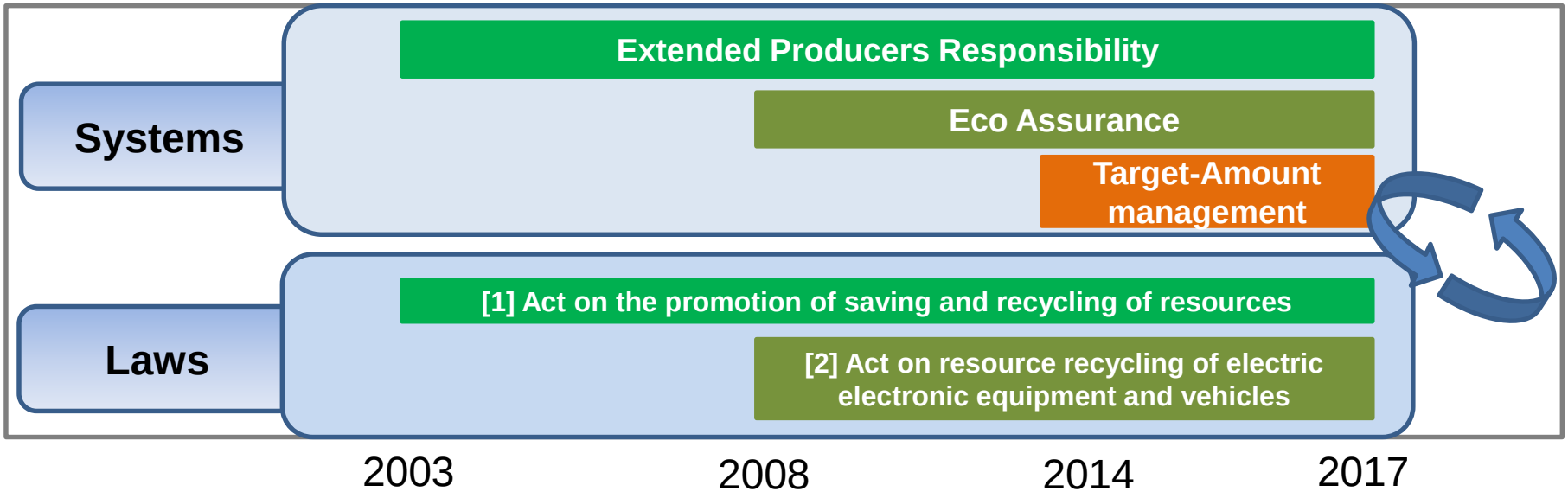
Related Laws

[1] ‘Act on the promotion of saving and recycling of resources’ (2003.1, EPR)

[2] ‘Act on resource recycling of electric electronic equipment and vehicles’(2008, EcoAS)

Related Laws

Main systems for e-waste recycling implemented with related two regulations (law)



System(legal) for E-waste(WEEE) recycling in Korea

- **Item of recycling target system (‘14 ~ / 4group, 27 items)**

Group	Item
Large home appliances	Refrigerator, Washing Machine, Air Conditioner, TV, Vending machine
Post and telegraph appliances	Cellular phone, Computer, Printer, Facsimile, Copy machine
Medium home appliances	Electric water purifier, Electric range, Electric oven, Dish dryer, Dishwasher
Small home appliances	Bidet, Air cleaner, Electric Heater, Audio, Rice pot, Softener, humidifier, iron, Electric fan, blender, Vacuum cleaner, Video player





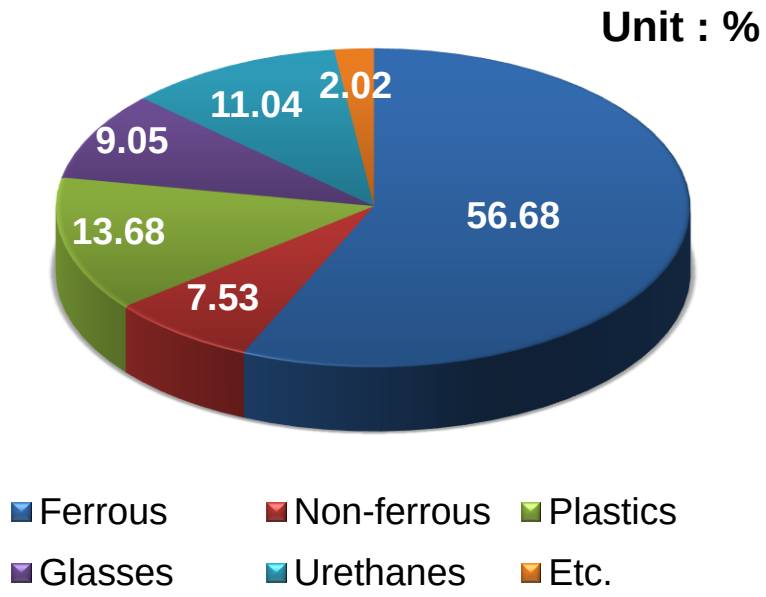
PU in E-Waste

▪ Overview of refrigerator material composition

· Composition rate of Polyurethanes in refrigerator

- PU accounts for 11.04% (13kg)of the total weight from a refrigerator
- Before compressing or SRF producing, the volume corresponds to about 1.5m^2
- Therefore, final treatment (disposal) is important task to reduce volume of PU

