Integrated Management of Regional Recyclable Resources: DanYang's Example (Eco-Recycling Complex)

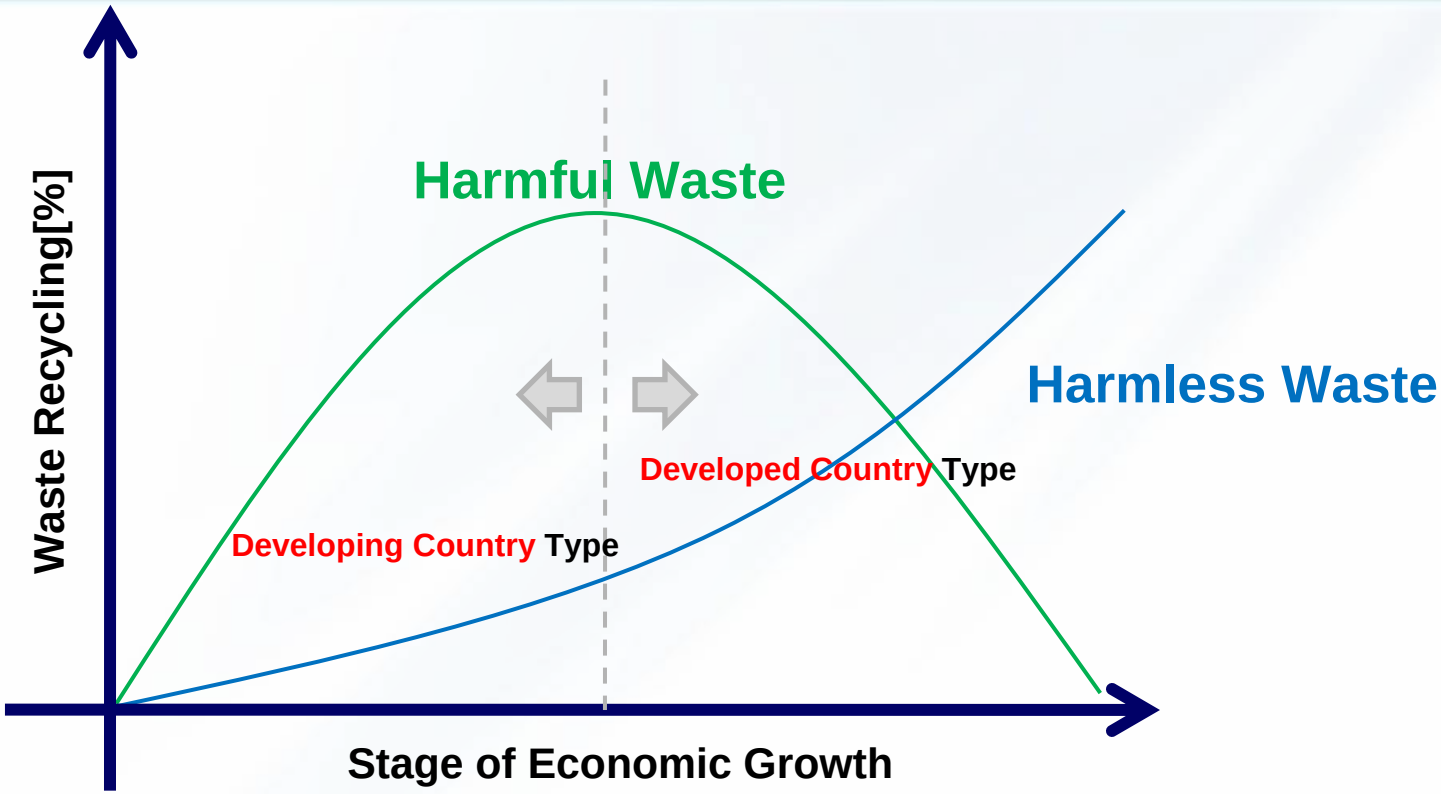
2012. 09.06

Mr. Dong Sung Kim (Mayor of DanYang-Gun)

Dr. Ji-Whan Ahn (President of KILAM)

Introduction

General Trend in Waste Recycling according to Economic Growth



As economic growth is closer to developed country type, the recycling percentage of harmful waste decreases.

- Development of waste management technology
- Expansion of material circulation management from raw materials and end products

→ Introduction of an advanced system for resource and waste by-product managements

Sustainable IE System

Sustainable Industrial Ecology system

- Introduced in the period of industrial growth of developing countries
- Initial stage of material recirculation management
- Established in each workplace of a particular industry

- Higher **competitiveness in national industry than in national environment protection**
- Created a social conflict due to environmental problems

IME System

Industrial Materials Exchange (IME) Tool

- Introduction stage of “Industrial Cluster”
- Utilized database on materials flow from each industry
- **Similar to the concept of “Waste Zero Emission”used in an industrial complex**
- Introduced in China and Mexico

- Applicable in a large scale-mixed industrial complex
- Great environmental impacts by the scale of each industry

NIME System

Dynamic Industrial Materials Exchange(DIME) System

- Advanced model of IME system
- Completed stage of material circulation management
- Introduction of storing system for re-circulated resources (higher demand & supply control function)
- Recyclable products gathering industrial complex
- A representative example: Jeonju Recycling Complex, Korea

- Higher competitiveness in national industry than in national environment protection
- To have an industrial competitiveness as a recyclable products gathering industrial complex.

Characteristics of Regional Resource Circulation Complex

- **Introduction of the concept of "National Net Zero Waste Emission"**
- **Introduction of a convergence system of national logistic network and GIS system**
- **Reinforcement of national resource circulation control function**
- **Strong cooperation between government departments**
  (Ministry of Environment, Ministry of Land, Transport and Maritime Affairs, and Ministry of Knowledge Economy, etc.)

- Establishment of a green industry model by the Ministry of Environment, Korea
- Application of an integrated management system of national waste resources

Comparison Between Industrial Ecology Complex and Resource Circulation Complex of Korea

Industrial Ecology Complex

by The Ministry of Knowledge Economy, Korea

An eco-industrial complex where generated wastes are recycled into raw materials or energy for other industries

- Existing five industrial ecology complexes in major industrial cities in Korea
- Established a local industrial cluster
- IME function
- Zero emission in an industrial complex

Reinforcement

Expansion

Resource Circulation Complex

by The Ministry of Environment, Korea

A local based eco-industrial complex for The integrated management of regional waste resources to strengthen national environmental competitiveness

Green technology + Low carbon

- Based on each region in a country
- Connection between local industrial clusters → National integration
- National DIME function (Resource management function)
- Connection between national logistics and GIS
- **National net zero emission**

Basic Principal of Planning

1. Realization of sustainable development

- Comprehensive consideration of economic and social aspects which affect the environment or environmental management

2. Connection and balance between related plans

- Acceptance of national environmental mid-term & master plans and cities & provinces' environmental protection plans

3. Space based-planning

- Utilization of space based-environmental information over the country
- Connection between environmental media based-information and GIS(geographic information system)

4. Reflection of local characteristics

- Planning by comprehensively considering spatial, ecological, economical and industrial characteristics

Characteristics of Recycling Resource Circulation Complex , Korea (Recycling Network System)

Establishment Policy of Resource Circulation Complex to Realize Sustainable Society

Environmental technology (ET)

- A representative convergence technology
- Emerged as a promising technology along with information technology (IT) and bio-technology (BT) all over the world
- But, very weak in Korea

Overseas related policy with ET

- Selected recycling technology as a promising technology for the next generation to realize sustainable society
  → Leading a new market by combining with state-of-the-art technologies

- Examples of resource circulation complexes in overseas developed countries:
  -Separated from a general industrial complex
  -Based on developing the hub of board local clusters with software industries rather than inviting hardware industries

- Created a new industry by establishing resource circulation complex such as "**Recycling Resource Circulation Complex** " connected with "Green city"

Recycling Resource Circulation Complex

CO_2 Reducing + Waste Recycling Technology

→ CO_2-Reducing Type Green Technology

● Background

- Needed solutions to reactivate weak local economy by dramatic change in the domestic industrial structure of Korea since 1982
- Difficult to invite a totally new industry in a region
- Alternative: Attractive recycling industry as a promising industry for the 21st century to realize a sustainable resource circulation society without environmental issue
- Started to strategically develop the recycling industry which creates a synergy effect with existing industries and has a bright vision for the future

Comparison of Recycling Resource Circulation Complex and Other Similar Systems

Critical Success Factors of Recycling Resource Circulation Complex

- **Administration and Human Power**
  - Increased the ability of a local government to promote a local recycling industry
  - Induced active participation of related experts and businesses and cultivated excellent government employees for waste management

- **Obligation of Opening Information on Business Occupants**
  - For understanding and cooperation between local residents

- **Business Management by Private Enterprises**
  - Required clear administrative responsibility of private enterprises

- **Waste Collection from Large Areas**
  - Collected wastes from large areas, not from a particular region (due to the development of private enterprises in an eco-town)

- **Organization of Industry-Institute-University-local Government Network from the Planning Stage of Recycling Resource Circulation Complex**

- **Maximum Utilization of Local Condition**

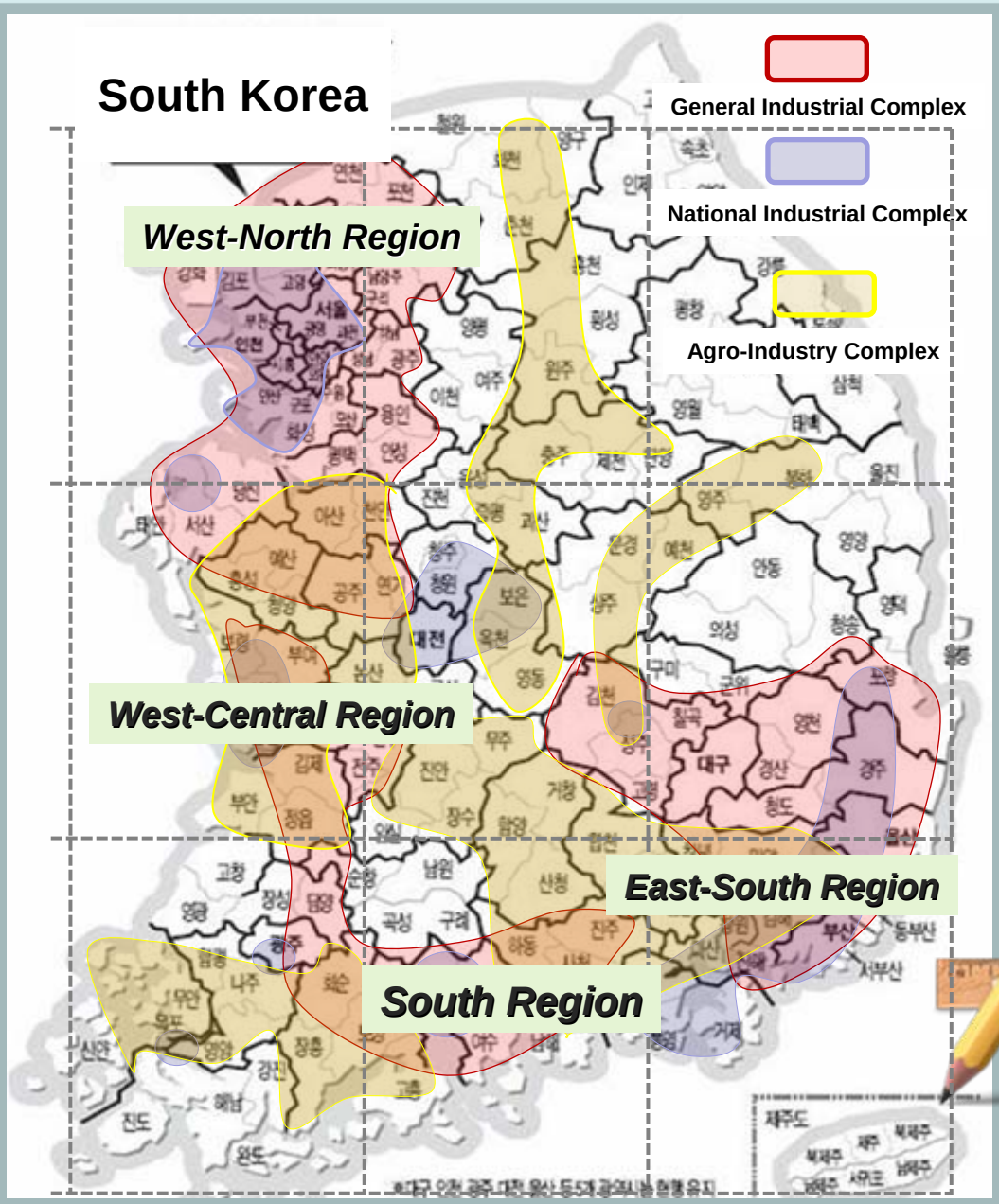
- **Connection with Existing Industries in a Region**
  - Invited and developed the recycling industry by connecting with regional existing industries such as the steel industry, cement industry, chemical engineering industry, and mining industry

