

Accomplishment and Challenges for Green Innovation of Kawasaki Eco-town

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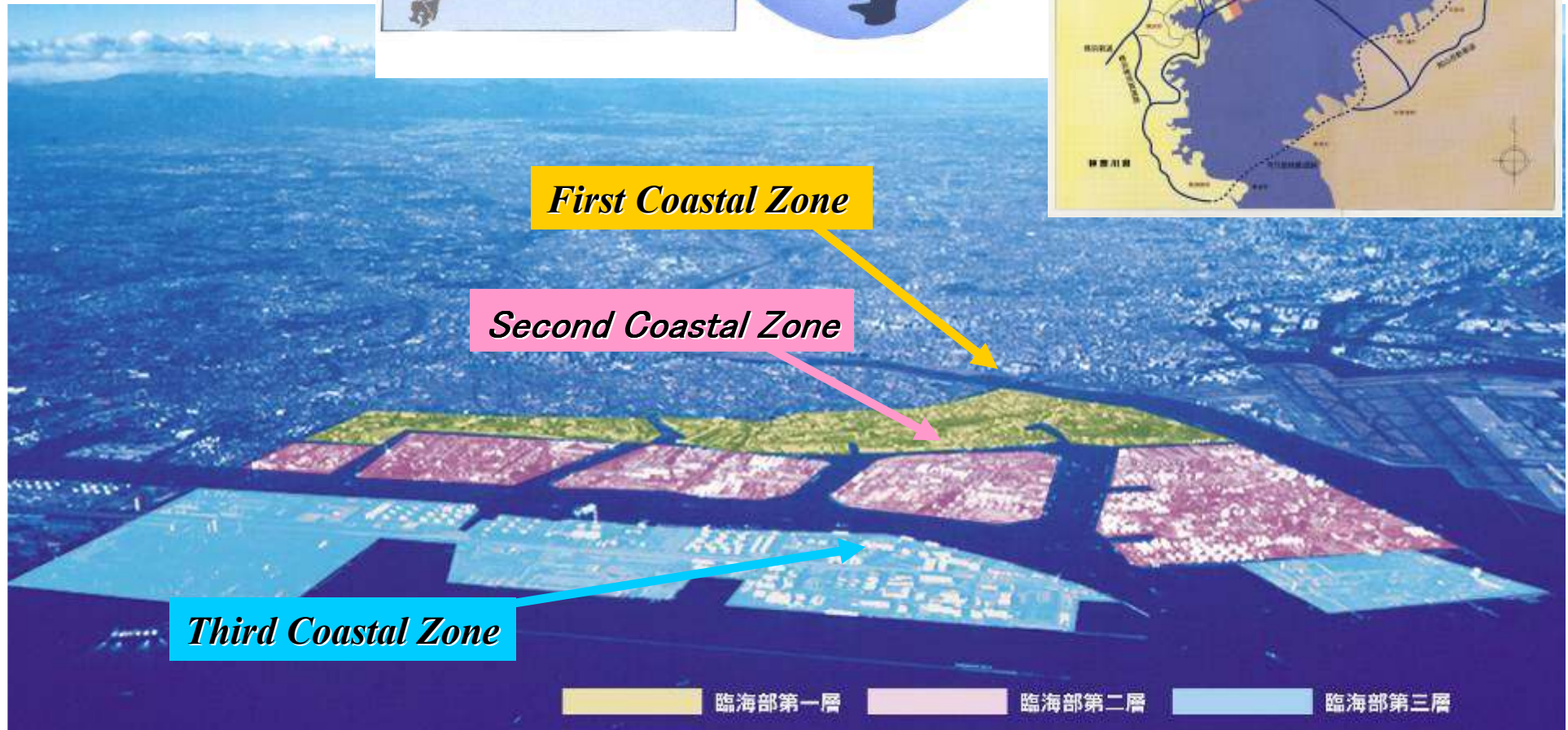
Background

- ▶ Eco-towns in Japan
 - ▶ From 1997 to 2006, 26 eco-towns had been approved
 - ▶ Totally 209 facilities (64 with subsidies, 145 without)
- ▶ In 93 facilities (out of 170 recycling facilities in 2009), totally 2.18 mil t of wastes were treated in 2007
 - ▶ Generation: within each eco-town (61%), within the Prefecture (8%), outside the Prefecture (27%), unknown (4%)
 - ▶ “industrial and urban symbiosis”
 - ▶ Utilization: recycled (1,220 kt, 56%), energy recovery (790 kt, 36%), residue (170 kt, 8%)
- ▶ Reduced wastes to landfill
 - ▶ 1.02 mil t (~3% of the total)



Source: Fujita, 2007

Geographical Conditions of Kawasaki Coastal Area



First Coastal Zone

Second Coastal Zone

Third Coastal Zone

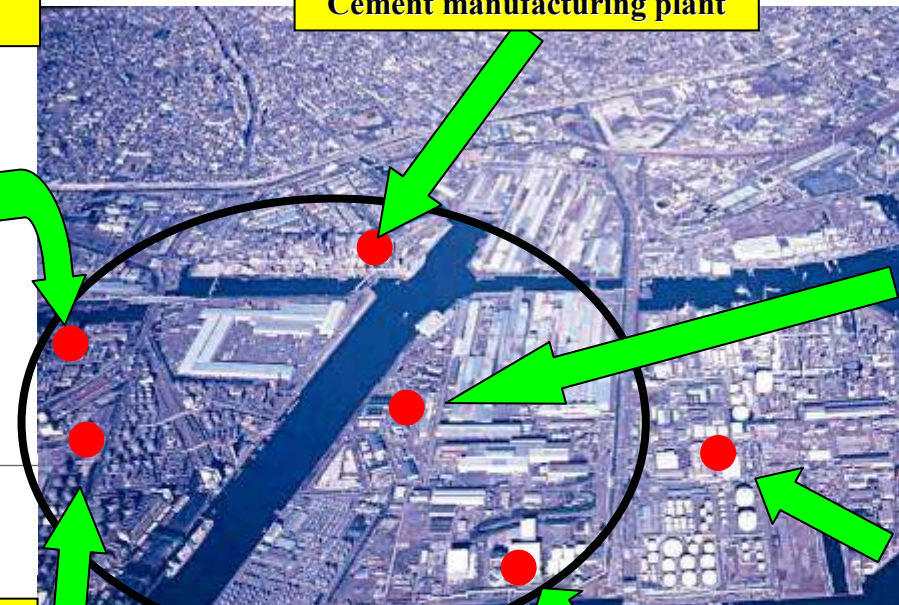
臨海部第一層 臨海部第二層 臨海部第三層

Accumulation of High-tech Recycling Plants

Plastic waste recycling plant
for ammonia production



Cement manufacturing plant



within a 1.5km radius

PET-to-PET recycling plant



Hard-to-recycle paper
recycling plant



(CORELEXグループHPより転載)

- Plastic waste recycling plant for blast furnace production
- Plastic waste recycling plant for concrete formwork production



Kawasaki Zero-emissions
industrial park (H14.11 操業)



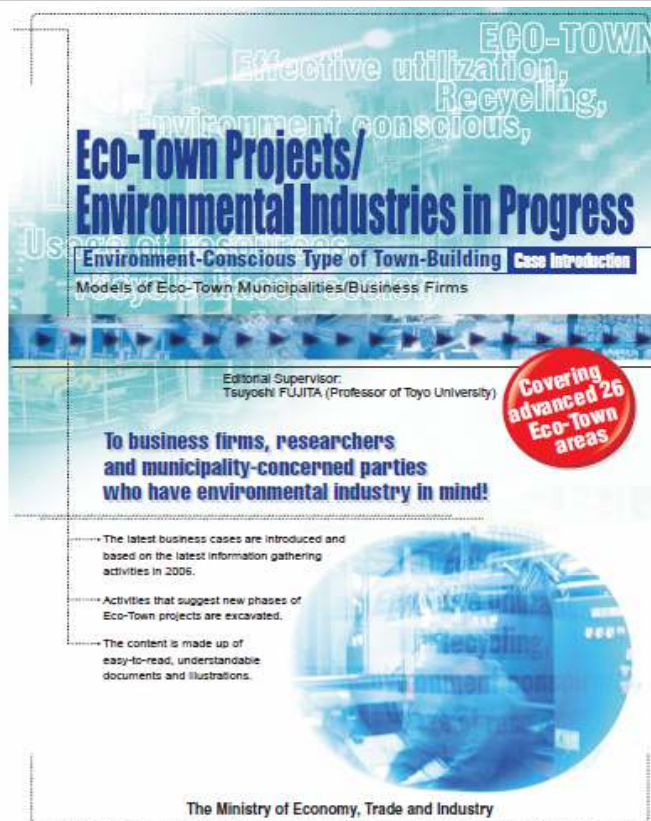
位置	川崎市川崎区水江町
敷地面積	3万332m ²
構成	14社(金属加工業、製紙業、メッキ業等)
就業者数	約400人

Major Efforts

- Use of natural gas vehicle
- Use of hydroelectric power plant for factories
- Circulation of industrial chemicals and water
- Operation of plating plant which never excrete liquid wastes to outside the factory

Eco-town Areas as demonstration projects of circular technologies

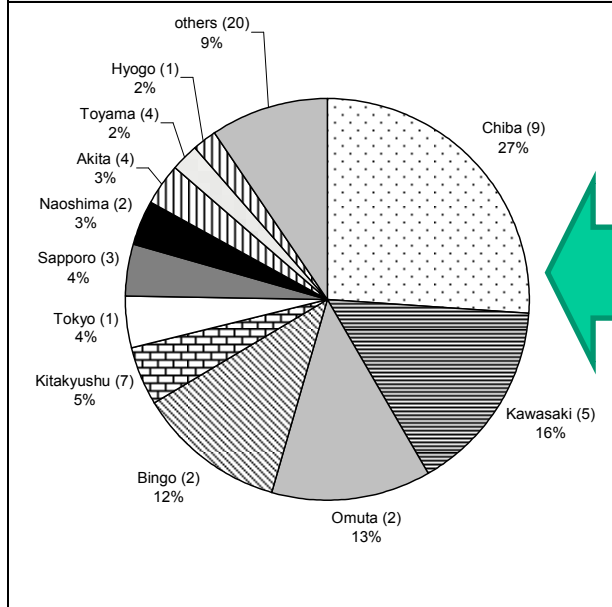
The Ministry of Economy, Trade and Industry and the Ministry of Environment approved Eco-Town Plans for 26 areas as of the end of January 2006, and they provided financial support to 62 facilities located within the appropriate areas.