Materials	Weight (Kg)	Rate (%)
Ferrous	66.763	56.68
Non-ferrous	8.868	7.53
Plastics	16.11	13.68
Glasses	10.66	9.05
PCBs	0.33	0.28
Rubber	1.59	1.35
Wires	0.46	0.39
Urethanes	13	11.04
total	**117.781**	**100.00**



PU Waste Recycling

- **The current status of refrigerators and PU recycling in Korea**

[Manual]

Pretreatment

[Automatic →]

Shredding

Crushing

Magnetic separation

Crushing

Poly Urethane→

Grinding

SRF facility

SRF

Refrigerant, PC
Comp', Motor e

/Non PP

/Non Cu

Optical separation (Color+EM)

ABS

PP

Al

Cu

[PU recycling(processing) pathway]

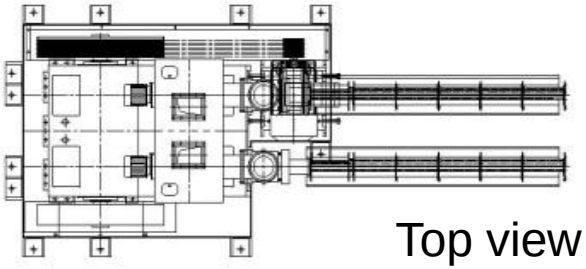
- After crushing the refrigerator, Bag-filter system captured most of **PU crushed**
- Captured PU was grinded again
- Fine (small-size) PU was made as a good SRF

- It's **not absolute**
- Types of system a
  machine can **vary in each R/C**

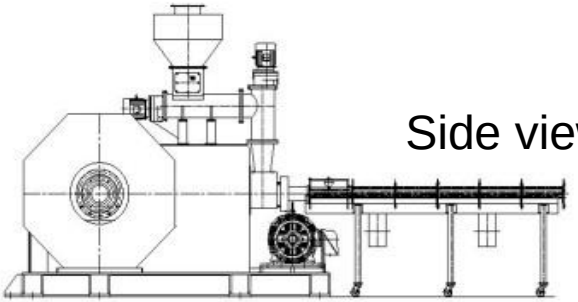
PU SRF facility

- **Introduction for PU SRF facility recently developed – Basic information**

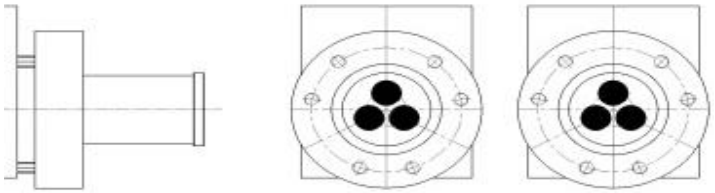
Facility Specification	Contents	
	1EA	2EA
Capacity (Productivity)	380 ~ 420 kg/hr	760~840 kg/hr
Power	175 HP (Horse Power)	350 HP
Pressure	1.2 ~ 1.6 ton/㎠	
Compression ratio	1 : 13~16	
Life expectancy	8~10 Year	
Price	USD 320,000 (Tax not included)	USD 640,000 (Tax not included
Maker	Korea Recycling Technology (KRT) [Domestic Company]	



Top view



Side view



PU SRF facility

- **Main characteristics in installation and operation**
  Increasing the recycling rate of Ref.

- **The Ref. Recycling rate is determined by the weight ratio between Ref. and Reproduced resources (Fe, Al, Cu, Plastics, etc.)**

As is

- Approximately 75~78%
  [PU foam were just waste]

To be

- Approximately 86~89%
  [PU foam were used SRF]