Investigation of Regional Industrial Complex of Korea

National Industrial Complex Structure of Korea

(Unit: Thousand ㎡)

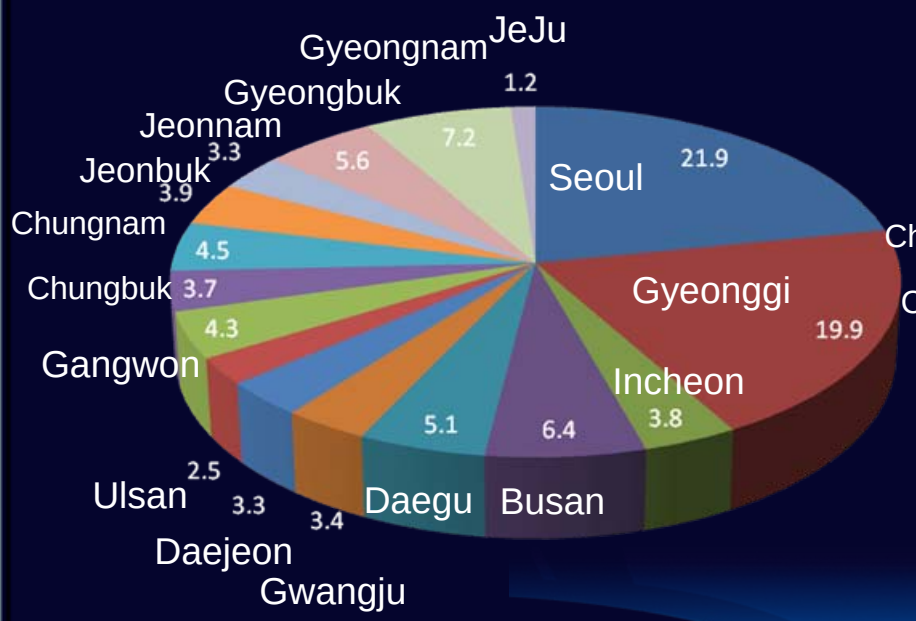
Region	Number of Complex	Space Area of Industrial Facilities
Total	**742**	**528,965**
Seoul	3	2,374
Busan	15	14,724
Daegu	13	15,697
Incheon	9	11,549
GwangJu	8	12,681
DaeJeon	3	5,818
Ulsan	14	54,411
Gyeonggi	92	53,502
Gangwon	48	9,165
Chungbuk	75	27,841
Chung Nam	117	63,664
Jeonbuk	66	51,050
Jeonnam	70	93,157
Gyeong-Buk	95	54,730
Gyoung-nam	111	57,931
JeJu	4	671



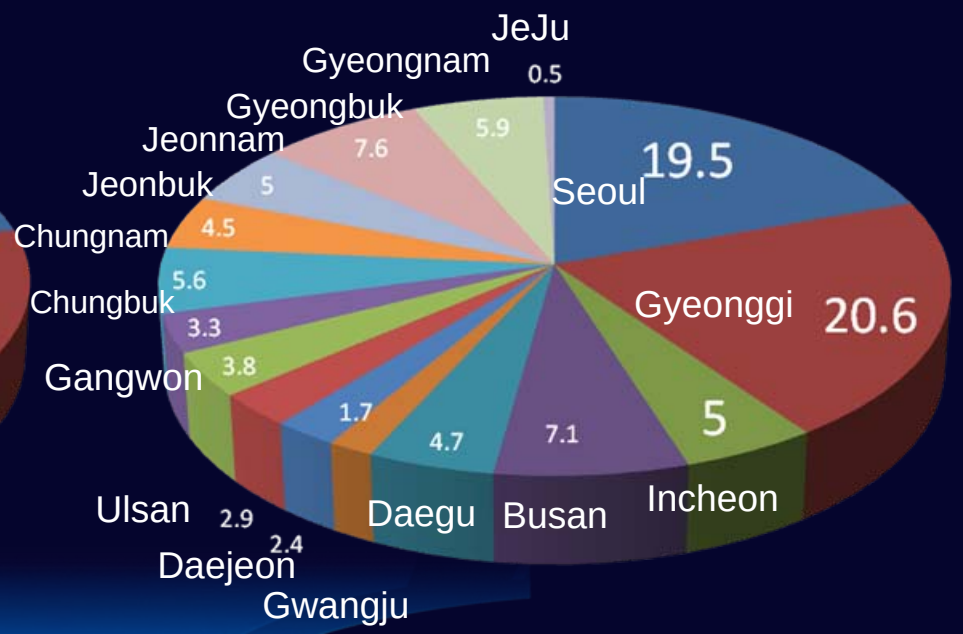
Metropolitan Area
(Seoul, Incheon, Gyeonggi)

Municipal Waste Generation Distribution

Regional domestic Waste Generation (%)



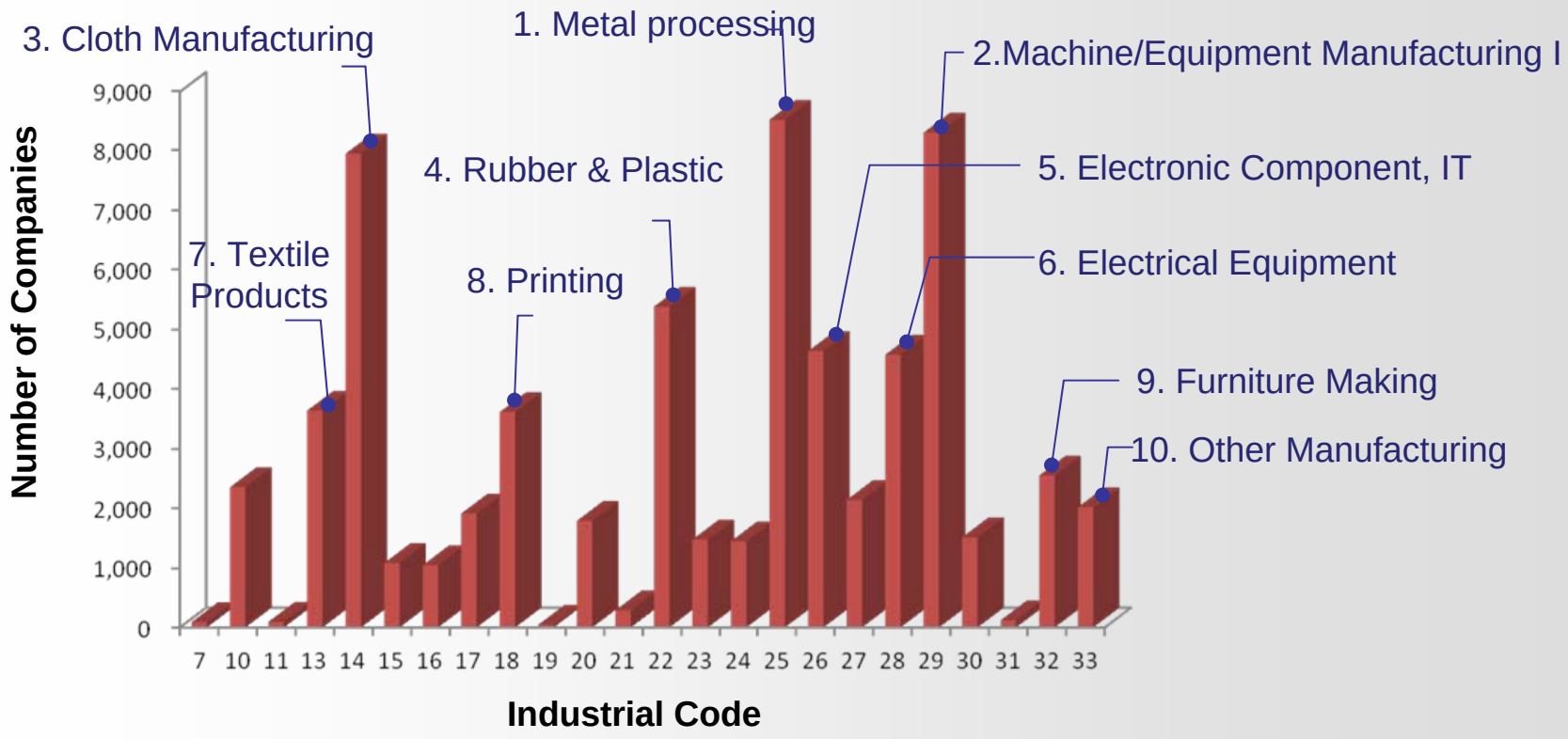
Regional Construction Waste Generation (%)



Large Quantity Generation of Municipal Waste

- **Large quantity generation of domestic waste by increase in population**
- **Large quantity generation of construction waste by city aging**

Metropolitan Industrial Infrastructure



- 66,695 companies in metropolitan area of Korea **(55.5% of total manufacturing companies in Korea)**
- Metal processing company, machine/equipment manufacturing company: in Gyeonggi Province and Inchean Industrial Complex
- Domestic products manufacturing companies: in Seoul

West-Central Region

West-Central Region

Electricity / Electronic / Semiconductor / Energy Industry

Electricity& Electronic Industries Mecca

- **Global Semiconductor Companies**
  - Samsung
  - Hynix

- Thermal Power Generation Focused Region - *20 % of Domestic Electricity*

- **Korea Midland Power Co. Ltd(KOMIPO)**
  - Headquarters : Soft Coal Thermal Power (4,000MW)
    LNG Complex Power(1,800MW)
  - Seochun Thermal Power:
    Hard Coal Thermal Power (400MW)

South Region

South Region Infra/Yeosu City

Petrochemical / Metal Processing Industry Focused Region

Yeosu Industrial Complex

- **History :** - In 1967 Yeochun Industrial Complex
  - In 1975 Yeochun Petrochemical Complex

- **Area :** 31,305 thousand m^2
- **Total Companies:** 199
- **Major Business:** - Oil Refining: 65million barrel/day (26.2% of South Korea)
  - Petrochemistry: 295 million tones/year (50% of South Korea)
  - Fertilizer: 136 million tones/year (31% of South Korea)
- **Business Statement:** Oil Refining(4 companies), Petrochemistry(110 Companies) Inorganic Metal(8 Companies), Machine(40 Companies)
- **Export:** 146 billion $(at the end of 2007)