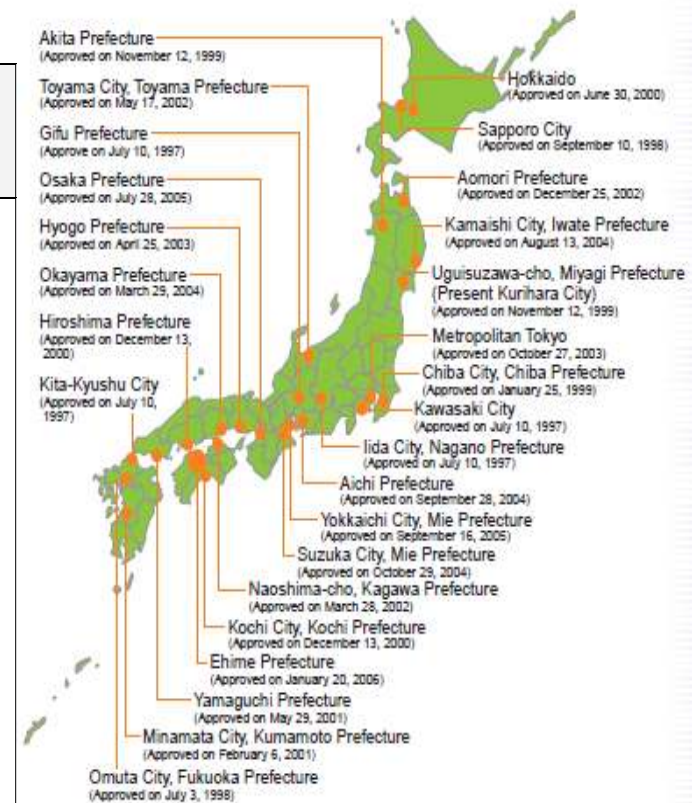
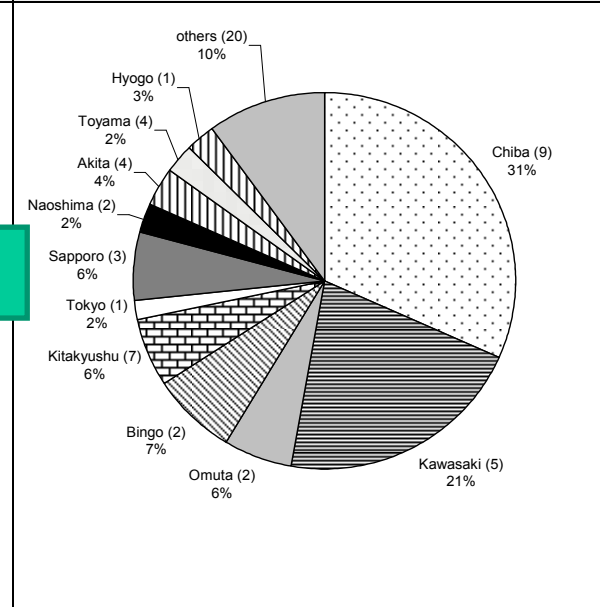
Eco-town Areas as demonstration projects of circular technologies; Berkel and Fujita et. al (2009)

The Ministry of Economy, Trade and Industry and the Ministry of Environment approved Eco-Town Plans for 26 areas as of the end of January 2006, and they provided financial support to 62 facilities located within the appropriate areas.

Distribution of Total Investment
60 projects in 24 Eco-Towns
165 billion JPY or **1.6 bil. US\$**



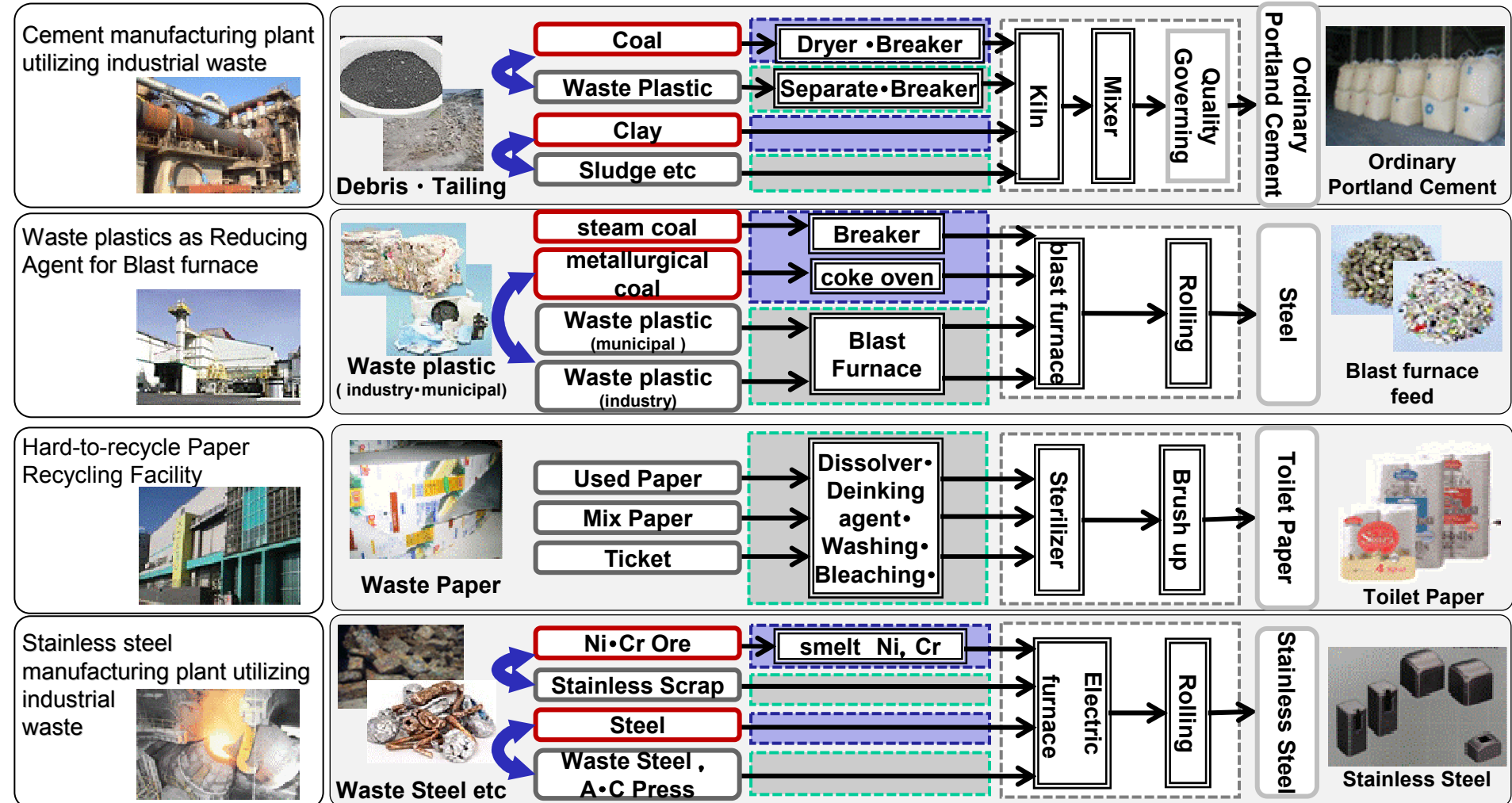
Distribution of Total Investment
Subsidy projects in 24 Eco-Towns
60 billion JPY or **600mil. US\$**



Quantified material accounting for Symbiosis in Kawasaki

R.V. Berkel and T. Fujita et. al.;
Environmental Science & Technology(2009)