11% Increased

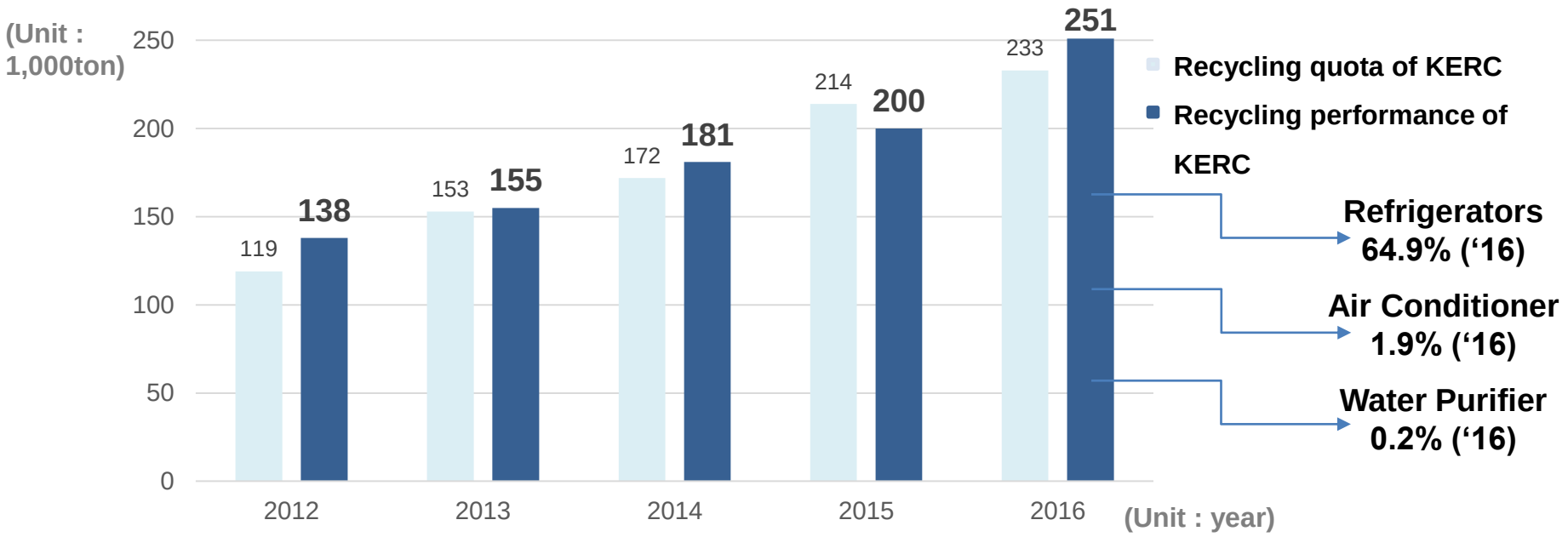
Recycling of Refrigerant

Goal

Evaluating the environmental impact of the WEEE refrigerants applying the Life Cycle Assessment (in recycling stage)

Background

- **Increasing the recycling quota and performance (KERC)**
- **〃 ratio of refrigerant-contained WEEE (Refrigerator, Air-conditioner, waster purifier)**

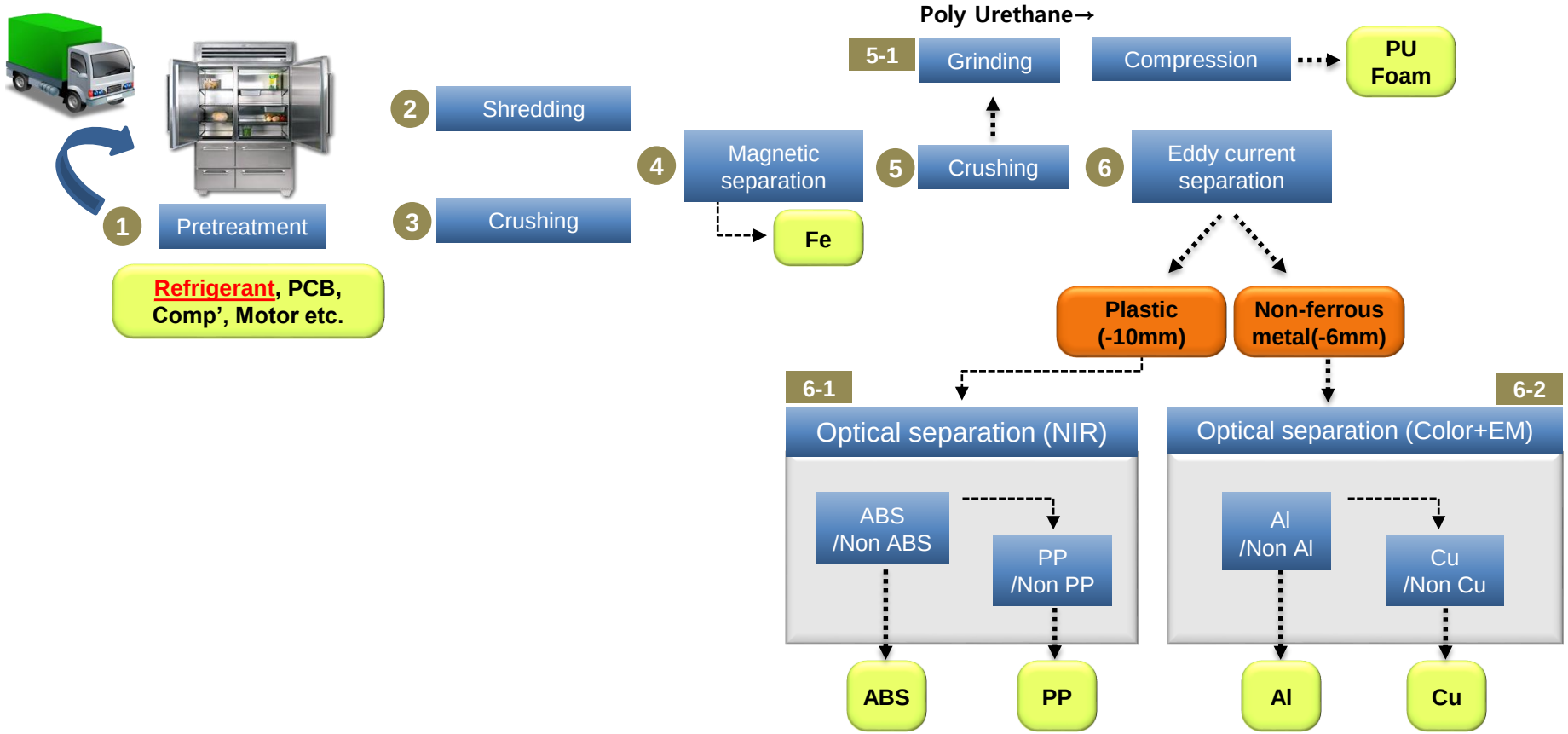


Recycling technology of refrigerant

- **Study preview – Selecting the boundary in research**

Waste/Recycling stage : Refrigerator

Recycling boundary (including transportation)