South Region Infra/Gwangyang City

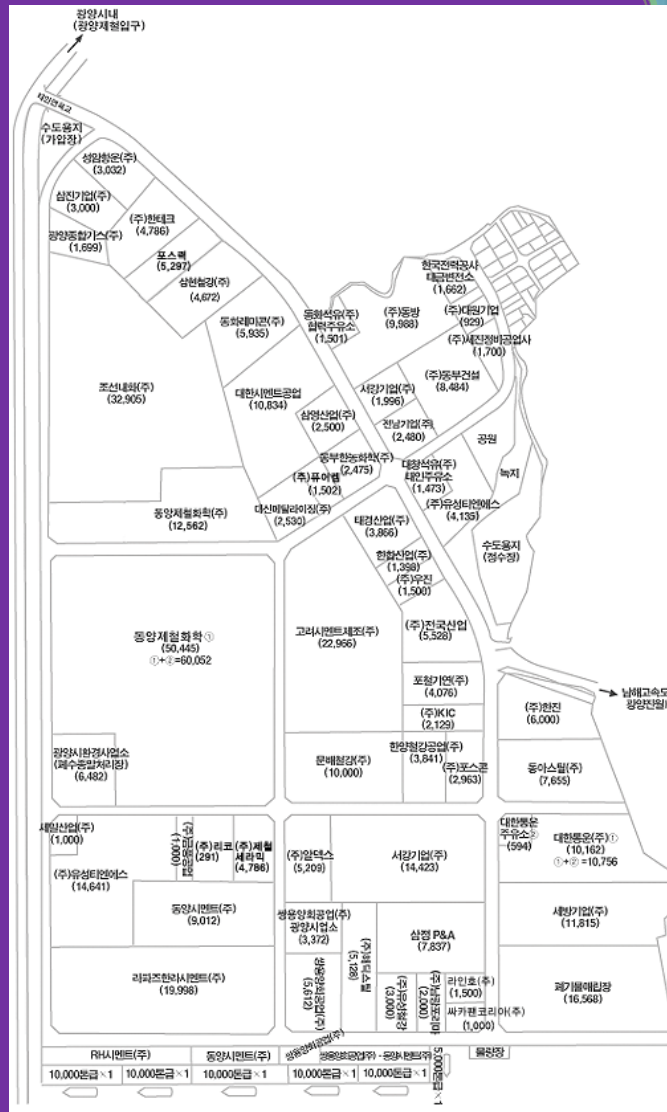
Metal Processing(Steel) Industry Focused Region

Gwangyang Steel Plant(POSCO)

- Area: 1,941m^2
- Steel Production Amount: 1,750 million tones
- Number of Employees: 6,300
- Main Product: Steel Plate for Automobile Parts

Gwangyang Industrial Complex

- Goal: To hose POSCO related industris
- Main Industry: Metal Processing, Transporting, Waste Industry
- Main Company: Oriental Chemical Industries Chosun Refractory, KOREX, Etc.
- Port Facility : - Cement Private wharf
  - Container Harbor



East-South Region
(Ulsan, Pohang)

South East Industry Infra/Ulsan Metropolitan city

Advanced new industries: **Automobile, Shipbuilding, Chemistry**

Auto Valley

- Establishment of The World's 4th largest Car Cluster (2007~Present)
- **Details**
  - Automobile Part Innovation Center (Project Cost: 758 million won)
  - Automobile Part Material Complex (607 million won, 562 thousand ㎡)
  - Module Complex (71,305million won, 865 thousand m^2)

Shipping Industry

- Hosted Shipbuilding·Automobile R&D Center
- **Details**
  - Shipbuilding·Automobile Technology Museum (107 million won, 10,734m^2)
  - RIST Ulsan R&D Institute, Hyundai Heavy Industry Co. Ltd.

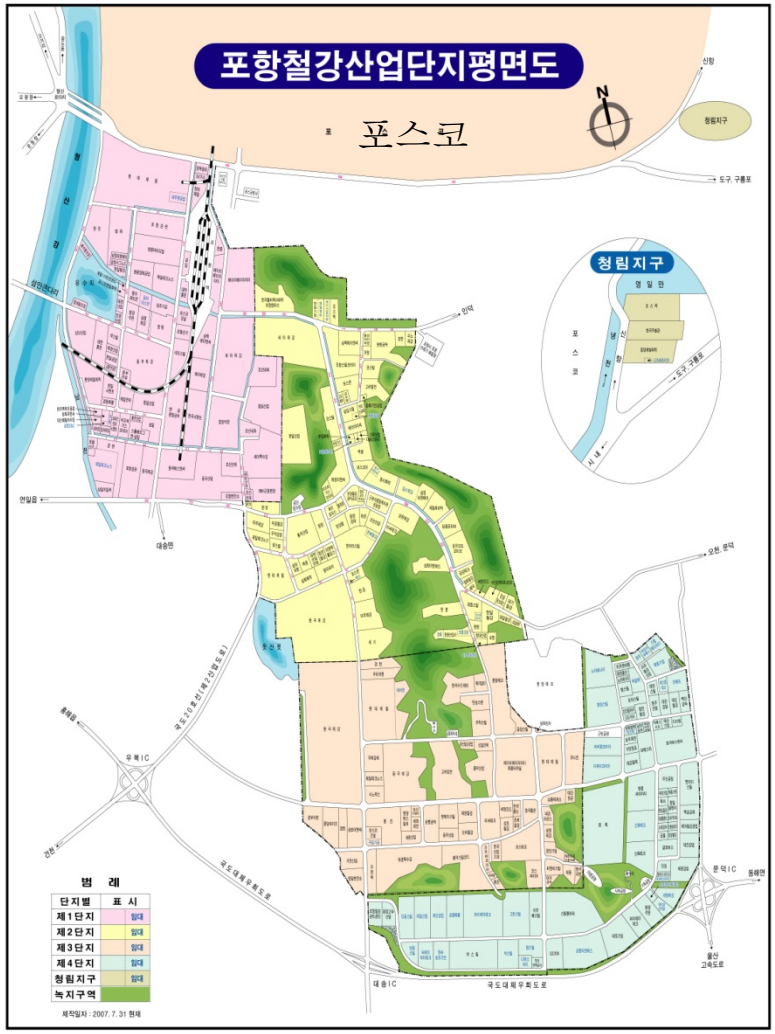
South East Industry Infra/Pohang city

Advanced Steel Industry and Next-Generation Growth Engine Industry

Pohang Steel Industry Complex

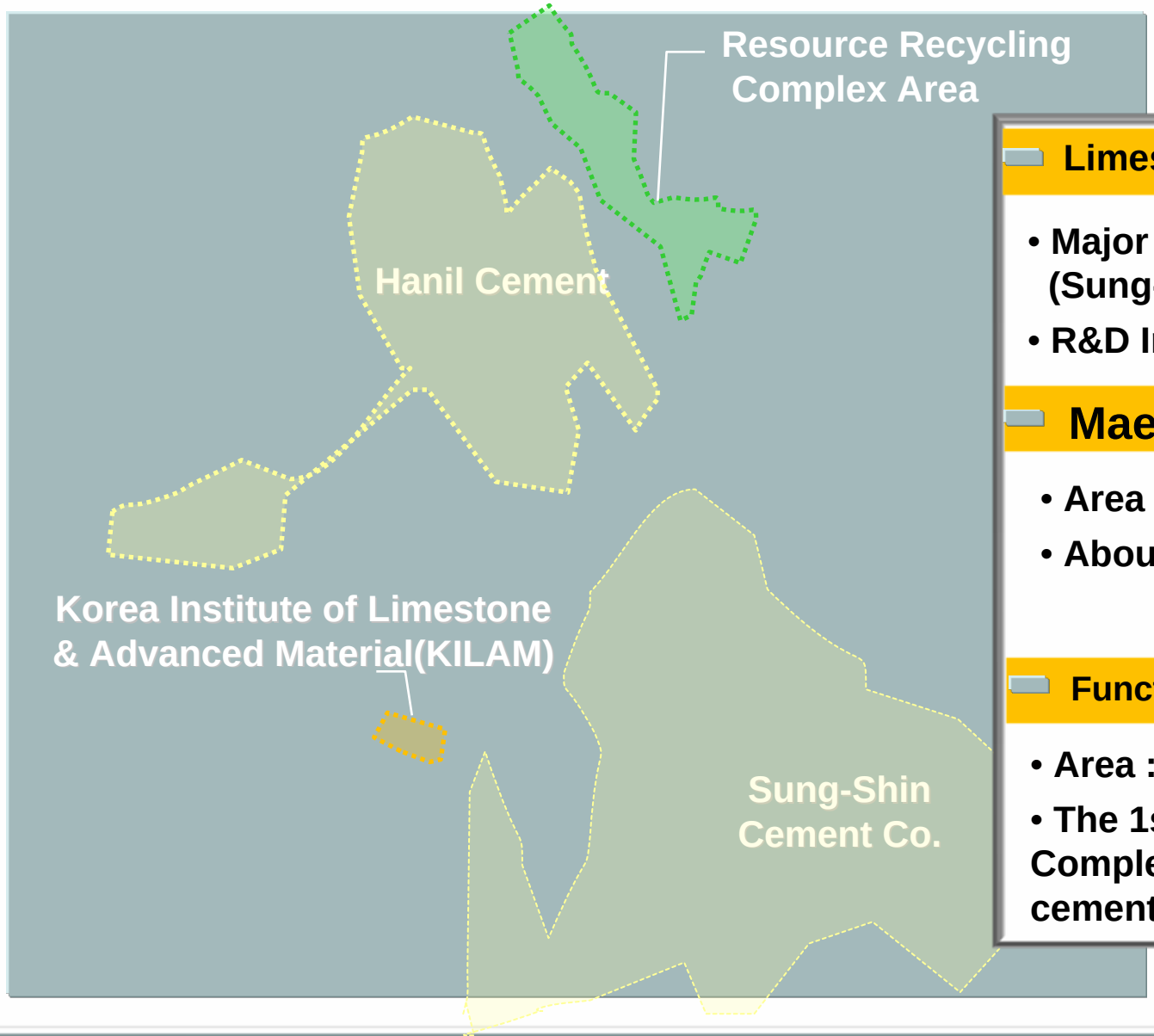
- **Area:** 22,438m^2
- **Complex Structure:** 1-4 complex, Cheonglim zone
- **Number of Companies:** 334
- **Number of Employees**: 25,559
- **Main Company**: POSCO, Hyundai Steel, Dongkuk Steel Mill Co. Ltd

  ➡ **Steel Company & Slag Recycling Company**
- **Export in 2008**: 9,733 million dollar



Case Study: Danyang

Inland Region/Danyang



Limestone Utilizing Industry Infra

- Major Cement Companies (Sung-Shin, Hanil, Hyundai)
- R&D Institute (KILAM)