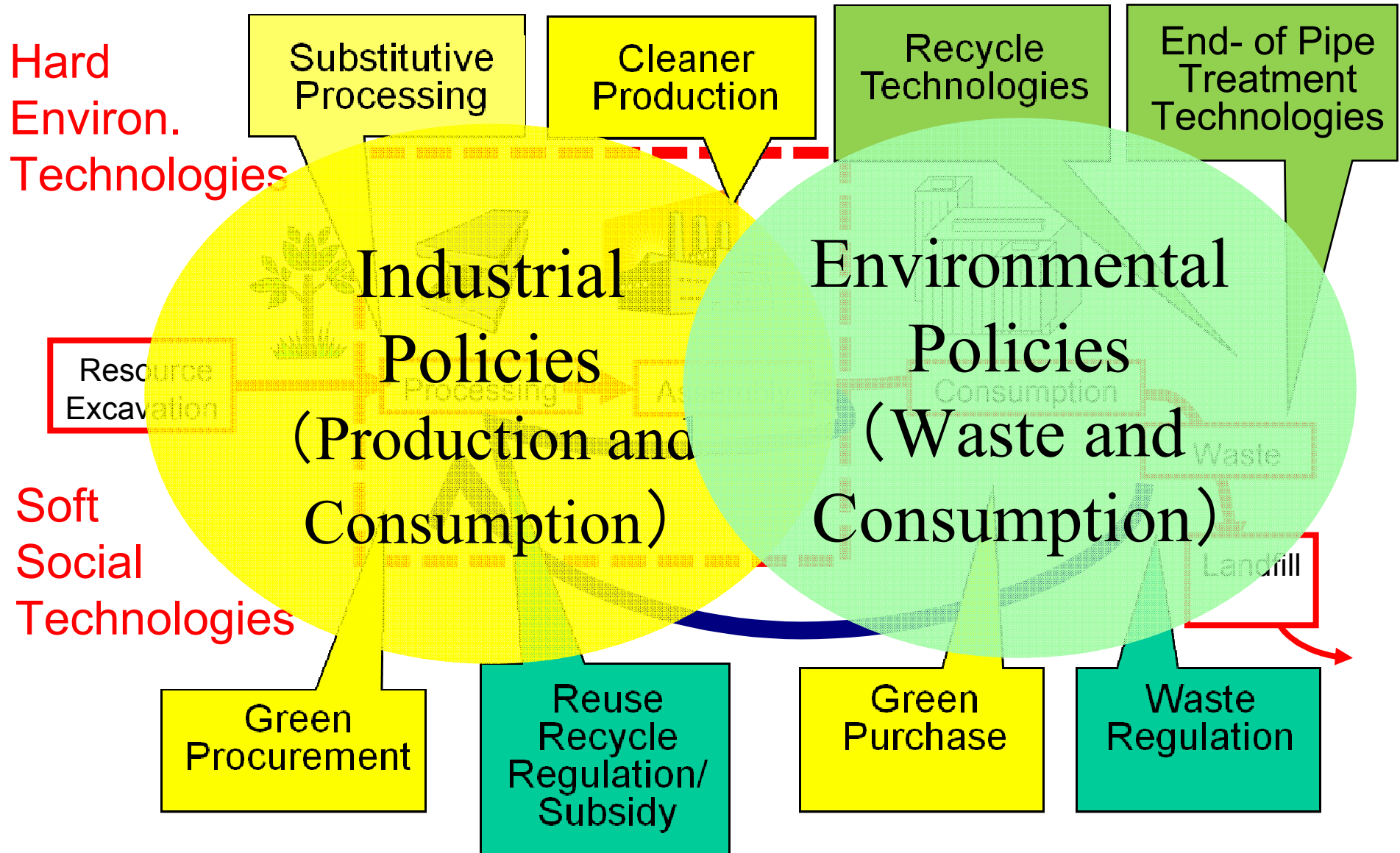
Recycling Facilities



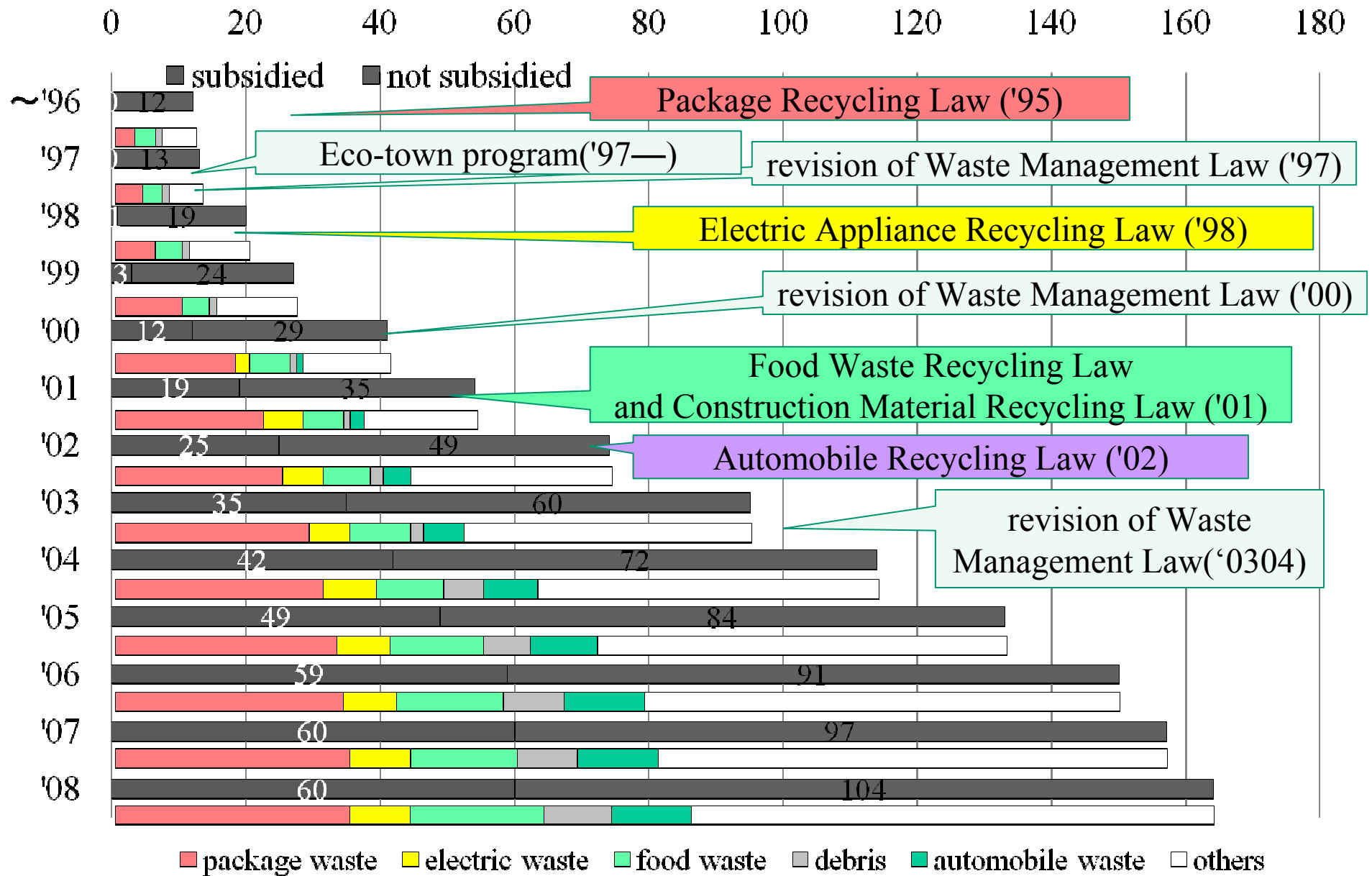
LEGEND :



Alternative technologies for circular economies; resource circulation

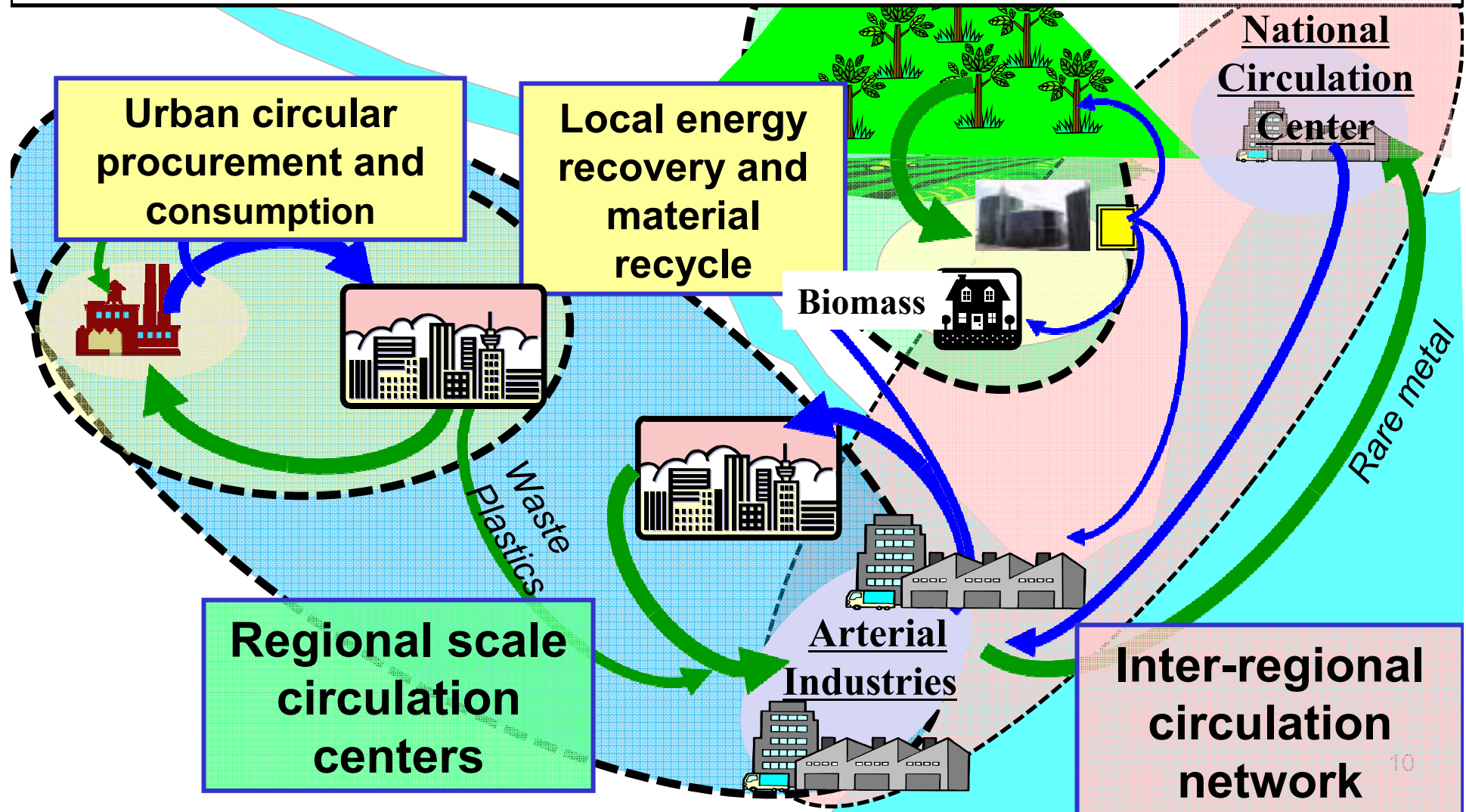


Recycle Facilities in 26 Eco-towns and Legislation System for Waste Management and 3R Promotion



Strategies to Promote Eco-town Development

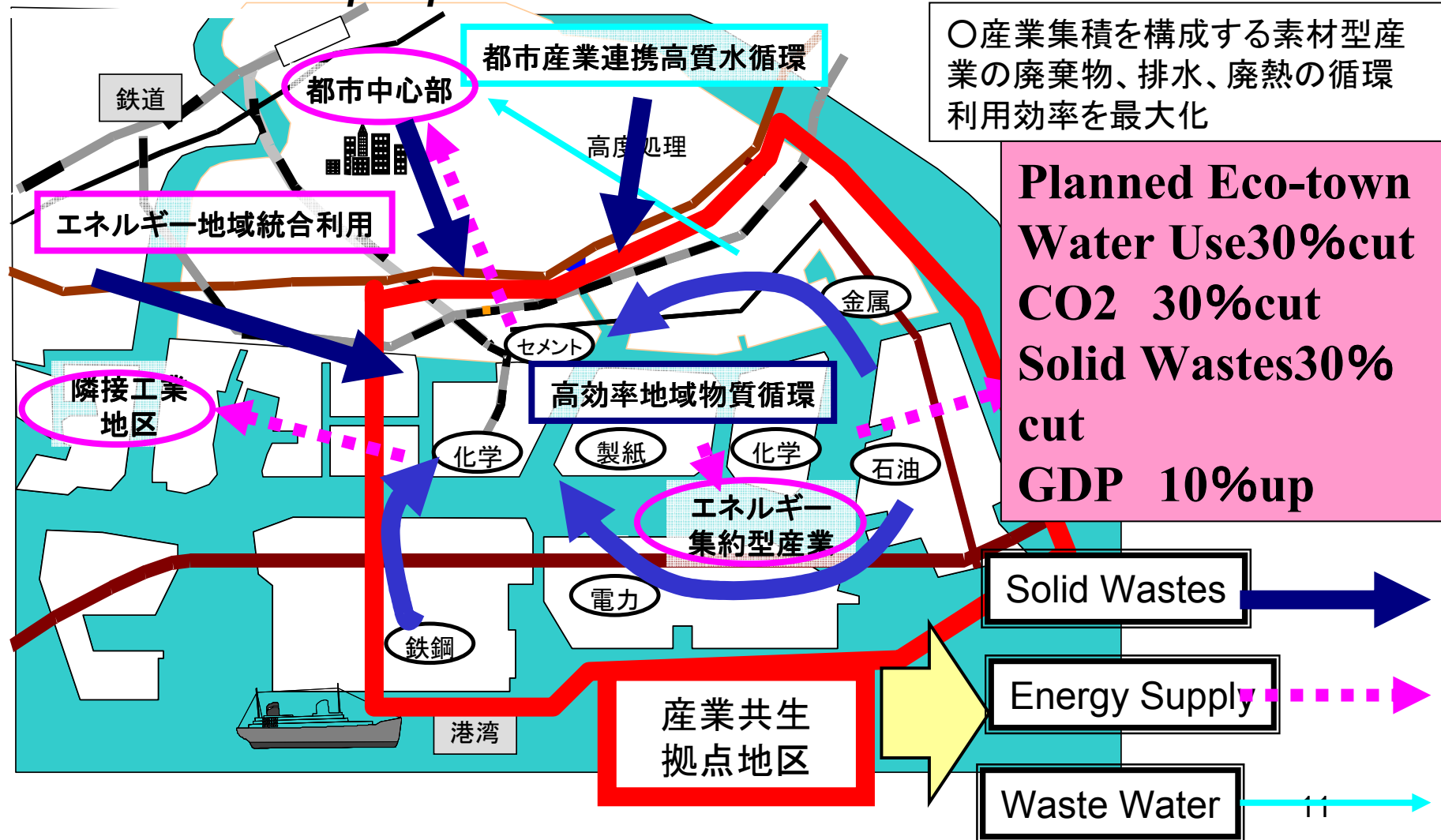
- Establishment of multi scale circulation system considering appropriate social waste transportation cost and environmental value of recycle products
- Social multi-stakeholder collaboration scheme for such separation, collection and green purchase
- Development of regional circulation center for multi-layered circulation areas