Recycling technology of refrigerant

- **Study preview – Selecting the boundary in research**

Waste/Recycling stage : Air conditioner

Recycling boundary (including transportation)

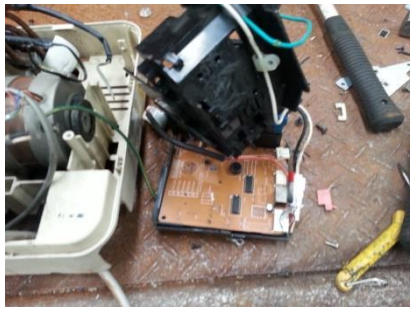
1 Pretreatment → **Refrigerant, Radiator, Comp', condenser etc.**

2 Separation (Plastics) → **Detached plastic covers**

3 Separation (Non-ferrous materials) → **Detached water Tank (Motor, Al, Fe)**

4 Separation(manually) → **Fe Plastics**

Radiator



PCB, Non-ferrous materials

Plastics

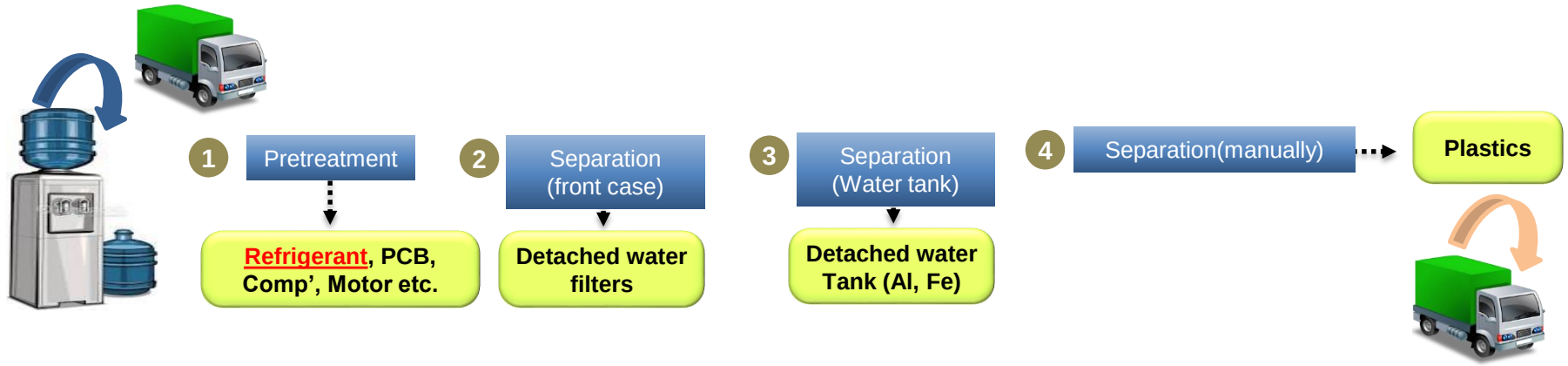
※ Transportation process : (WEEE)stored and (reproducing resources)released in MERC

Recycling technology of refrigerant

- **Study preview – Selecting the boundary in research**

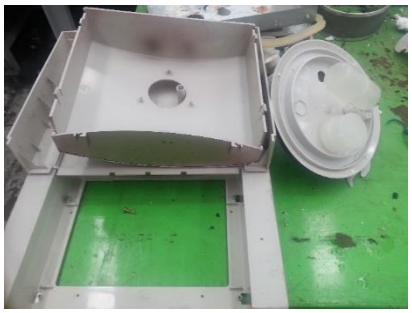
Waste/Recycling stage : Water purifier

Recycling boundary (including transportation)



Comp'