Maepo EcoValley

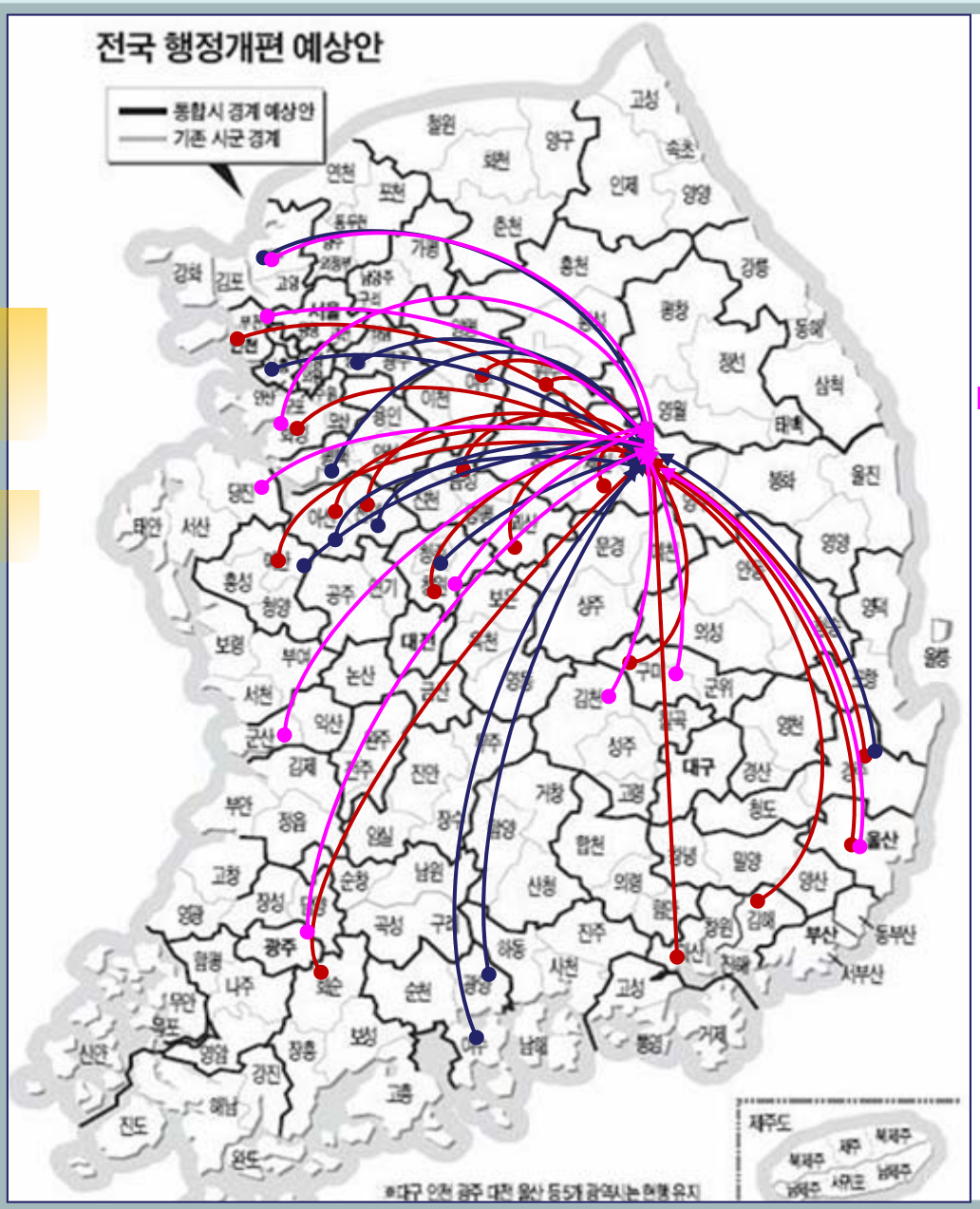
- Area : 148,853㎡
- About 10 companies

Function of Recycling Complex

- Area : about 30million㎡
- The 1st Resource Recycling Complex in Korea (linked to cement industry)

Flow Chart of Cement Industry Waste
(A Case of Recycling as Alternative Raw Material)

- **Wastewater Sludge**
- **Inorganic Wastes**
  - Incineration Ash
  - Waste lime & Waste Plaster

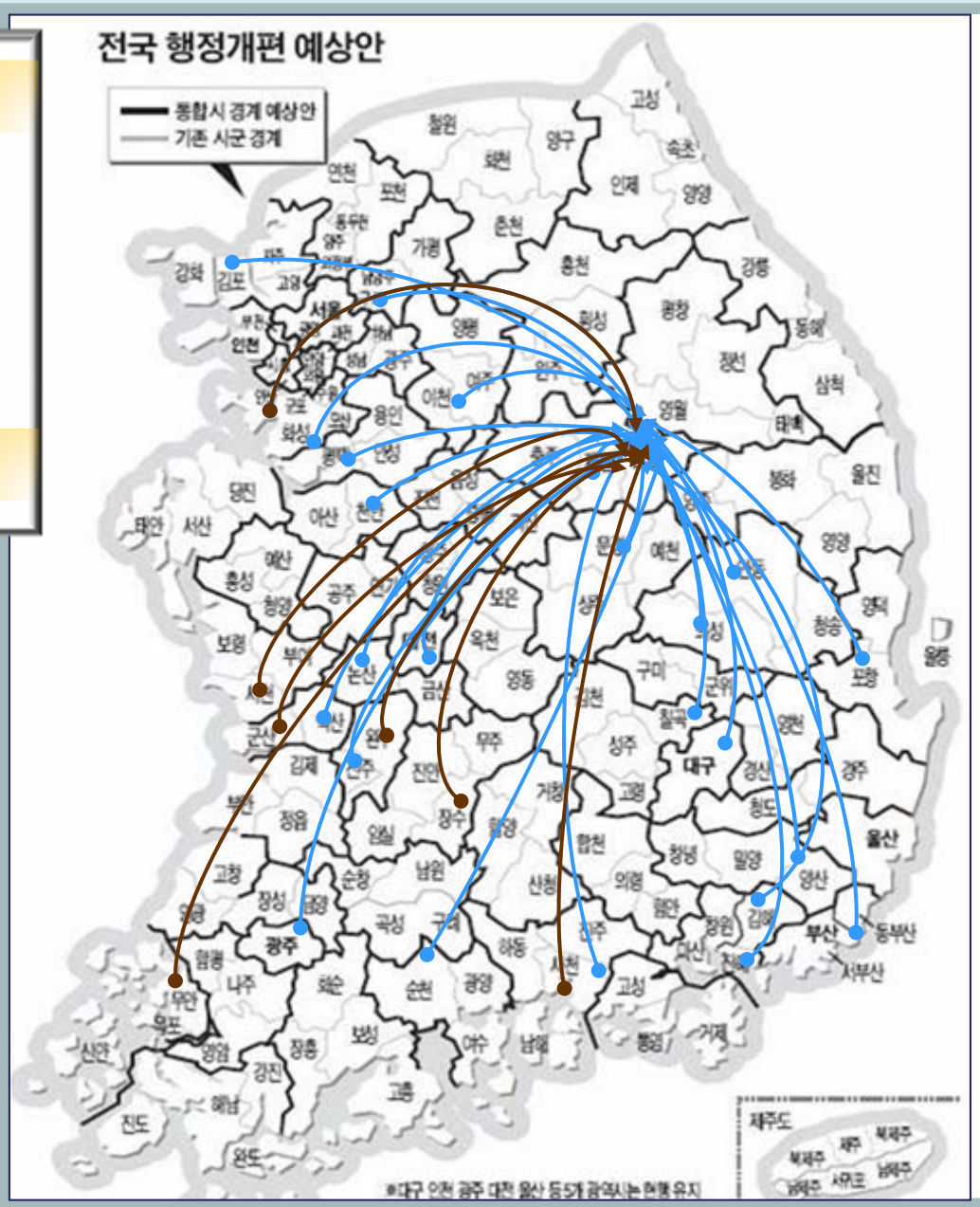


Flow Chart of Cement Industry Waste
(A Case of Recycling as Alternative Raw Material)

Waste Molecular

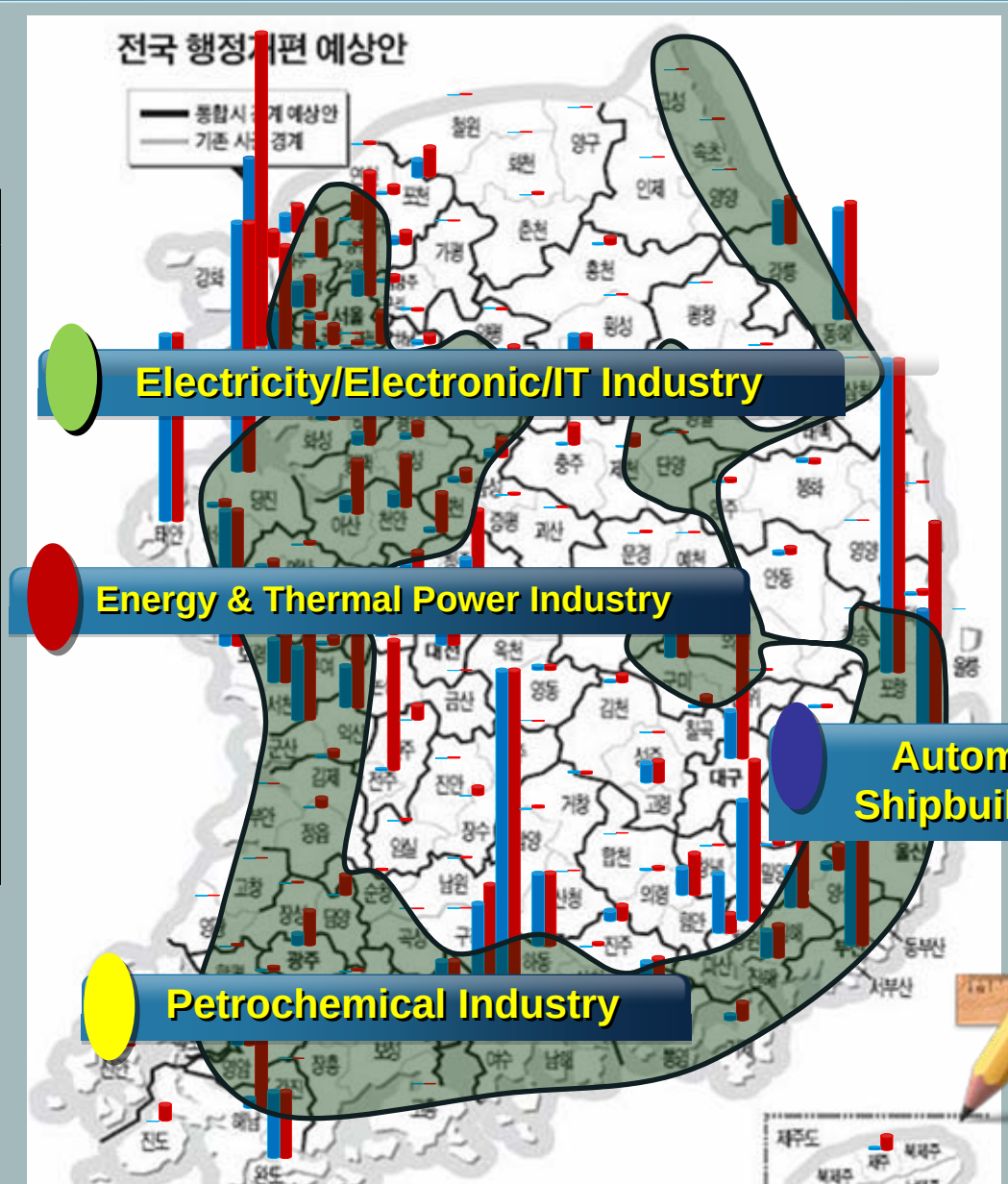
- Waste Rubber
- Waste Resin
- Waste Tire
- Waste Oil