Eco-town as a Driver toward Low Carbon City

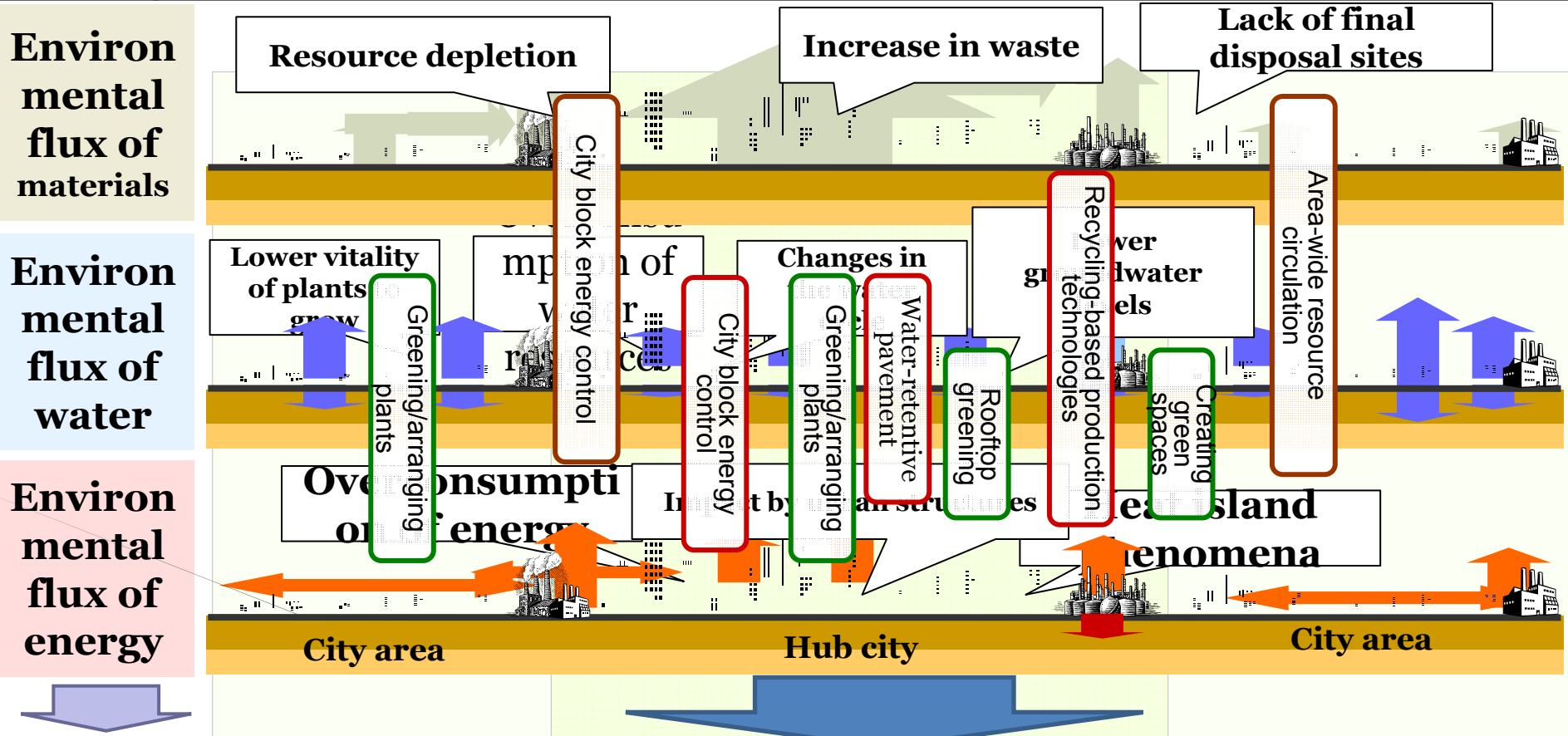
-Industrial Re-development from Eco-town Guideline

-Urban and Industrial Infrastructure from Eco-city perspectives



Low-carbon technologies and their impact: water, materials, and energy in cities

The urban environmental GIS database and environment analysis model are used to calculate environmental flux, based on environmental impacts. Processes are in place to evaluate technologies for low-carbon cities.




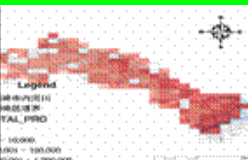
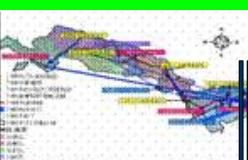
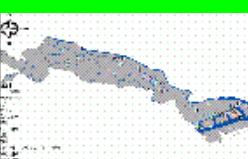
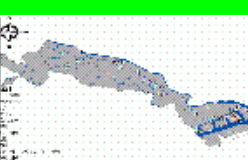
- Evaluation with environment analysis model**
- A system for analyzing the spatial characteristics of environmental impact (generation and transfer of waste water, thermal energy, and waste)
 - Calculating annual low-carbon effects attained by introducing technologies within a target zone
 - Setting up a framework for providing information obtained from the technology evaluation system to governmental bodies, citizens, and companies

Keys for Sustainability of EIDs as Energy/Resource/ Carbon Efficiency

- 1) Greening Industries and technologies
- 2) Appropriate combination of technologies and policy systems
- 3) Design of regions and core districts considering of locational characteristics of cities and regions

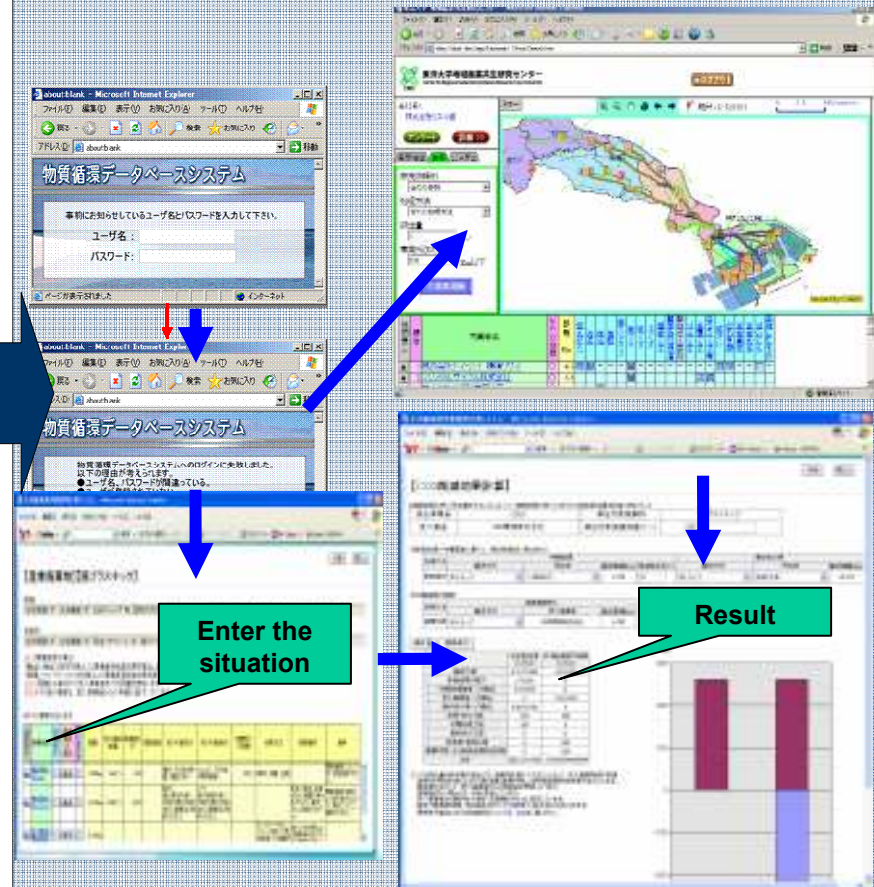
Web-GIS decision support system to promote resource circulation in Keihin Coastal Area

1. Questionnaire survey and environmental economics database

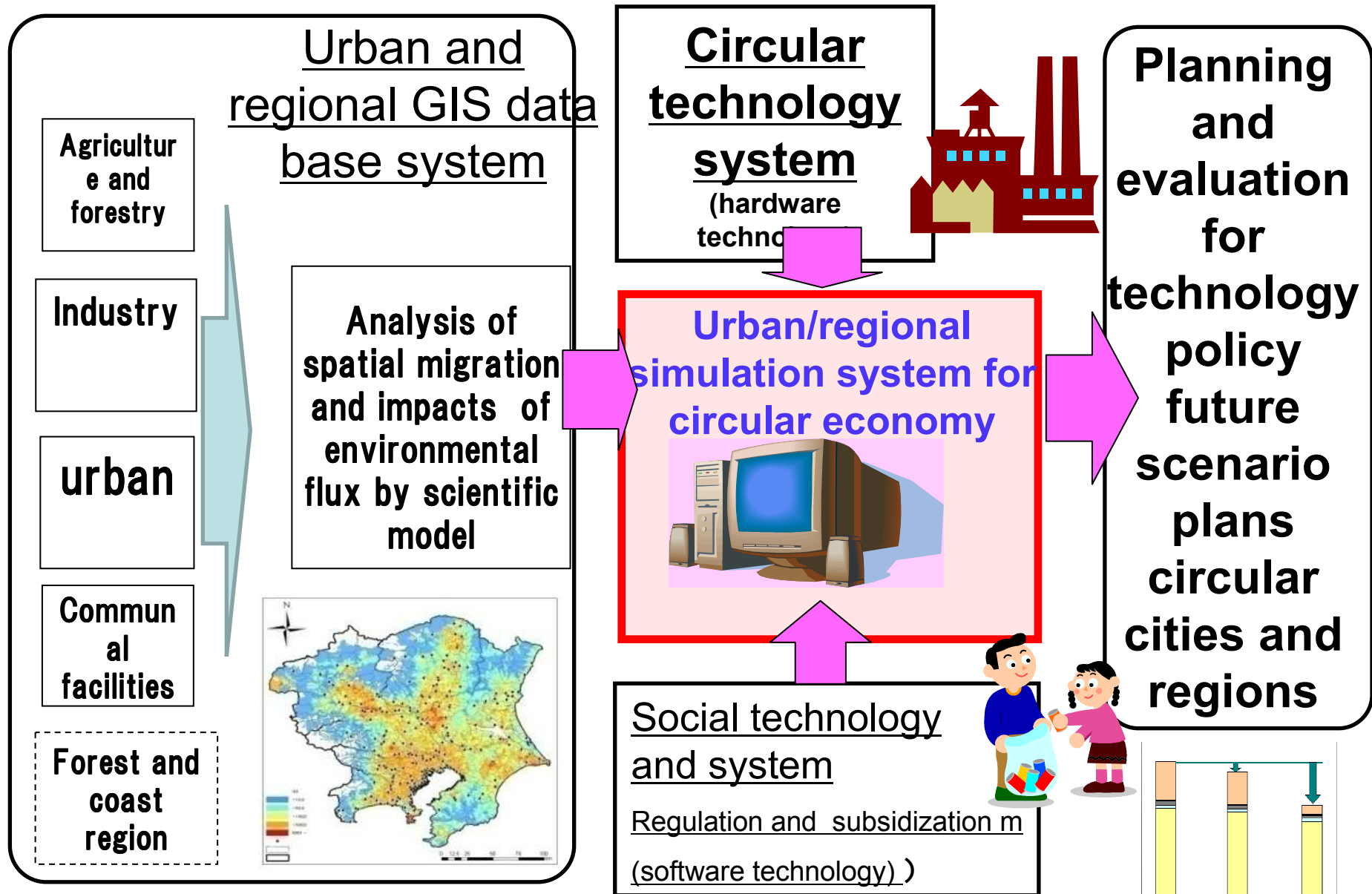
Tokyo Bay	Geography information in Tokyo Bay	<ul style="list-style-type: none"> Industrial Business District Agriculture 
	Waste information in mesh	<ul style="list-style-type: none"> Waste distribution of manufacturing industry Waste distribution of business Waste distribution of family 
Kawasaki City	Waste information	<ul style="list-style-type: none"> Life ward information Enterprise information Incineration facilities information Reclaimed land information Railway information 
	Enterprise information	<ul style="list-style-type: none"> Enterprise position information Classification information Discharge 
	Enterprise information	<ul style="list-style-type: none"> Enterprise position information Classification information Discharge 

2. Web-GIS decision support system for material circulation

- Questionnaire surveys and monitoring are to be conducted through the Web-GIS system
- Result could be reflected on the system so that it better reflect the needs of users (those who discharge wastes)