Filters



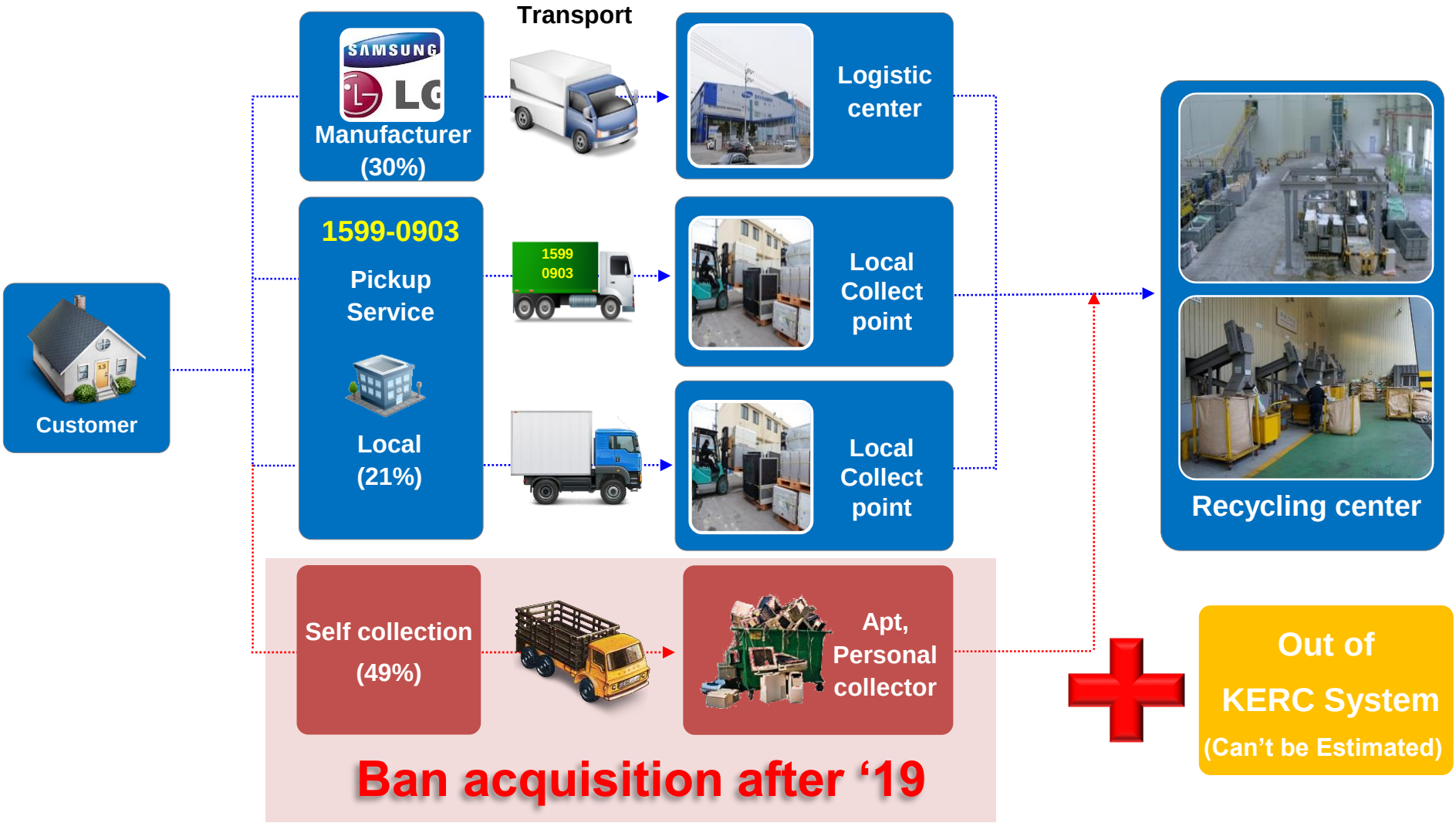
Front case

Water Tank

※ **Transportation process : (WEEE)stored and (reproducing resources)released in MERC**