Water Sludge



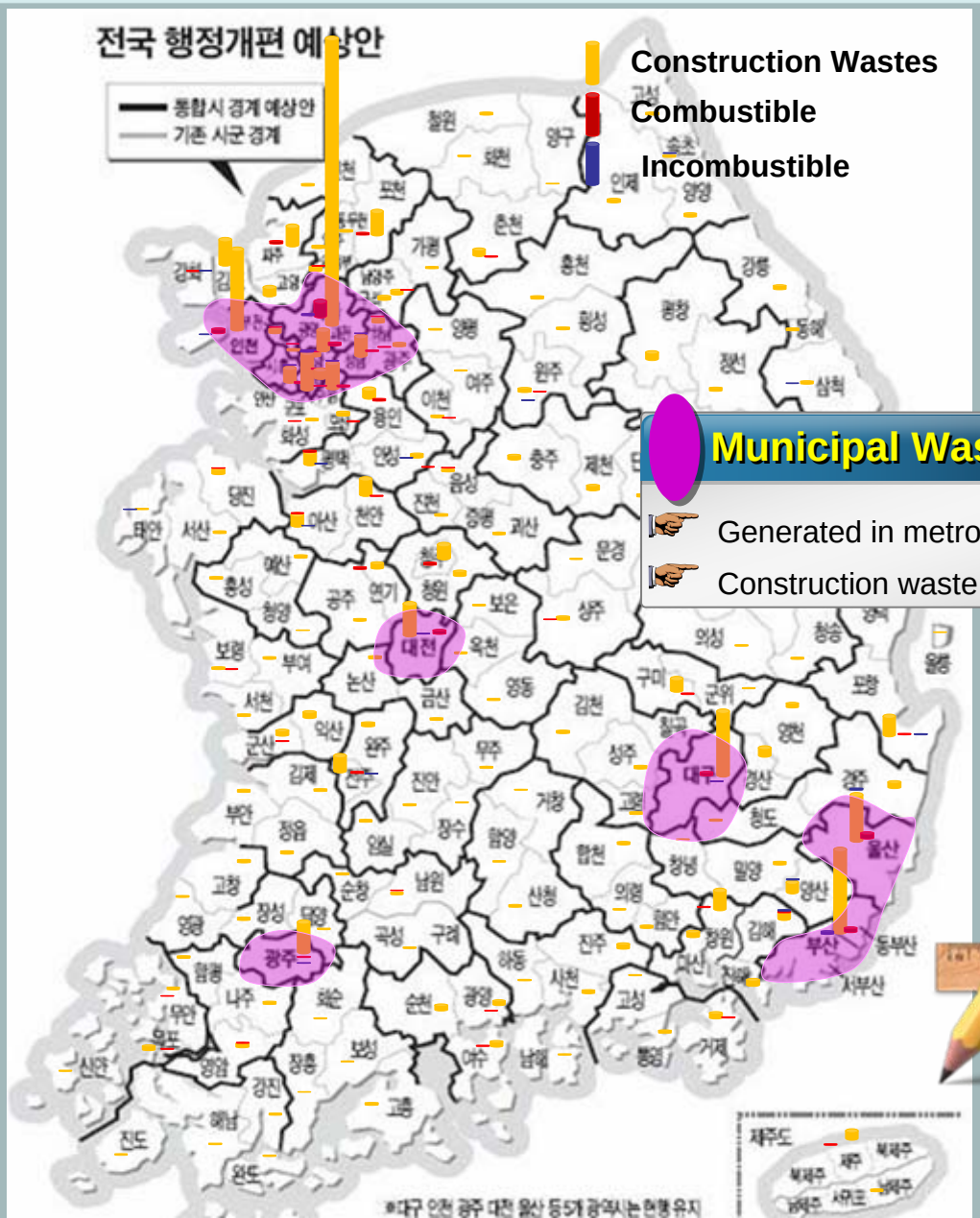
Distribution Diagram of Municipal Domestic Waste in Korea

	TYPE
Combustible wastes	· Waste Paper · Waste Lumber · Waste Fiber · Waste Resin · Waste Leather · Organic Sludge · Waste Cooking oil
UnCombustible Wastes	· Slag · Incineration Ash · Dust · Waste Metals · Waste plaster & Waste Lime · Waste Catalyst · Glass, Ceramics

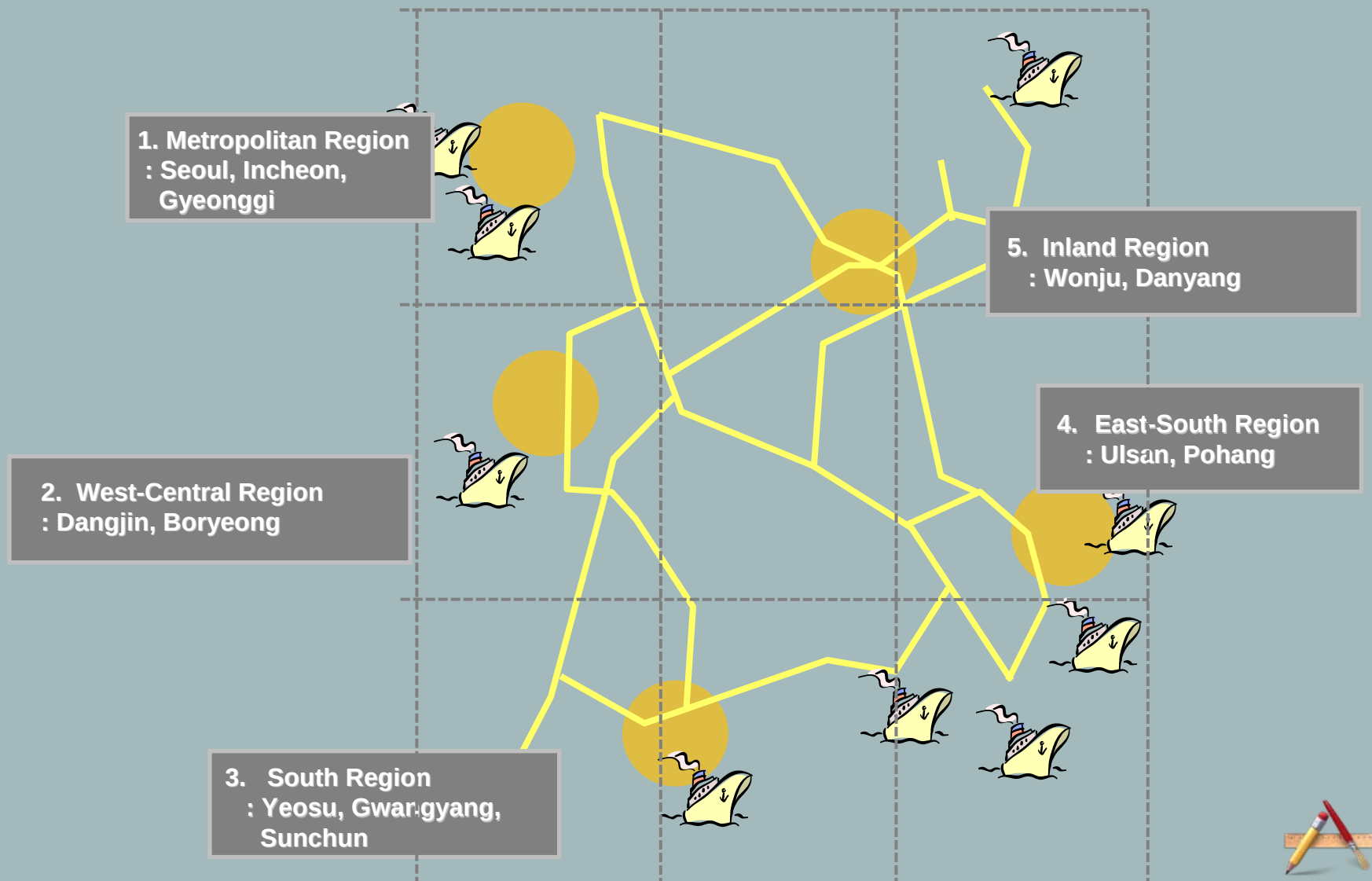


Waste Status in Korea: Construction Waste

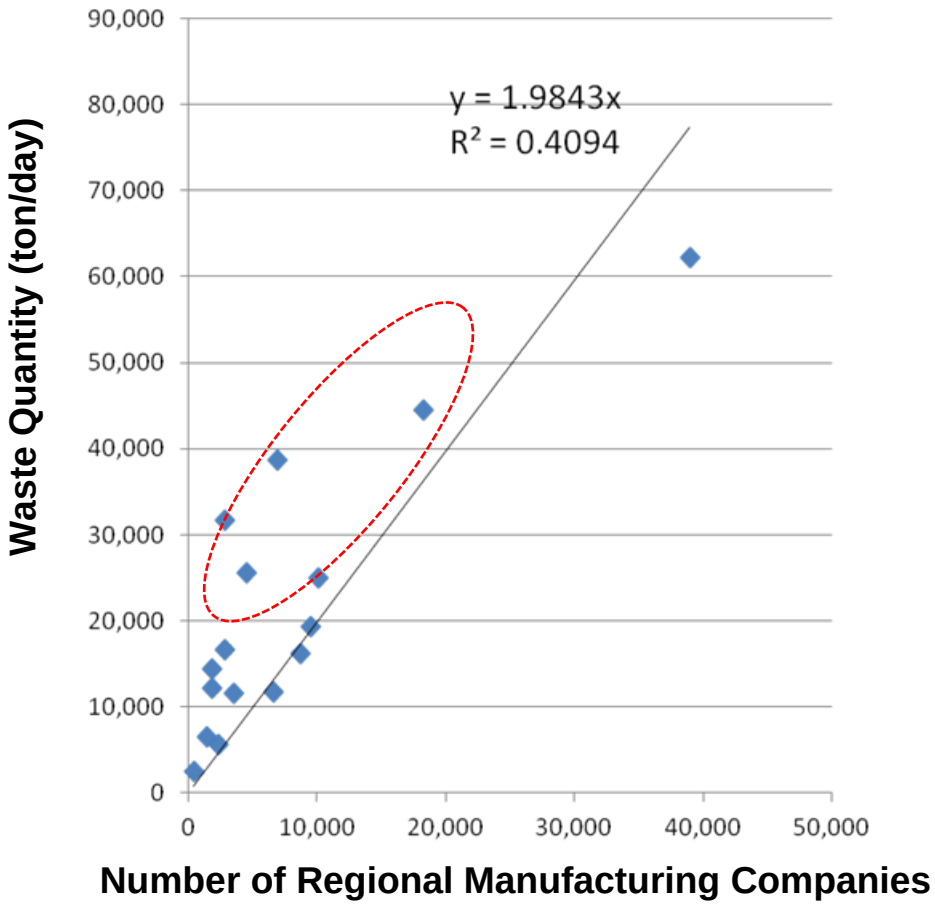
	TYPE
Construction Wastes	• Waste Concrete • Waste Brick • Waste Tile • Waste Block • Waste sand
Combustible	• Waste Lumber • Waste Resin • Waste Fiber • Waste Wallpaper
Incombustible	• Construction Sludge • Waste Metals • Waste Glass

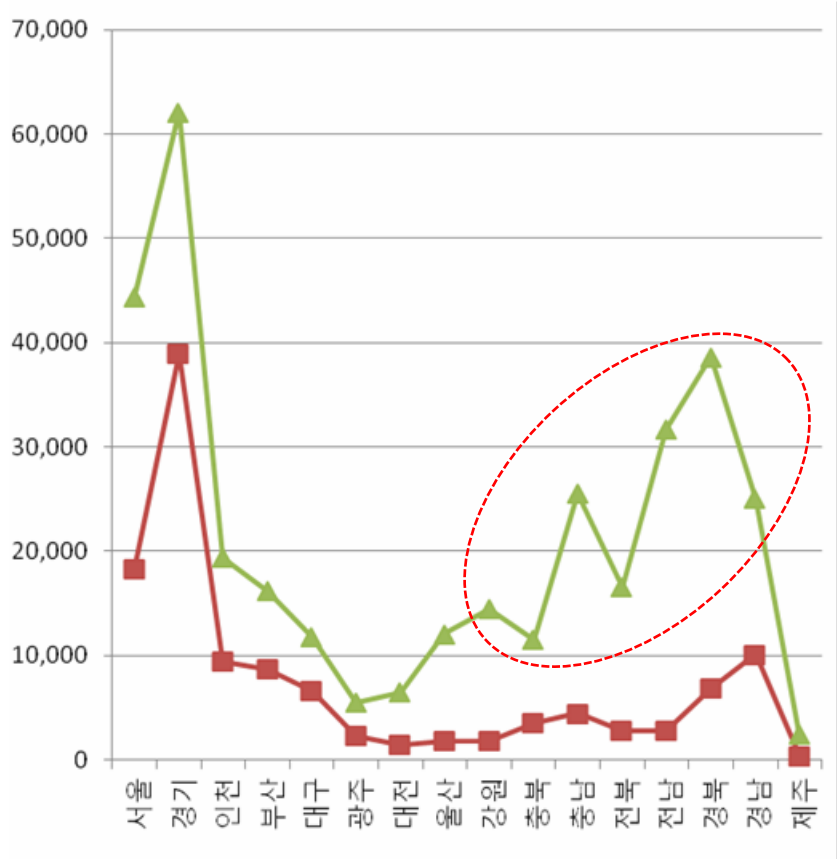


Potential Areas of Next Resource Circulation Complex and Distribution Traffic Network