3) Integrative scenario simulation of environmental technologies and policy regulations in Japan

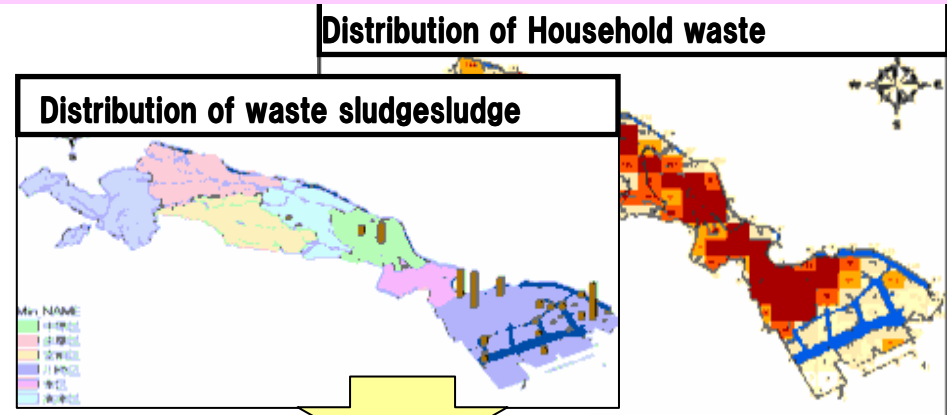
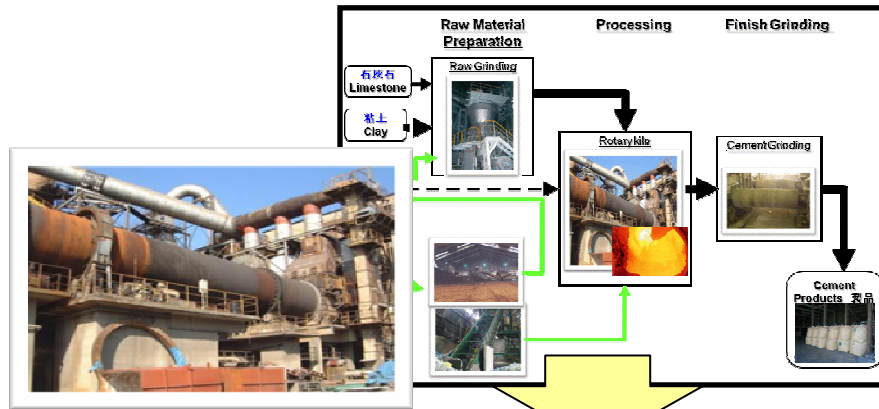


Urban and Regional Simulation System for Circular Economy

Different scenarios were applied to evaluate effectiveness of the cement production process

Circular Technology Analysis System

Urban and Regional Env. Data Base System



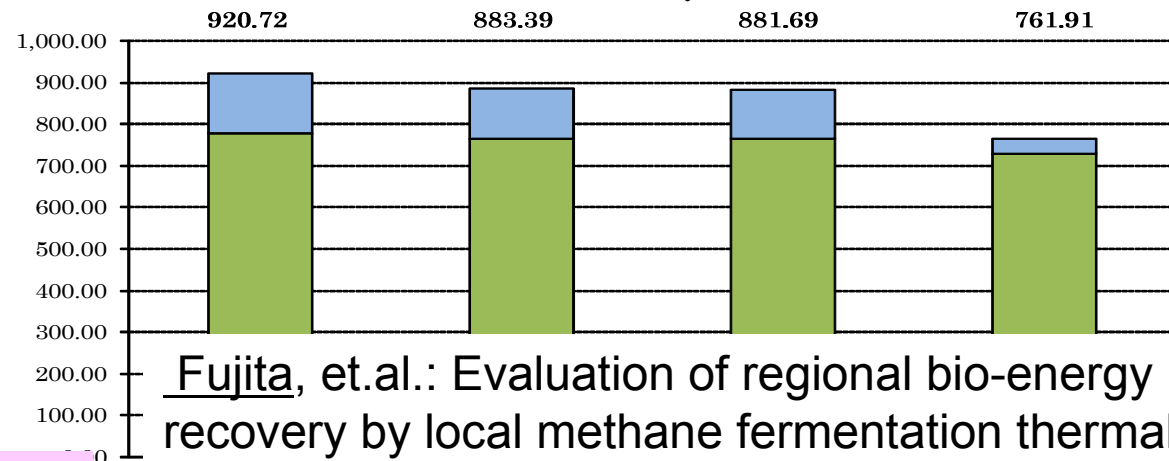
[1,000 tons / year]

Current waste recycle performance

Industrial waste:
about 0.25 million ton/year

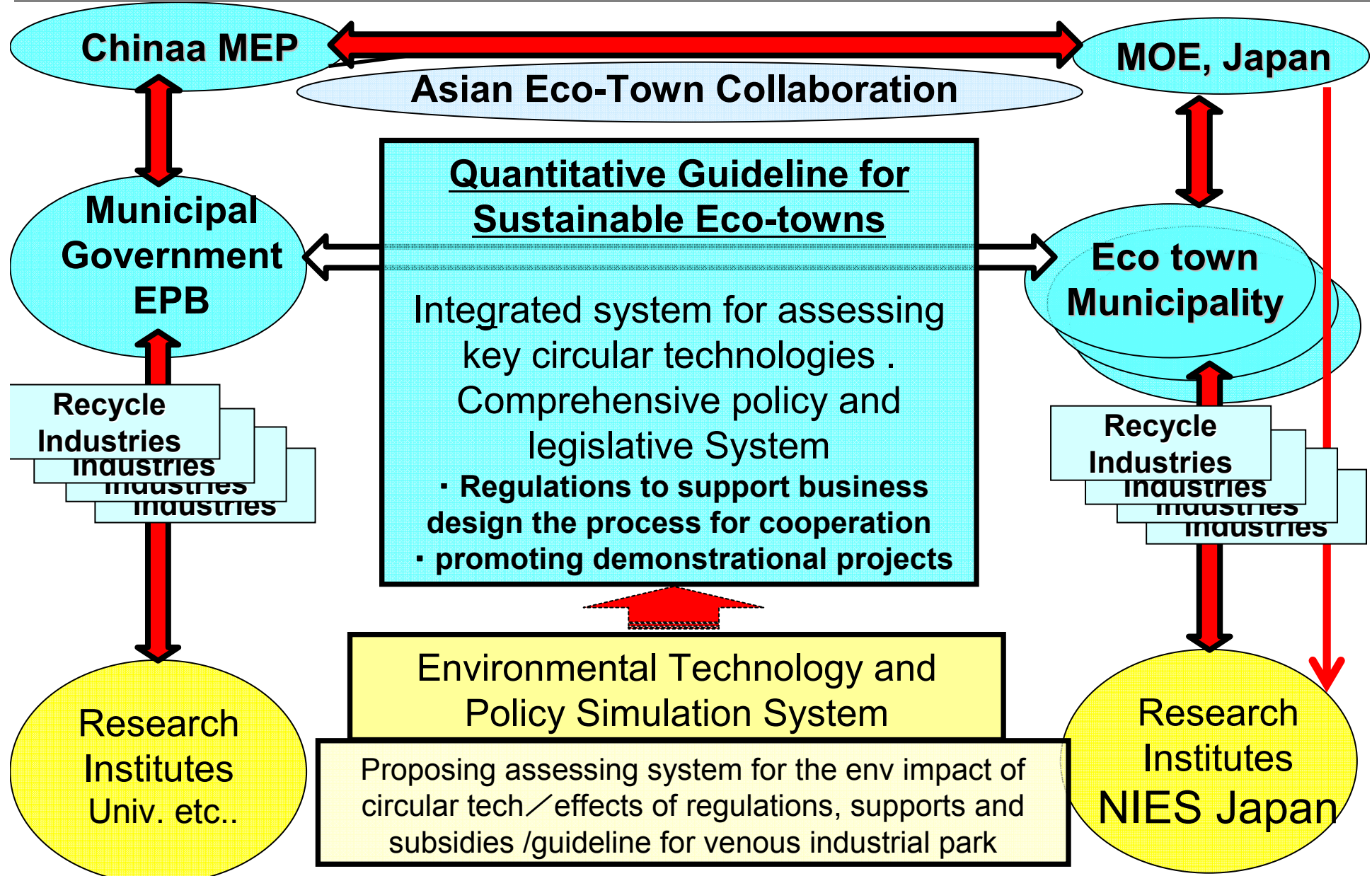
【Waste substitution as clay】
Sludge, soot dust, debris, etc

Policy Scenario Design and Evaluation System

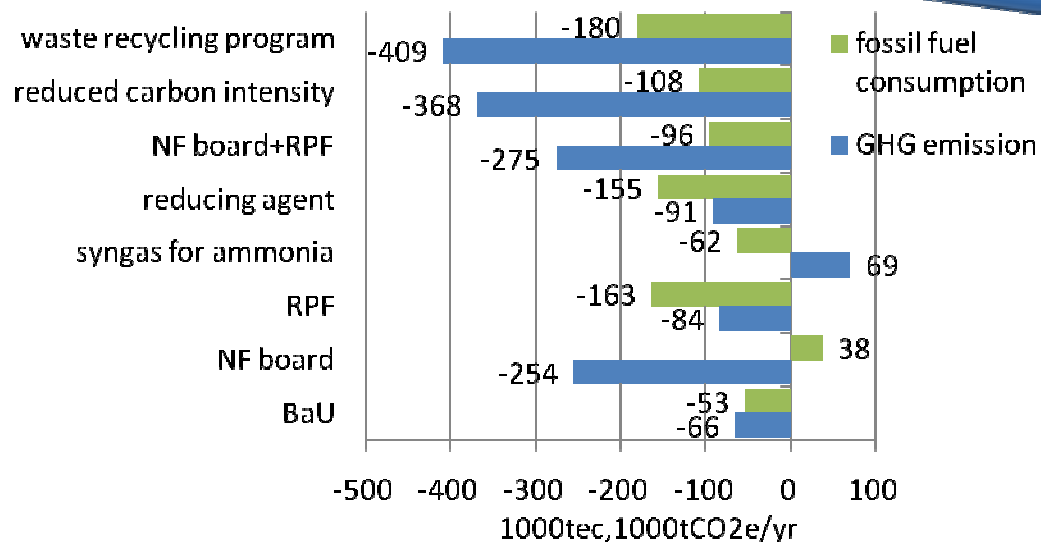
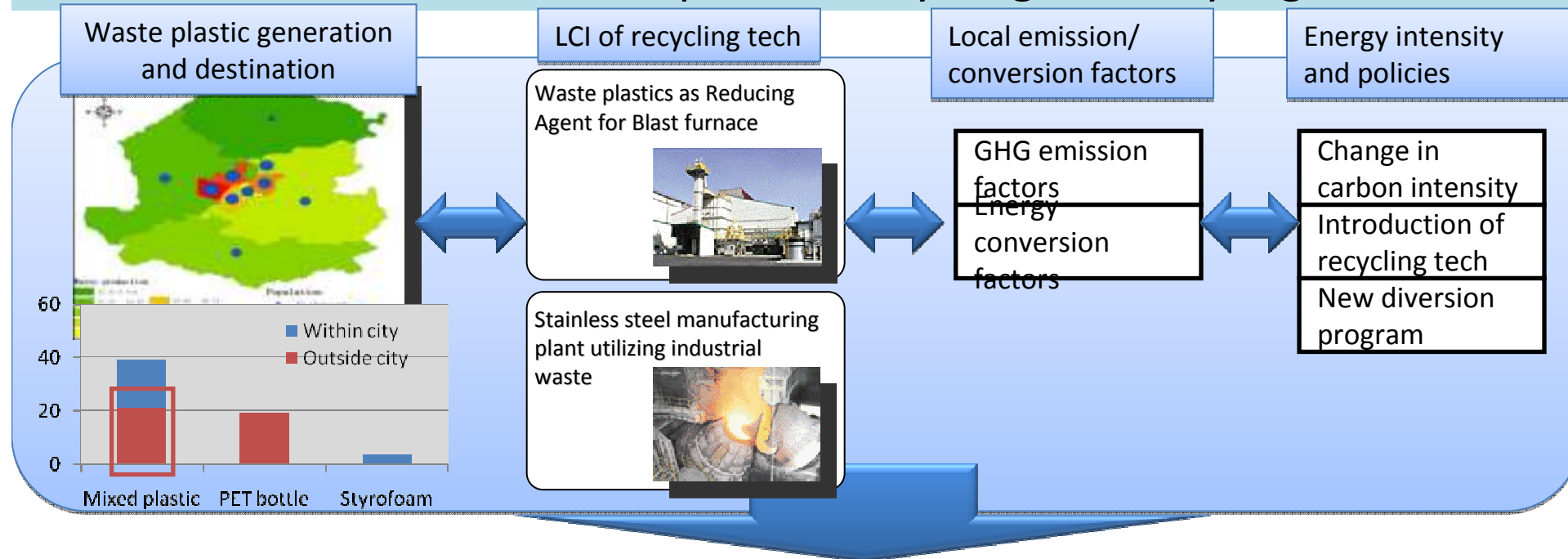