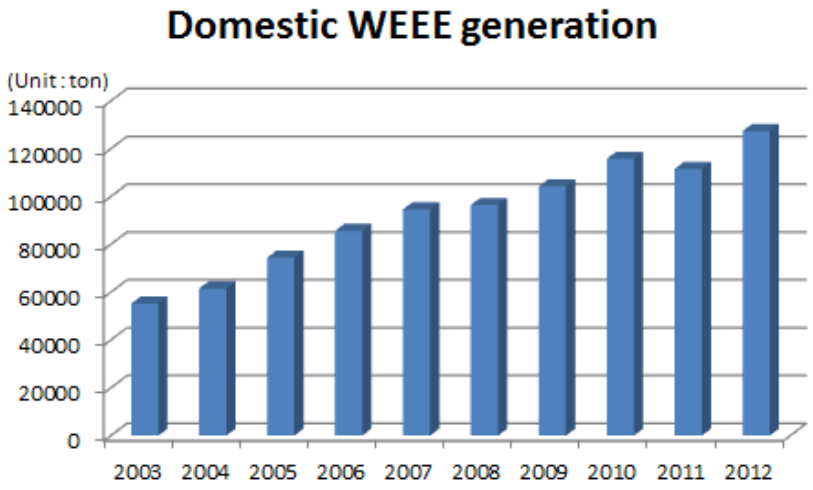
Handling of small size WEEE

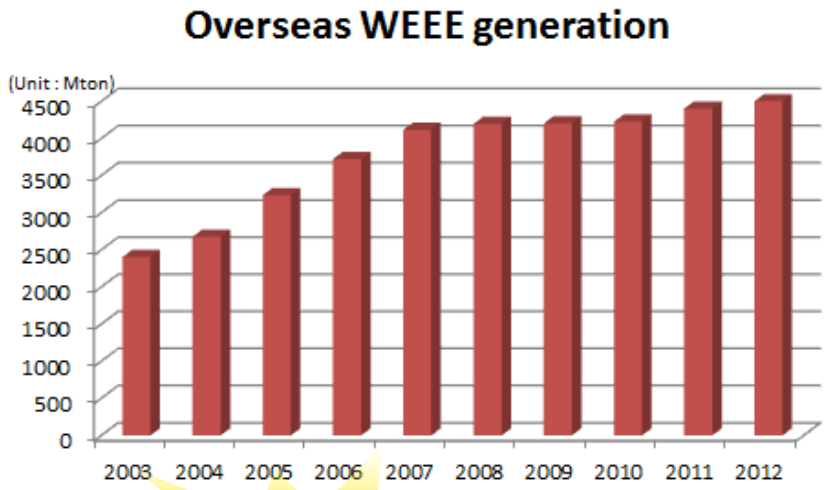
- **Small WEEE collecting system**



Handling of small WEEE

- **Status of WEEE generation**





Keep Generate WEEE

160% increase

Technologies develops -> Production & Consumption↑ enormously
-> Shortened life cycle -> WEEE generated continuously

Handling of small WEEE

- **Value of small WEEE**

Small WEEE	Value($/ea)
Audio	0.5
Bidet	1.2
Heater	0.9
Cooker	1.8
Air purifier	0.8
Softener	16.4
Fan	1.6
Blender	0.4
Cleaner	1.1
Iron	0.7
Humidifier	0.6
Video	1.0

Analysis Parts

Fe

Non-Fe

(Cu + Al)

Plastic

(Non-Black, Black)

Component

(PCB, motor,

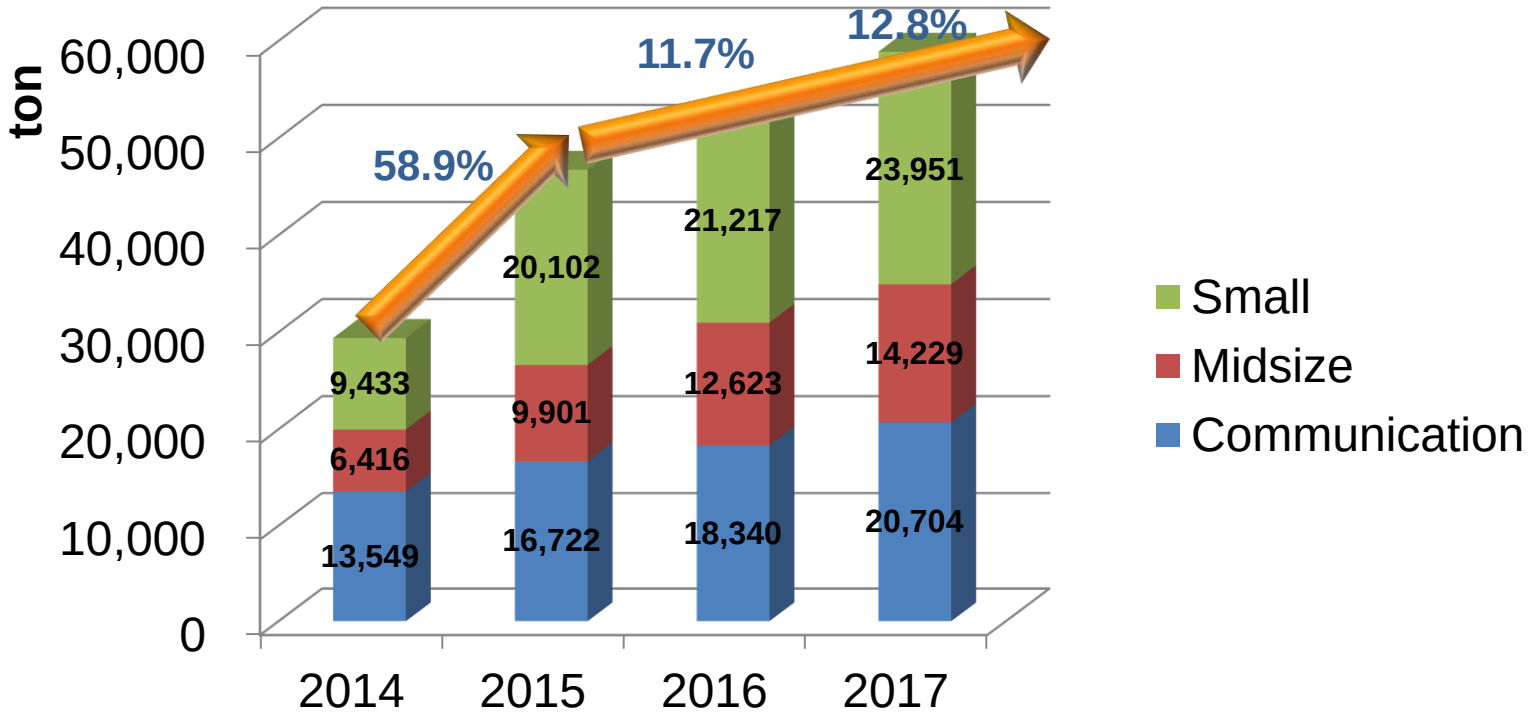
glass, wire, Etc.)