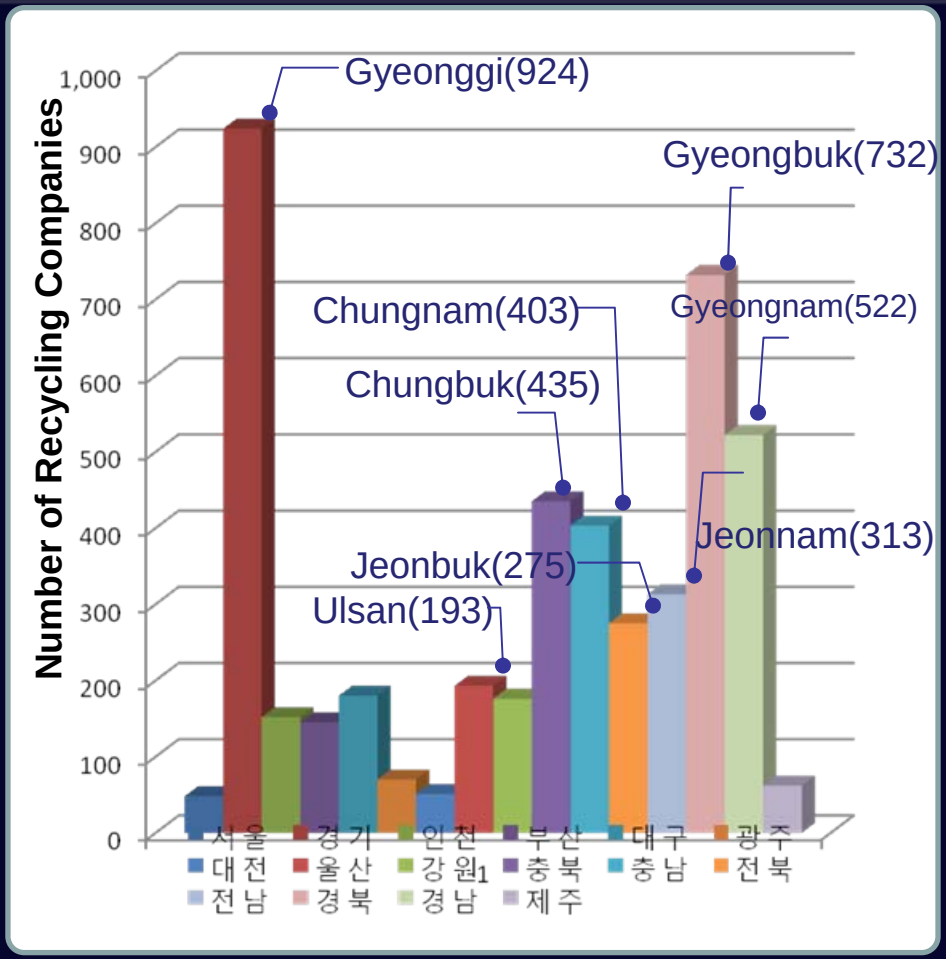
Relation Between the Number of Manufacturing Companies and Waste Quantity

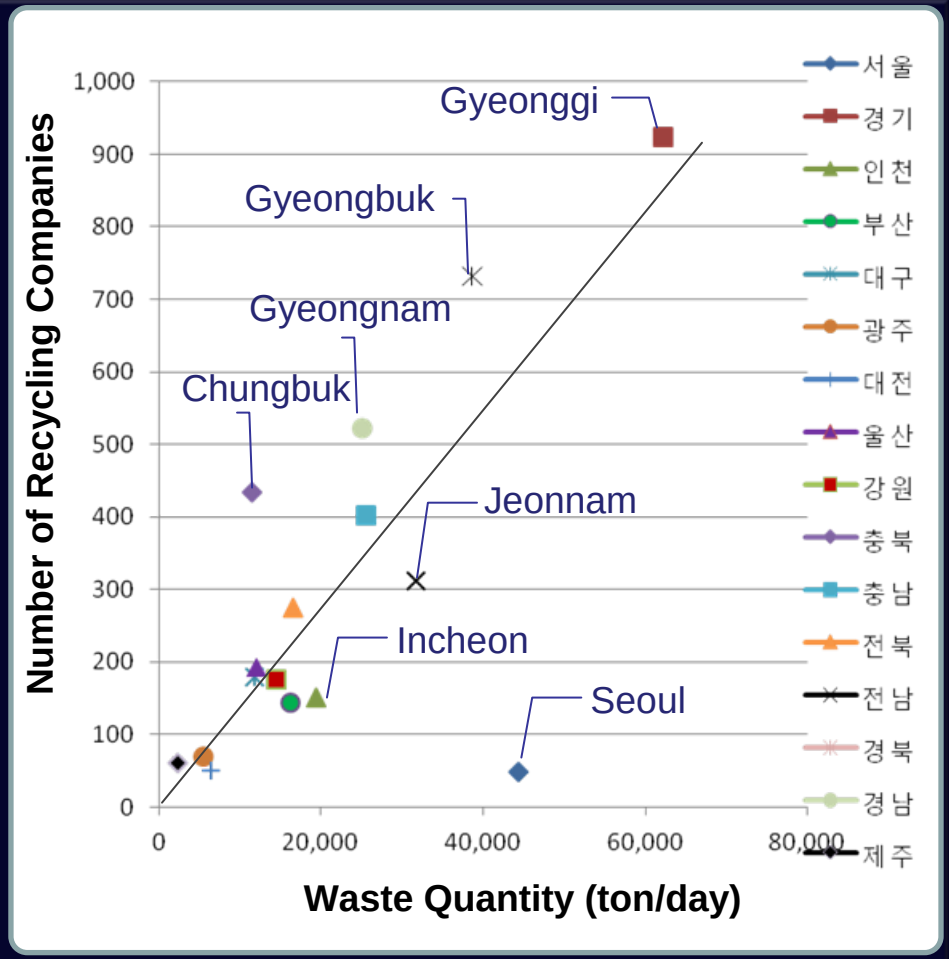




- The more number of regional manufacturing companies, the more waste quantity (but, not exactly in a direct proportion)
  → Indicating waste quantity is greatly dependent on a particular region or industry
- Estimated the biggest waste quantity from manufacturing companies in Kyeongnam Province, Jeonnam Province, and Choongnam Province in Korea

Relation Between the Number of Recycling Companies and Regional Waste Quantity





- The order in the number of regional recycling companies:
- The provinces: Gyeonggi > Kyeongbuk > Kyeongnam > Chungbuk > Jeonnam > Jeonbuk Province
- The metropolitan cities: Ulsan > Deagu > Inchen > Busan

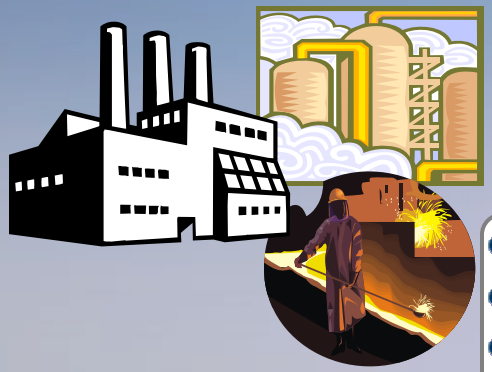
→ **Recycling companies for wastes quantity in Jeonnam, Incheon, and Seoul are less distributed compared to other areas**

In particular, much less number of recycling companies in Incheon and Seoul

Expected Effect of Recycling Resource Circulation Complex

Existing System

Industry (Waste Source)



Cement Company

Problems

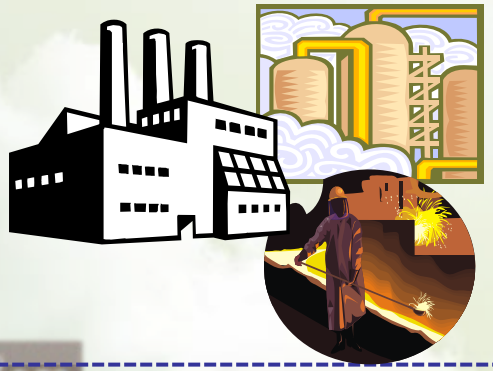
- Insufficient waste quality management
- Insufficient waste treatment management
- Concerned about environmental pollution near cement companies
- Insufficient safety of cement related products

Problems

- Needed big investment in facilities for utilizing wastes into raw material or energy
- Difficult in products usage due to big quality difference between end products
- No stable materials quantity

Resource Circulation Complex Introduced New System

Industry (Waste Source)



Cement Company

Expected Effects

- Available waste quality and heavy metals level management
- Available waste circulation database
- Available standard collection and analysis methods of raw sample
- More confidence with participations of regional administrative institutes and residents
- A representative model: “Resources Recirculation Specialized Complex (RRSC)” of The Ministry of Environment, Korea

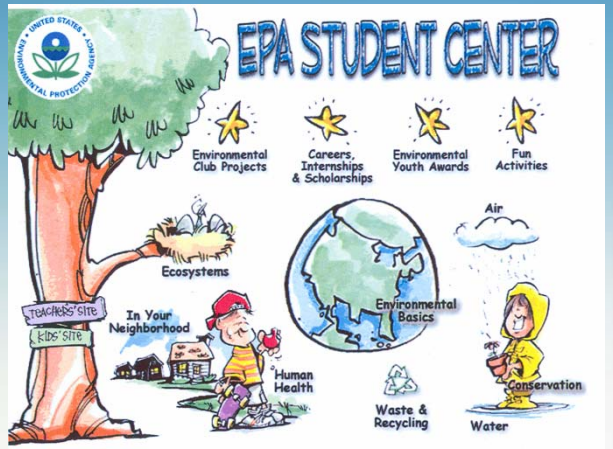
Concept of the Eco-Museum@Danyang

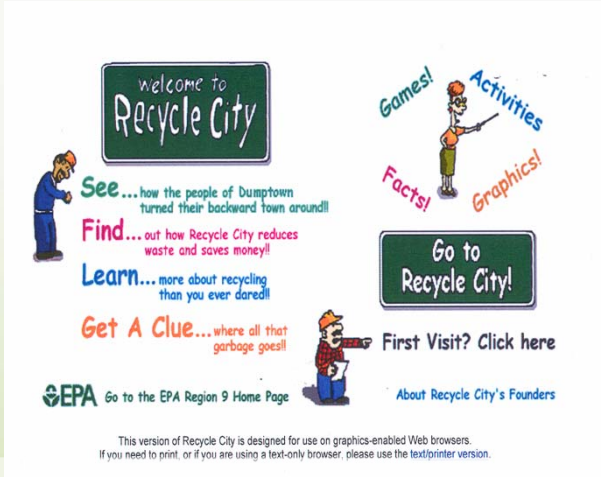
Eco-Education in the US

Applet

Games

- **Environauts Mission to Earth**
  HTML popups
- **Detective Training**
  - Hidden Hints
  - Materials Lineup
  - P.I. in the Sky