Fujita, et.al.: Evaluation of regional bio-energy recovery by local methane fermentation thermal recycling systems, Journal of Waste Management, vol.28, pp.2259-2270, 2008

Guideline for Sustainable Eco-towns / Eco-Industrial Developments in Asian Cities and Regions



Example of results from the urban env tech simulation model: The case of waste plastics recycling in Shenyang



Potential of recycling non-PET plastics treated outside of Shenyang

- Over 200 kt-CO₂e reduction and 100 ktce fossil fuel saving against BaU could be realized by technology transfer only
- Additional 134 kt-CO₂e reduction and 35 ktce saving could be achieved by reduction in carbon intensity in electricity and new recycling programs

Source: X. Chen, F. Xi, Y. Geng & T. Fujita (2011) The potential environmental gains from recycling waste plastics: Simulation of transferring recycling and recovery technologies to Shenyang, China. *Waste Management*, 31, 168-179.

Growing diversity of Eco-Industrial Practices in the world

Variation of case studies of Eco-Industrial Developments



Solid waste recycle --- Energy and water circulation

Technology development---Social system evolution

Industrial Symbiosis-- Urban Symbiosis

Dynamically developing cities--Stably developed cities

Market driven economy--Green economy

Local case studies – Universal analytical framework

Japan's low-carbon cities in the context of the international community

Knowledge and wisdom of low-carbon cities in Europe and America (Western style)

- Low-carbon efforts in the midst of a shift toward a post-industrial and post-material society
- High levels of eco-consciousness among citizens and companies and capabilities to coordinate diverse entities and manage cities



Knowledge and wisdom of low-carbon cities originating in Japan (*Japan's unique Eco-town /low-carbon style*)

- Low-carbon packages that take advantage of technology and product development capabilities focusing on fulfilling targets (a combination of device technologies, network technologies, and social technologies)
- A social governance system encompassing efforts to build eco-consciousness among citizens and companies
- Communities with capabilities to take eco-action based on experiences with environmental pollution



Efforts to build EIPs low-carbon cities in Asia (Asian style)

- Promoting low-carbon efforts interlocked with industrialization and economic growth
- Promoting projects based on a top-down approach; capabilities to implement policies

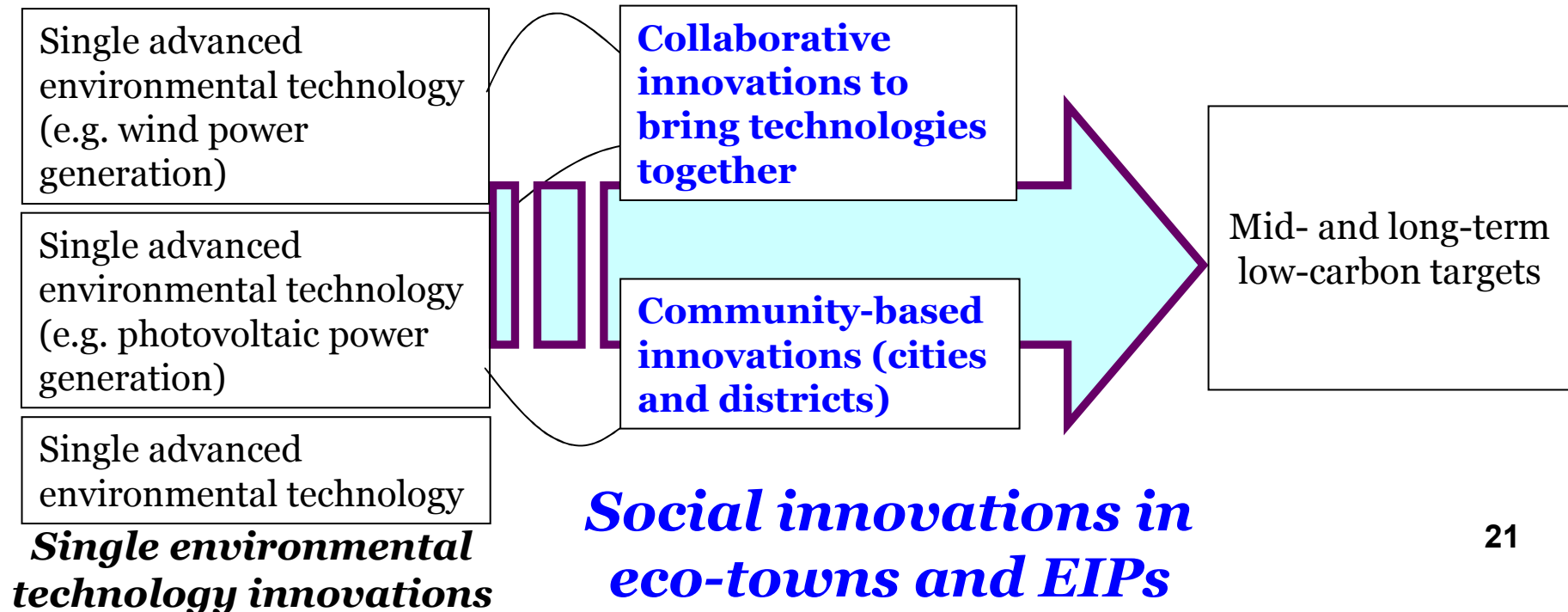
Eco-cities that lead to a low-carbon society

- Shifting from single innovations to collaborative social innovations

Technology Innovation →

System Innovation or Collective Innovation

- Applying best practices to structural innovations in the social system



Growing diversity of Eco-Industrial Practices in the world

Variation of case studies of Eco-Industrial Developments



- Integrative planning tool for EID or Eco-City design
- Combination of local and generic indicators
- Engagement system for multi stakeholders
- Industrial symbiosis as the path for collective innovation