Handling of small WEEE

- **Prospect of small WEEE**

Regulatory amount of Recycling

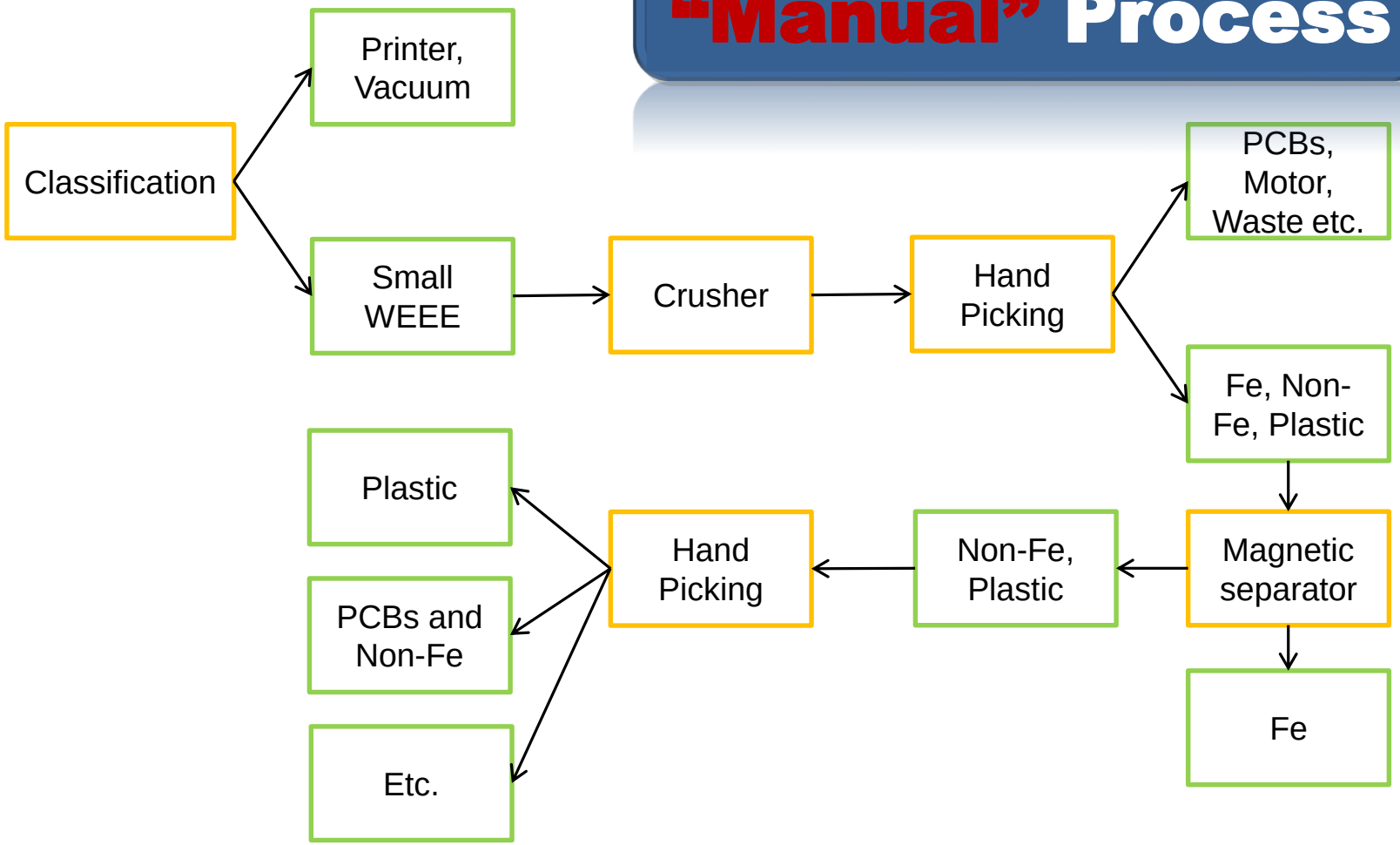
$$Annual\ Target(kg/person) \times \text{Population} \times \frac{Output\ by\ product\ in\ last\ year(kg)}{Totoal\ output\ in\ last\ year(kg)}$$