View Large Version

Interest → Experience → Education

Roles of Organizations for Eco-Education

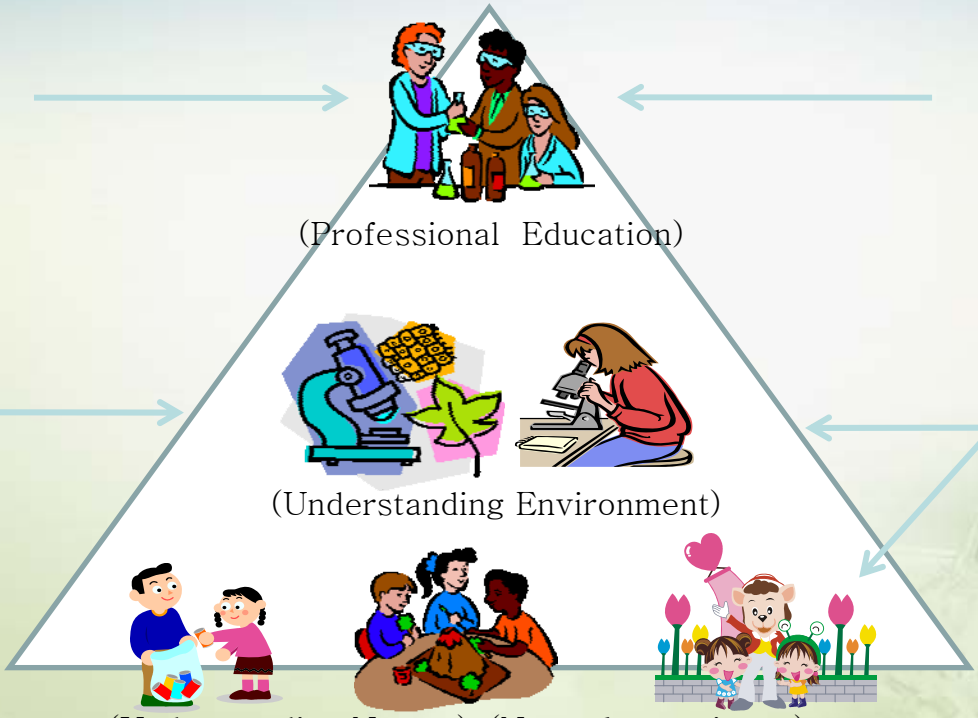
Theme Park

Regular Education

•University

Middle- and
High- Schcool

•Elementary School



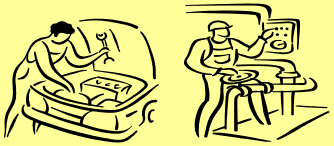
(Professional Education)

(Understanding Environment)

(Understanding Nature), (Natural experience)

Irregular Education

- National Institute



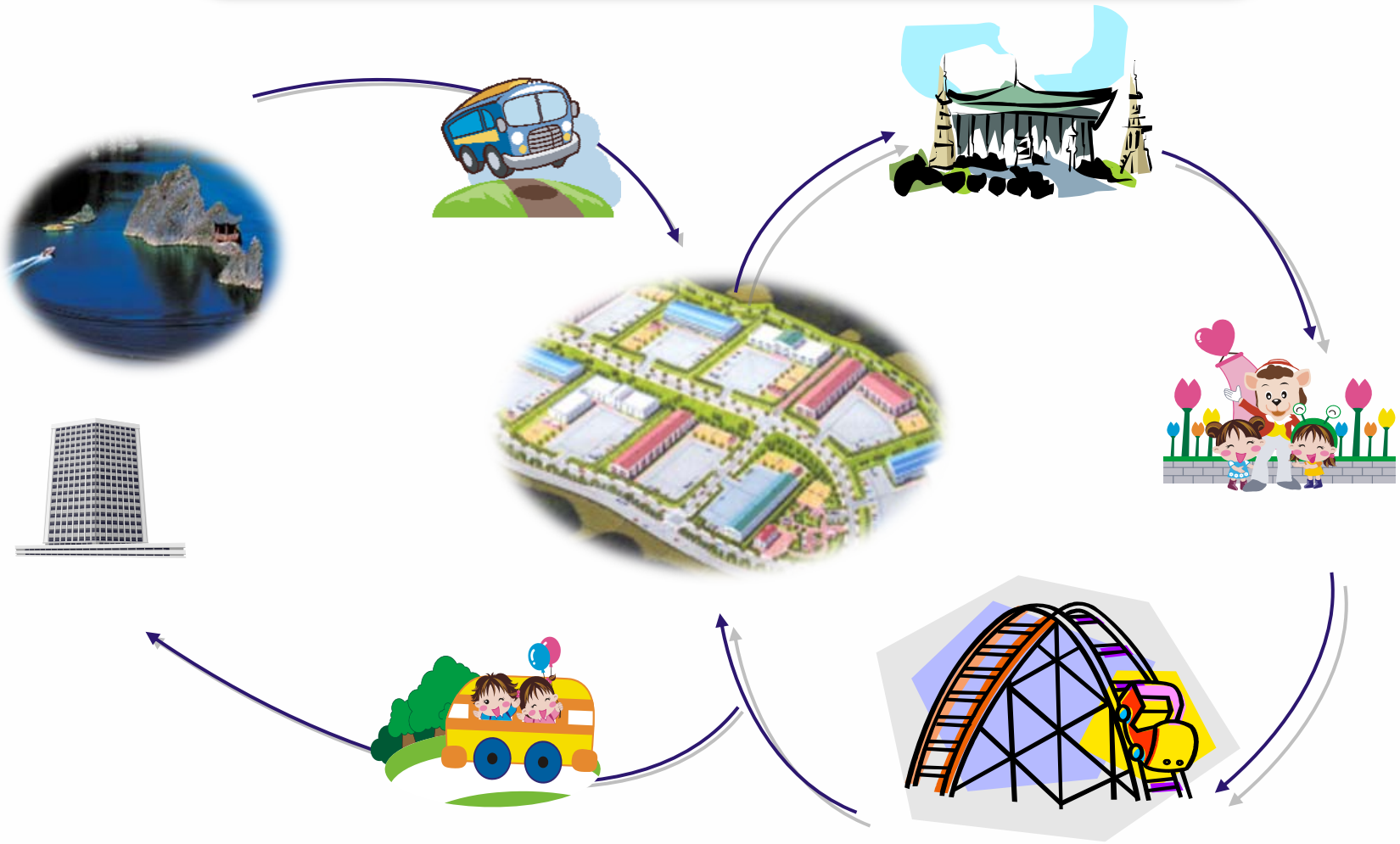
- Foundation

- Museum of Natural History

Plan of the Eco-Museum Construction

단양군
함께 만들어요 행복한 단양!

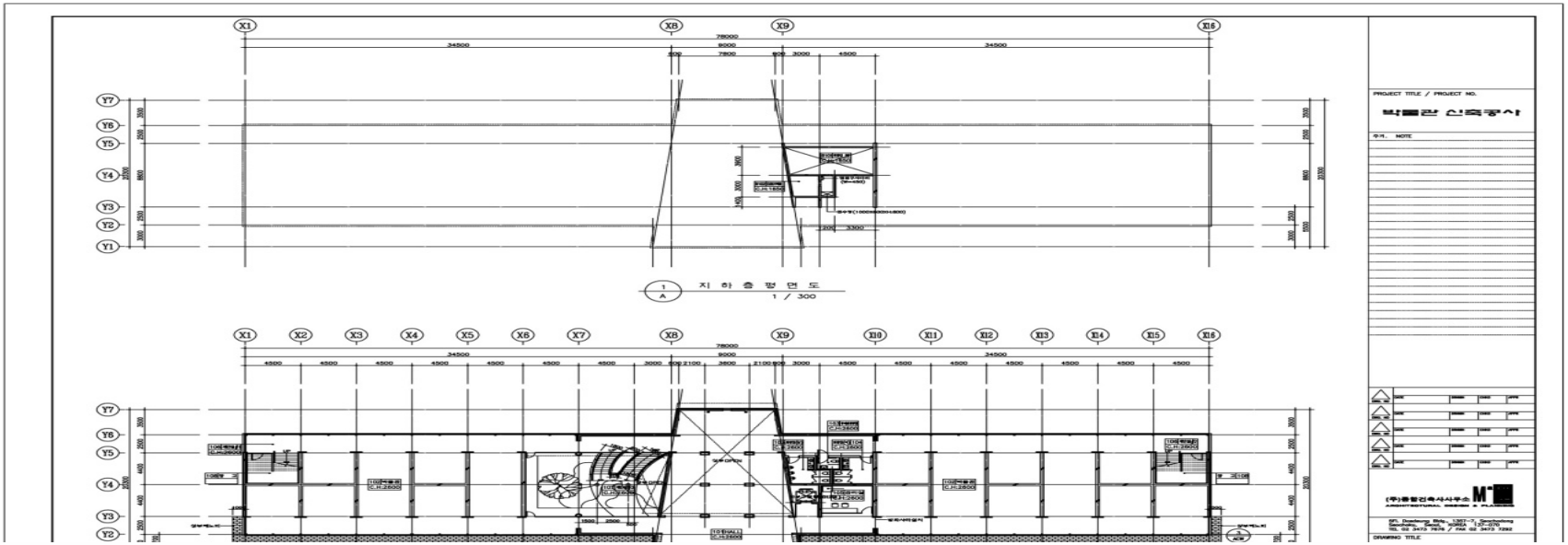
Theme Park @ Danyang



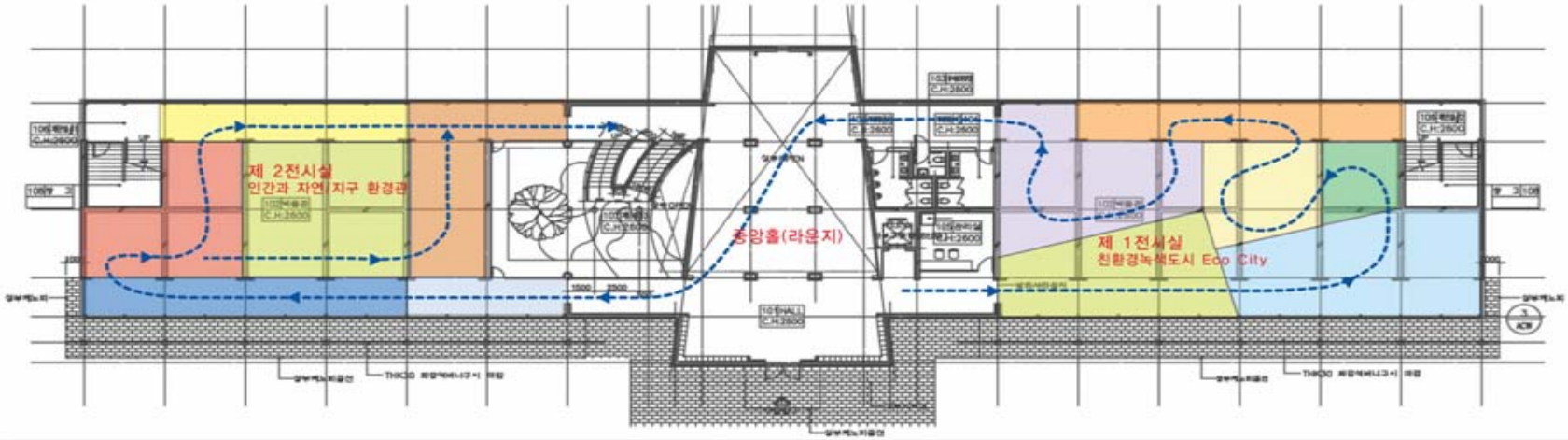
Eco-Museum@Danyang

Story	Area	
	M^2	Pyeong
B1	11.17	3.38
1F	1144.98	346.35
2F	944.73	285.80
Total	**2,100.88**	**635.53**