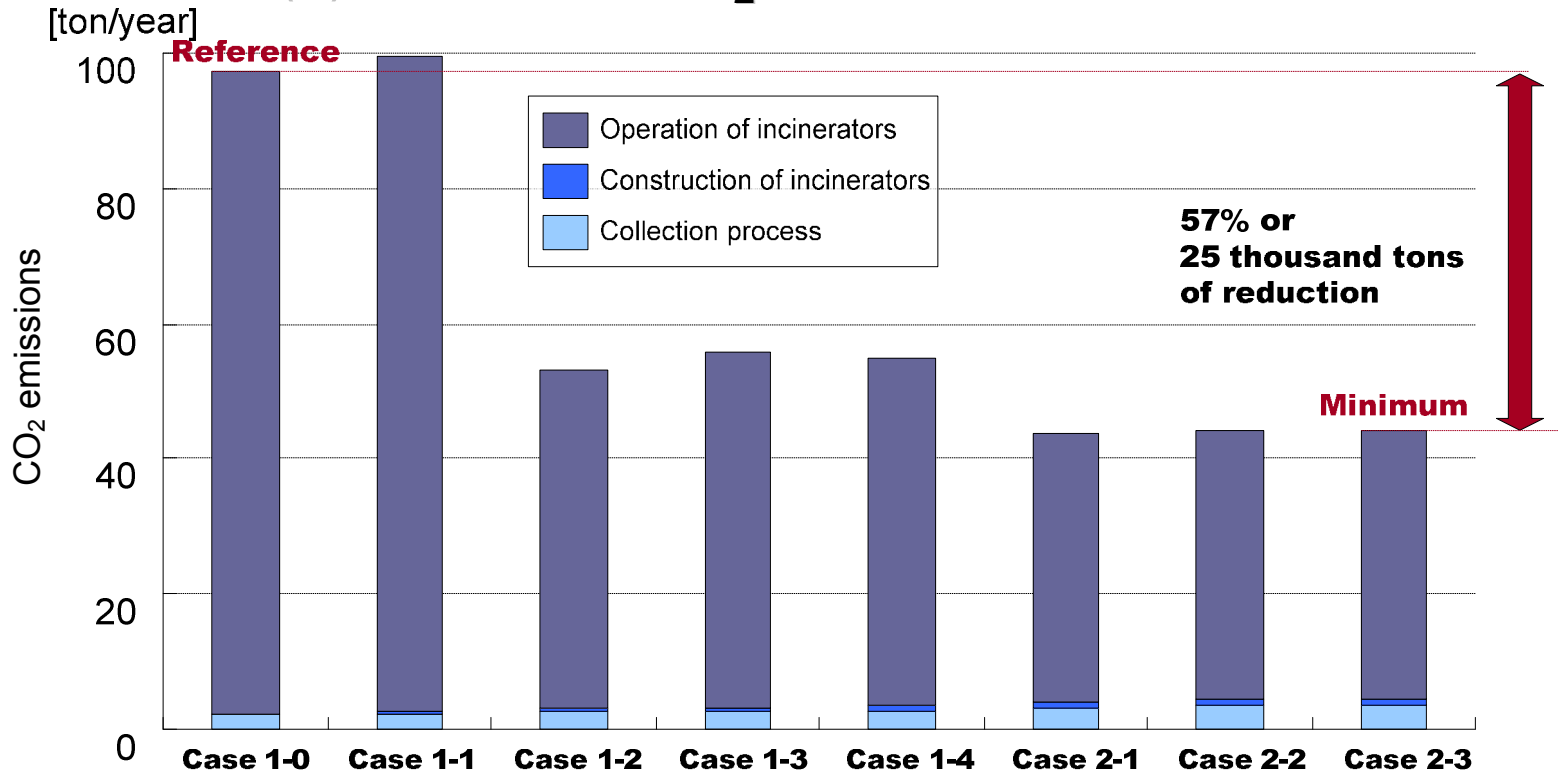
List or related publications

- Rene Van Berkel, Tsuyoshi Fujita, Shizuka Hashimoto, Minoru Fujii; Quantitative Assessment of Urban and Industrial Symbiosis in Kawasaki, Japan, *Environmental Science & Technology* , Vol.43, No.5, 2009 ,pp.1271-1281,0129.2009
- Rene van Berkel, Tsuyoshi Fujita, Shizuka Hashimoto, Yong Geng; Industrial and Urban Symbiosis in Japan : Analysis of the Eco-Town Program 1997-2006 ; *Journal of Environmental Management*, vol.90,pp.1544-1556,2009
- Shizuka Hashimoto, Tsuyoshi Fujita, Yong Geng, Emiri Nagasawa ; Achieving CO2 Emission Reduction through Industrial Symbiosis: A Case of Kawasaki , *Journal of Environmental Management*, 2008 (submitted)
- Yong Geng, Qinghua Zhu, Brent Doberstein, Tsuyoshi Fujita; Implementing China's Circular Economy Concept at the Regional Level: a review of progress in Dalian, China, *Journal of Waste Management*, vol.29,pp996-1002,2009
- Yong Geng, Rene Van Berkel , Tsuyoshi Fujita ; Regional Initiatives on Promoting Cleaner Production in China: A Case of Liaoning, *Journal of Cleaner Production*, 2008 (submitted)
- Zhu Qinghua, Yong Geng, Tsuyoshi Fujita , Shizuka Hashimoto ; Green supply chain management in leading manufacturers: Case studies in Japanese large companies, *International Journal of Sustainable Development and World Ecology*, 2008 (submitted)
- Yong Geng, Pang Zhang, Raymond P. Cote, Tsuyoshi Fujita; Assessment of the National Eco-industrial Park Standards for Promoting Industrial Symbiosis in China, *J. of Industrial Ecology*, Vol.13, No.1, pp.15-26, 2008
- Looi-Fang Wong, Tsuyoshi Fujita, Kaiquin Xu ; Evaluation of regional bio-energy recovery by local methane fermentation thermal recycling systems, *Journal of Waste Management*,vol.28, pp.2259-2270, 2008

Thank you for your Attention

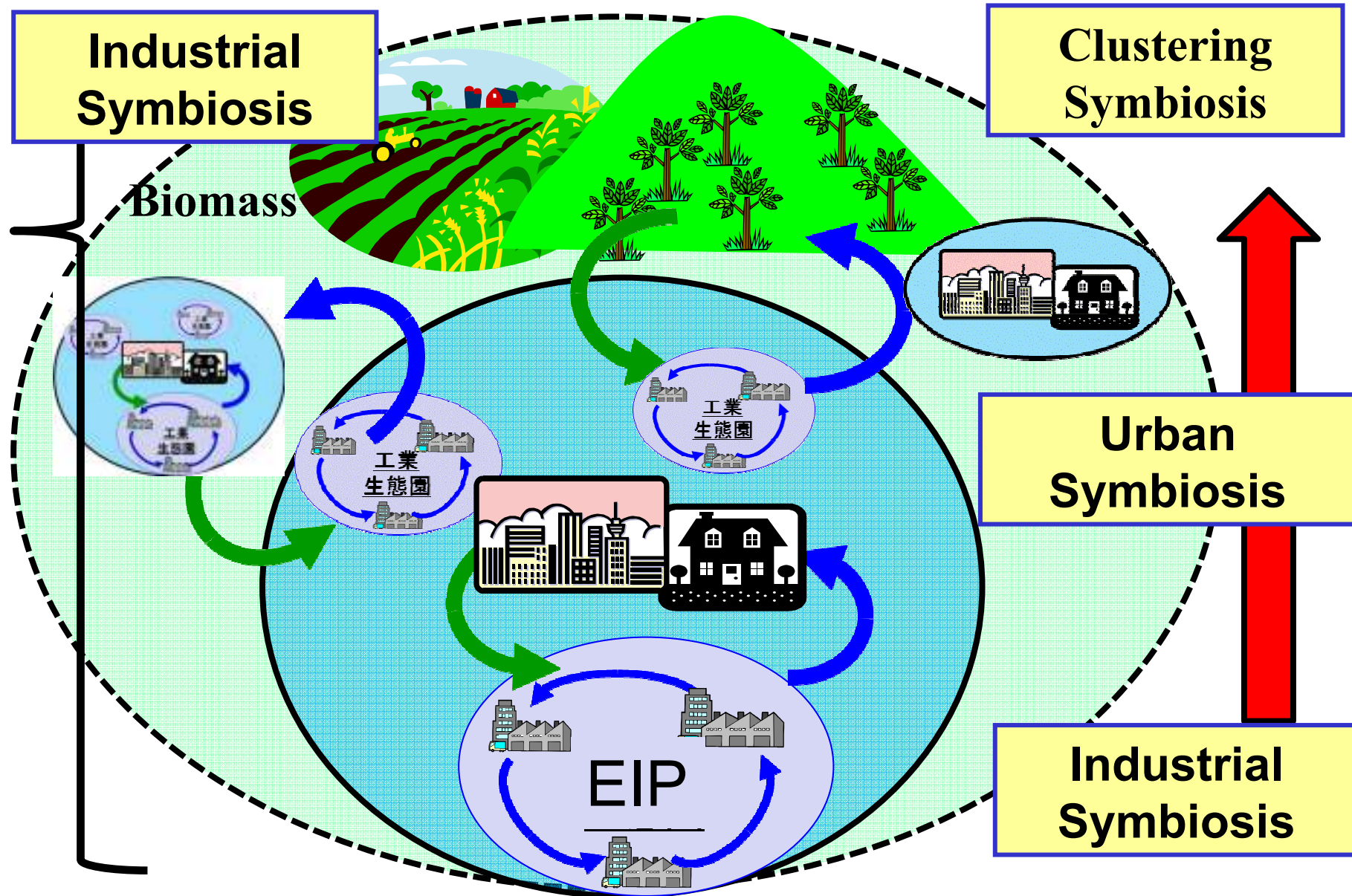
Results of environmental impact

(3) Amount of CO₂ emission

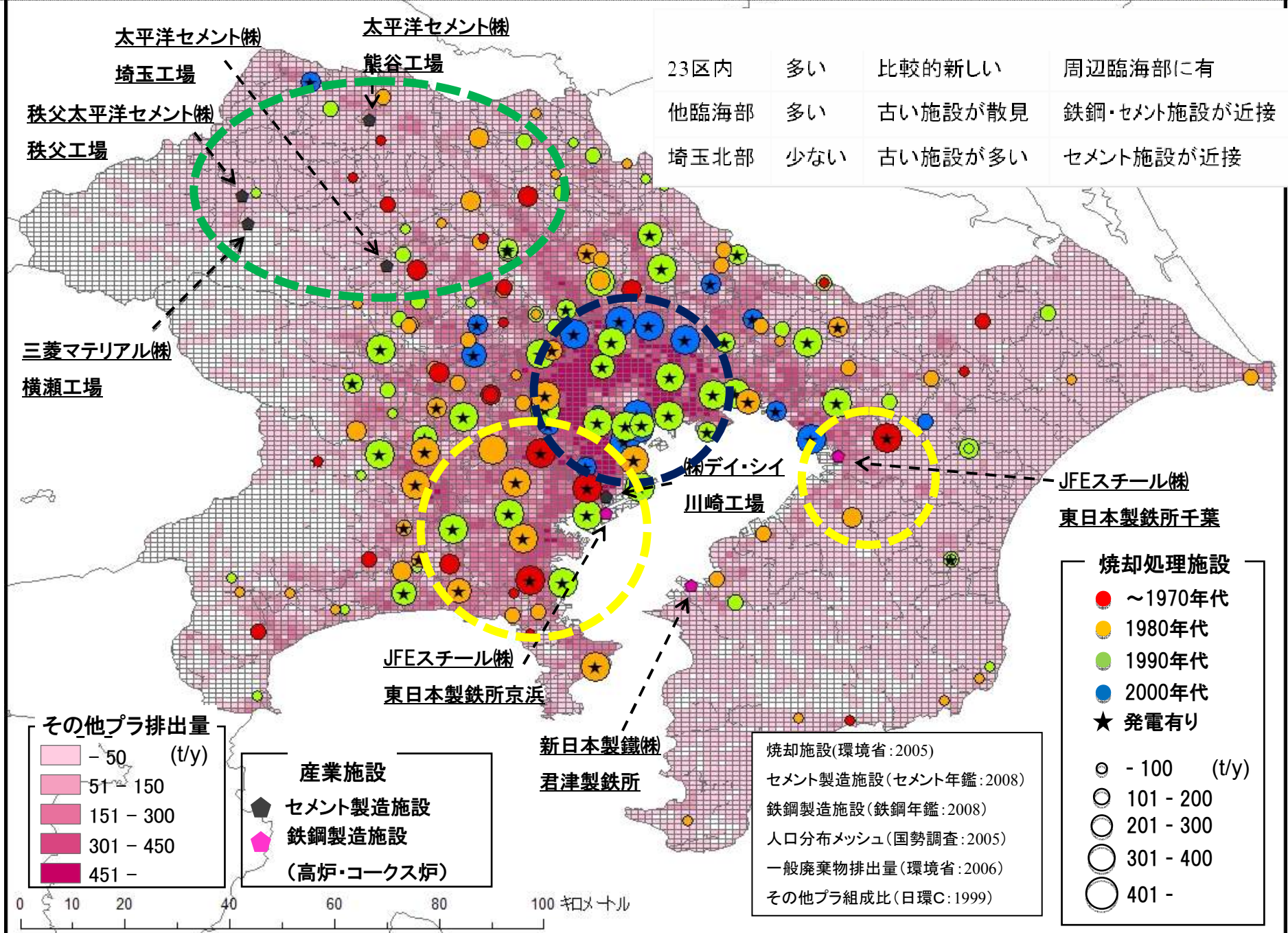


Scenarios	# of incinerators	Case 1-0	Case 1-1	Case 1-2	Case 1-3	Case 1-4	Case 2-1	Case 2-2	Case 2-3
			4	4	4	4	4	3	3
Incineration ash		Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey
Food waste		Grey	Grey	Grey	Grey	Orange	Grey	Orange	Orange
C&P plastic waste		Grey	Grey	Green	Green	Green	Green	Green	Green
Mix paper		Grey	Yellow	Grey	Yellow	Yellow	Yellow	Yellow	Yellow
Findings	Case 2-3 (combination of recycling mix paper, waste container & packing plastic, food waste and incineration ash with 3 incinerators) can reduce 57% or 25 thousand tons of CO₂ emission annually								