Recycling Process of Small WEEE

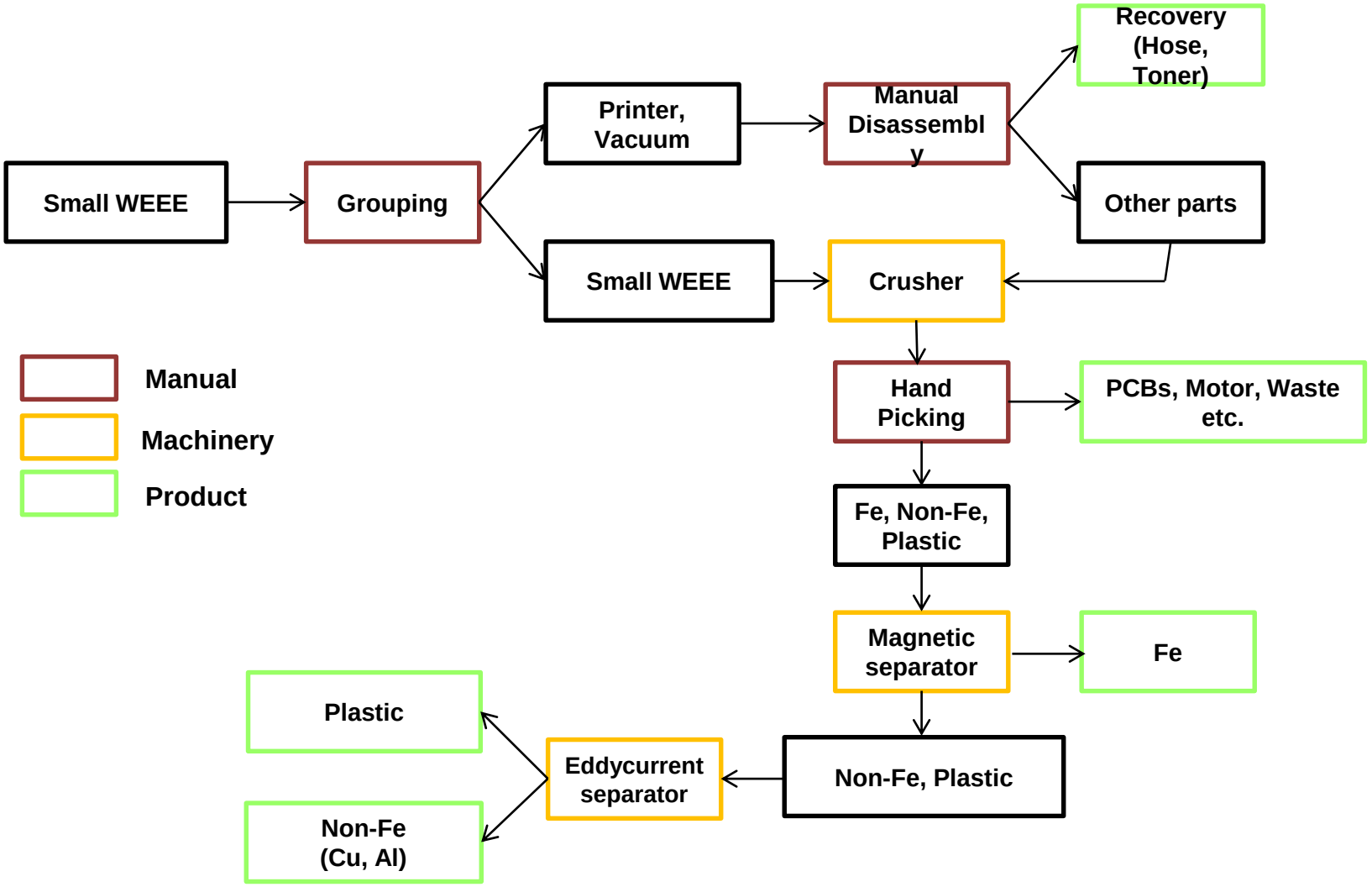
- **Recycling process in Korea**

Mostly "Manual" Process



Handling of small WEEE

- KERC(Korea Electronic Recycling Cooperative) recycling process (2 TPD)



Conclusions

- **Settlement of recycling system for WEEEs by systematic and regal efforts**
  - **Producers and sellers** actively participated in EPR system
  - Recyclers/recycling centers properly recycled WEEEs on formal section
  - MoE(government) and KERC operated recycling scheme in an effort to improve recycling rate of WEEEs
- **Expansion of the WEEEs targeted for recycling**
  - **27 electronics** targets are mandatory and were set by regulations related environment and resources (‘14~)
- **Global regulations are expanding**
  - Korea : **4.8kg/cap (‘16) → 5.4kg/cap** (‘17) (recycling target increased)

- **For achieving such requirements, Technological Interventions have been needed for better management of E-waste.**

Conclusions

- **To Resolve the Major Difficulties in E-Waste Management recently, the Following Technological Interventions were Implemented;**
  1) PU Waste to SRF for Energy Recovery
  2) Effective Recovery of Refrigerant
  3) Management of Small Size E-Wastes

- **Advantages of PU to SRF**
  · **Increasing** recycling rate of Ref. and **Saving** the total disposal costs
  · **Secure** the technology for energy recovery from PU foam
- **Improving Refrigerant Recovery Facility**
  . **CO_2 Emission Reduced from 9,163.7 tCO_2 /yr to 10,683.5 tCO_2 /yr**
- **Establishment of Small Size E-Waste Handlings**
  . **Recycling rate improved through pretreatment (Grouping) instead additional facility**
  . **Recovery of valuable materials according to the characteristics of secondary vendor (color and type)**

*** Need More Advanced Technological Interventions**

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