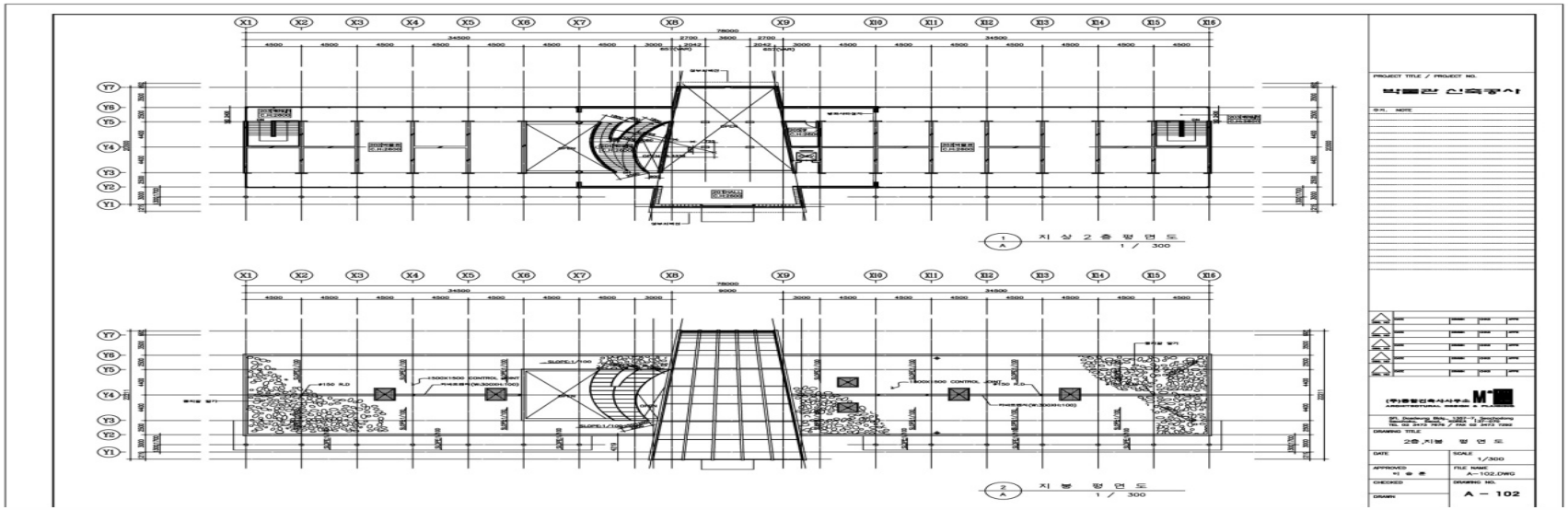
Eco-Museum@Danyang



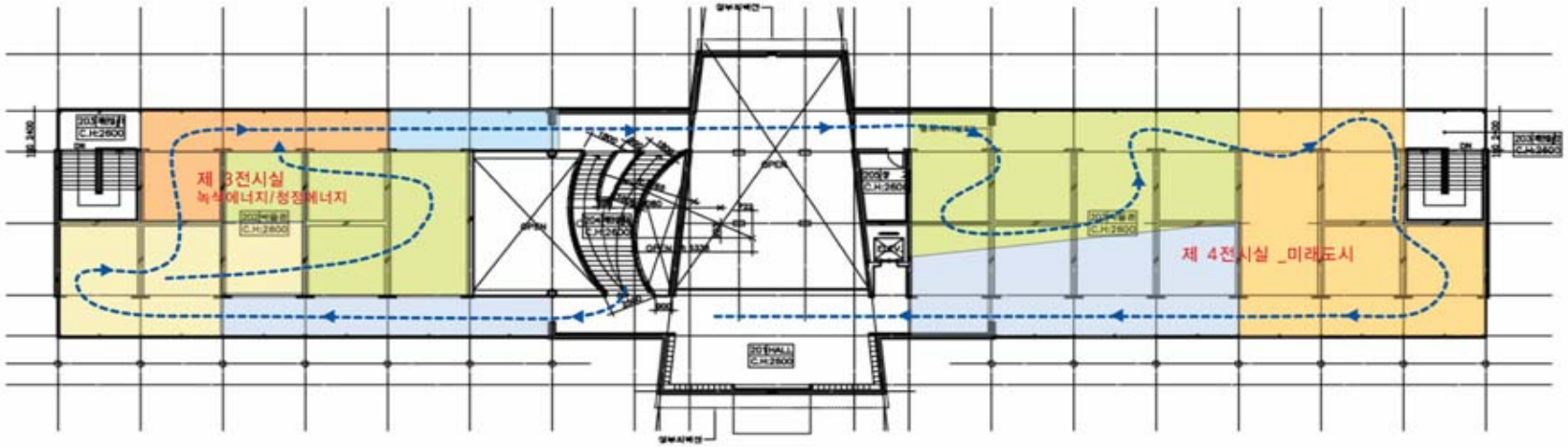
1층 전시 스토리라인 계획



Eco-Museum@Danyang



2층 전시 스토리라인 계획



Connection Model Between Regional Recycling Resource Circulation Complexes

National Waste Integration Management System

Municipal Waste Focused Resource Circulation Complex

- Municipal Waste and Construction Waste
- Landfill waste circulation and landfill gas utilization

Urban Mine Industry Belt

Electricity/Electronic/IT/Energy Resource Circulation Complex

- Electric and electronic products circulation complex
- Renewable energy circulation complex for thermal power generation

Renewable Energy Industry Belt

Heavy Chemical/Petrochemical Industry Resource Circulation Complex

- • Renewable energy resource circulation complex for combined material production
- • Slag circulation complex

Cement Industry Focused Resource Circulation Complex

- Growth of alternative raw material/energy industries

Material Circulation Industry Belt

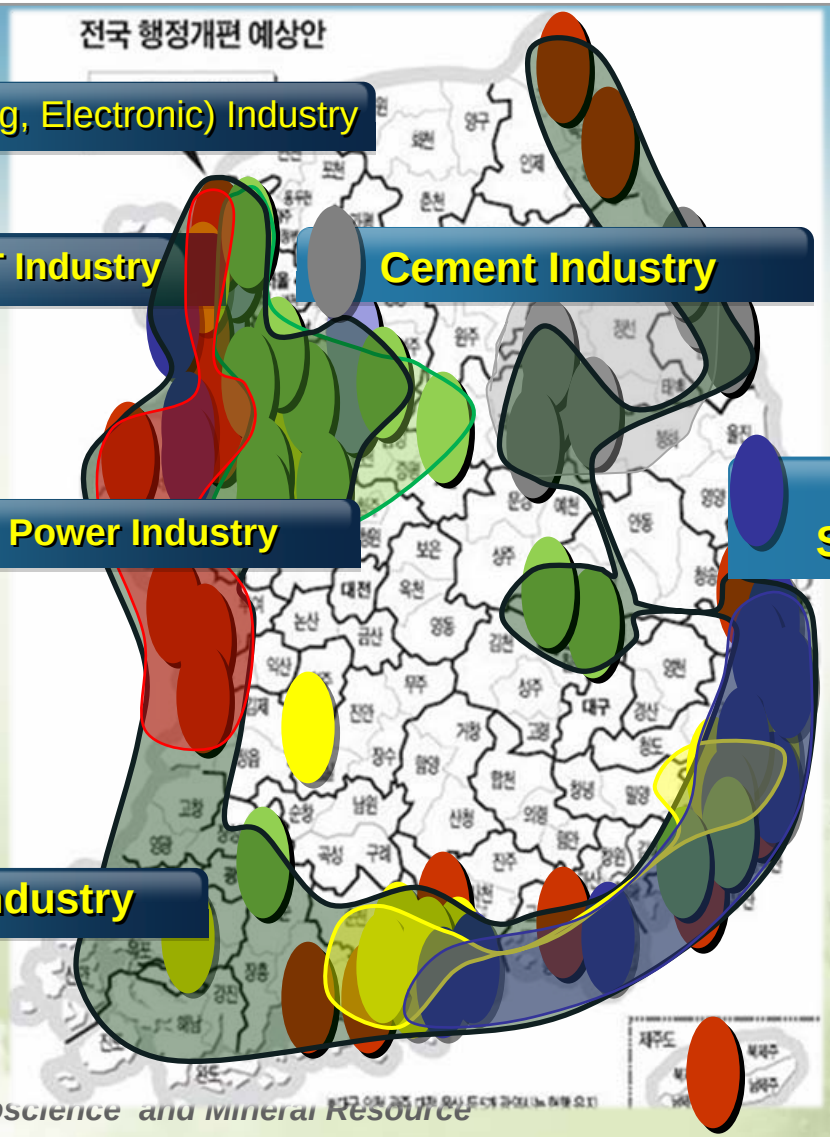
Steel/Automobile/Shipbuilding Industry Focused

- •Growth of specialized industries based on low carbon green technology
- •Slag circulation complex

Low Carbon Green Technology Belt

Industrial Structure of Korea and Geological Characteristic

Characteristics of South Korea's Industries



Urban(Textile, Transporting, Electronic) Industry

Electricity/Electronic/IT Industry

Cement Industry

Energy & Thermal Power Industry

Automobile, Steel, Shipbuilding Industry

Petrochemical Industry

Application Method of Recycling Resource Recirculation Specialized Complex (RRSC) Project of The Ministry of Environment, Korea

Background

- **Needed re-examining of the project content and direction according to recent surrounding environment changes related to RRSC Project**
- **Needed establishing a basic plan to strengthen competitiveness of recycling business and to support national low carbon green growth by reflecting reorganized administrative districts**

Determined circulation complex suited for the administrative distracts system of 50~70 local governments

- Based on an appropriate scale of each local complex
- Based on priority to build a local complex

To achieve “Zero Waste”and to minimize the cost and time for material circulation between regions
→ Suggested a resource circulation complex model

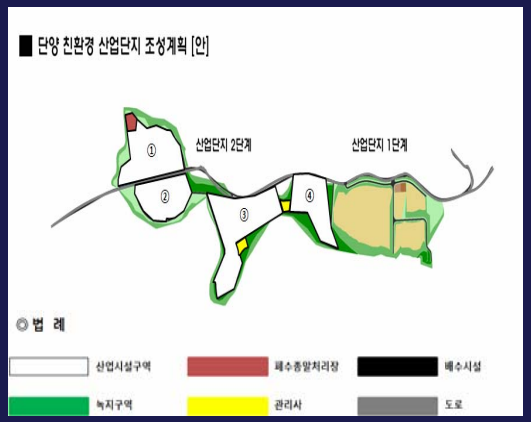
Studying the complex creation/operation/management method

Application Plan

- **Applicable in a basic plan for a follow-up project of Jeonju Resource Recirculation Specialized Complex**
- **Useful as a basic material for Eco-Industrial Complex Set Up Project of The Ministry of Knowledge Economy, Korea based on “Act on Resources Saving and Recycling Promotion**

Conclusion

- **Danyang Recycling Resource Recirculation Specified Complex Project, Korea**



- 2009. 03: Application for assigning Danyang as a resource recirculation specified complex
- 2010. 06: Approved the application for the specified complex
- 2011. 11. Scheduled to announce the complex set up plan approval

- Budget: 28 billion won in Korean currency
- Scale: 325,837㎡
- Project period: 2010~2013

To satisfy national green growth through creating Korean style environmental friendly industry

<u>Next site</u> of resource recirculation specified complex: **Busan Metroplitan City**

Acknowledgement

Policy Project of The Ministry of Environment, Korea
- A Study of Resource Recirculation Specified Complex Optimizing Method

Project Manager: Dr. Ji-Whan Ahn

Danyang-gun Environmental Protection Mid-and Long Term Project
- "A Fundamental Policy Study for Creating Resource Recirculation Specified Complex"
Project Manager: Dr. Ji-Whan Ahn