Industrial symbiosis, urban symbiosis, and clustering symbiosis

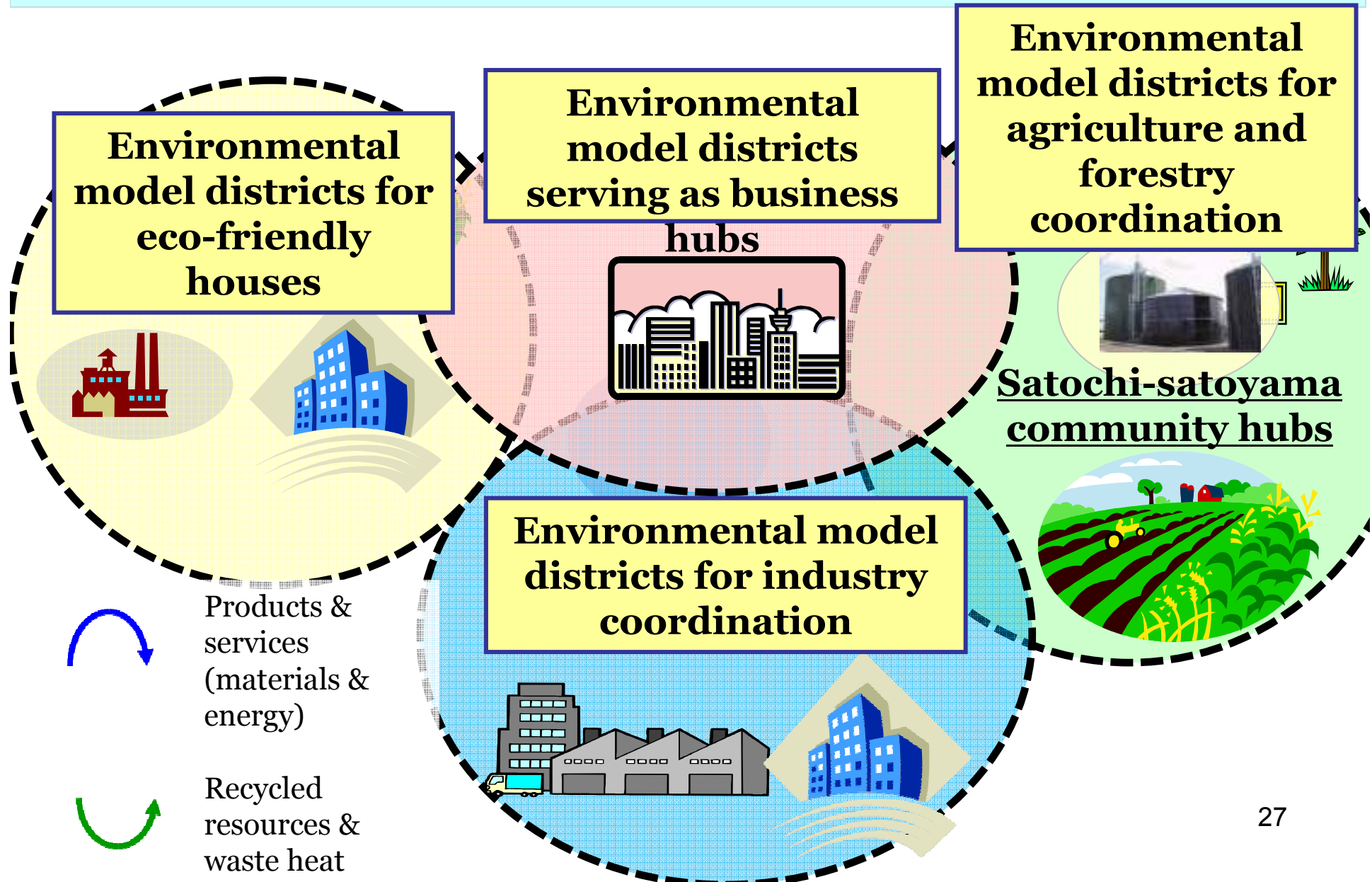


循環資源排出分布(その他プラ製容器包装の例)とごみ焼却施設・循環拠点産業施設の立地



Organizing low-carbon countermeasures into packaged solutions to meet the characteristics of communities

Low-carbon environmental model districts taking advantage of communities' characteristics



産業連携型の低炭素モデル地区の実現イメージ

環境都市機能
検討会(国立環
境研他)資料)



Eco-towns, targets and lessons for a decade

1997-Subsidization of recycle facilities (62fac. 26ecs)
1998- National Fundamental Law for Recycle Economy Oriented Society

Eco-towns as Social environmental infrastructure (1997-2007)
-capacity control of landfill site
-revitalization of heavy industries
>hazardous waste treatment
>circular business promotion

1997- Recycle Promotion Law for Electronics, drink cans and bottles, and construction wastes
2003- Stringent Regulation against illegal dumping

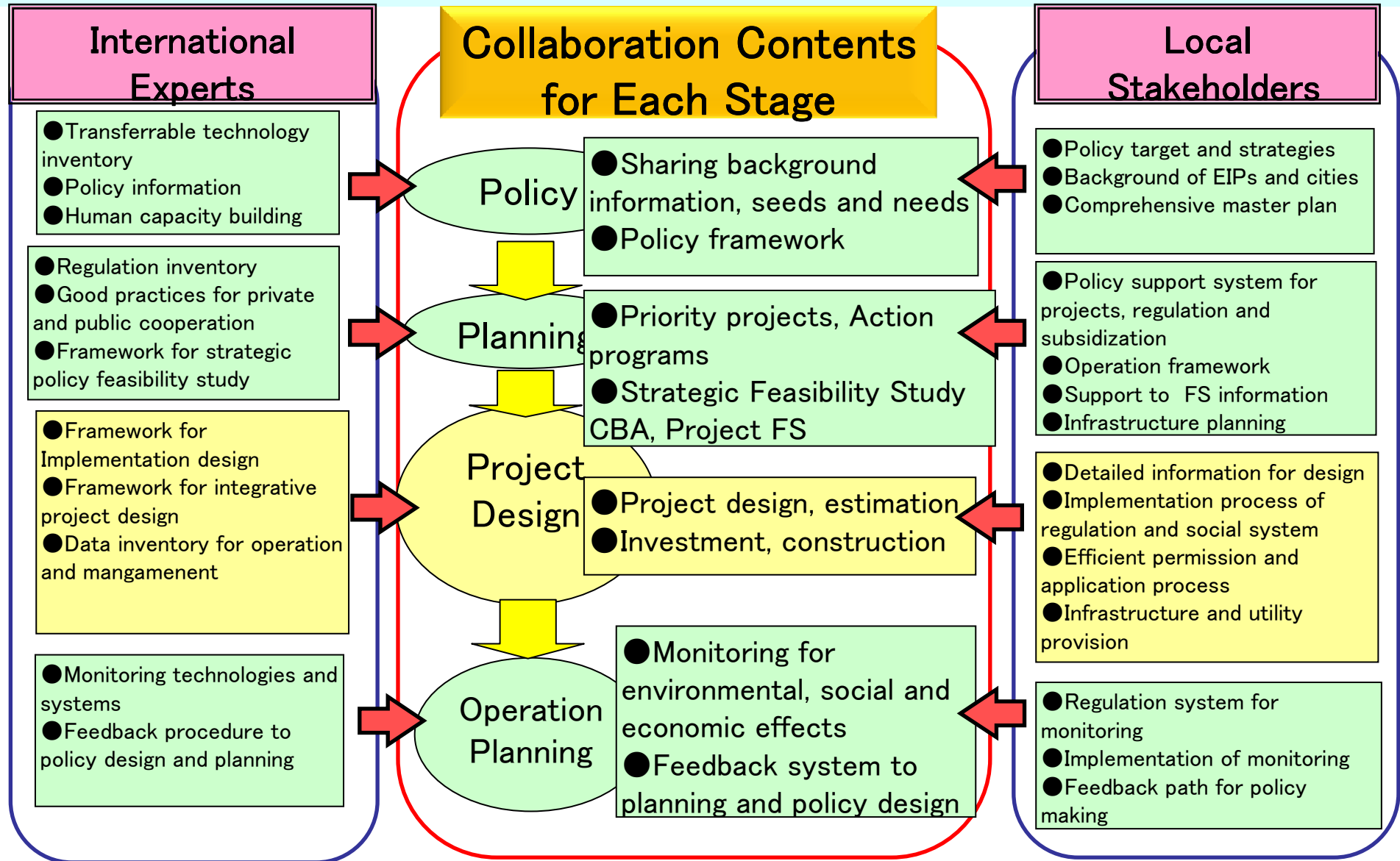
Circular cities and regions
-rare metal
-carbon resources

Low carbon cities and regions
-national target of 60-80% reduction by 2050

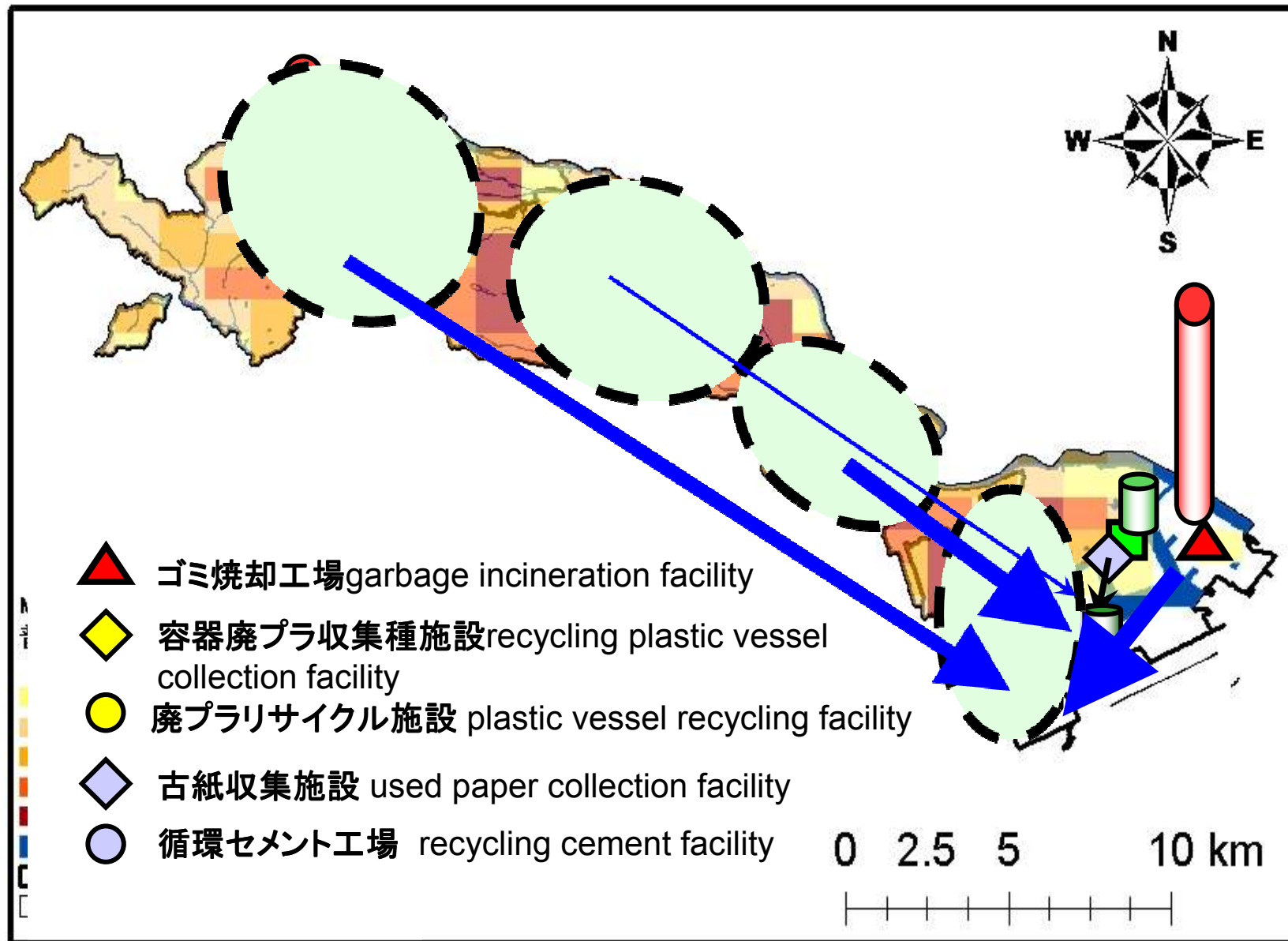
Asian Eco-industrial networks with knowledge data base of eco-towns

Quantification methodology and tools for further national projects and generalization among Asian Cities

International Platform for Smart Growth EIPs and Eco-Industrial Cities



Urban resource recycling technology/policy simulation calculation



Evaluation of Local Industrial Symbiosis Effects

