The 4th WGIA: 14-15 Feb., 2007

Recent development on Japan's inventories with regard to solid waste disposal

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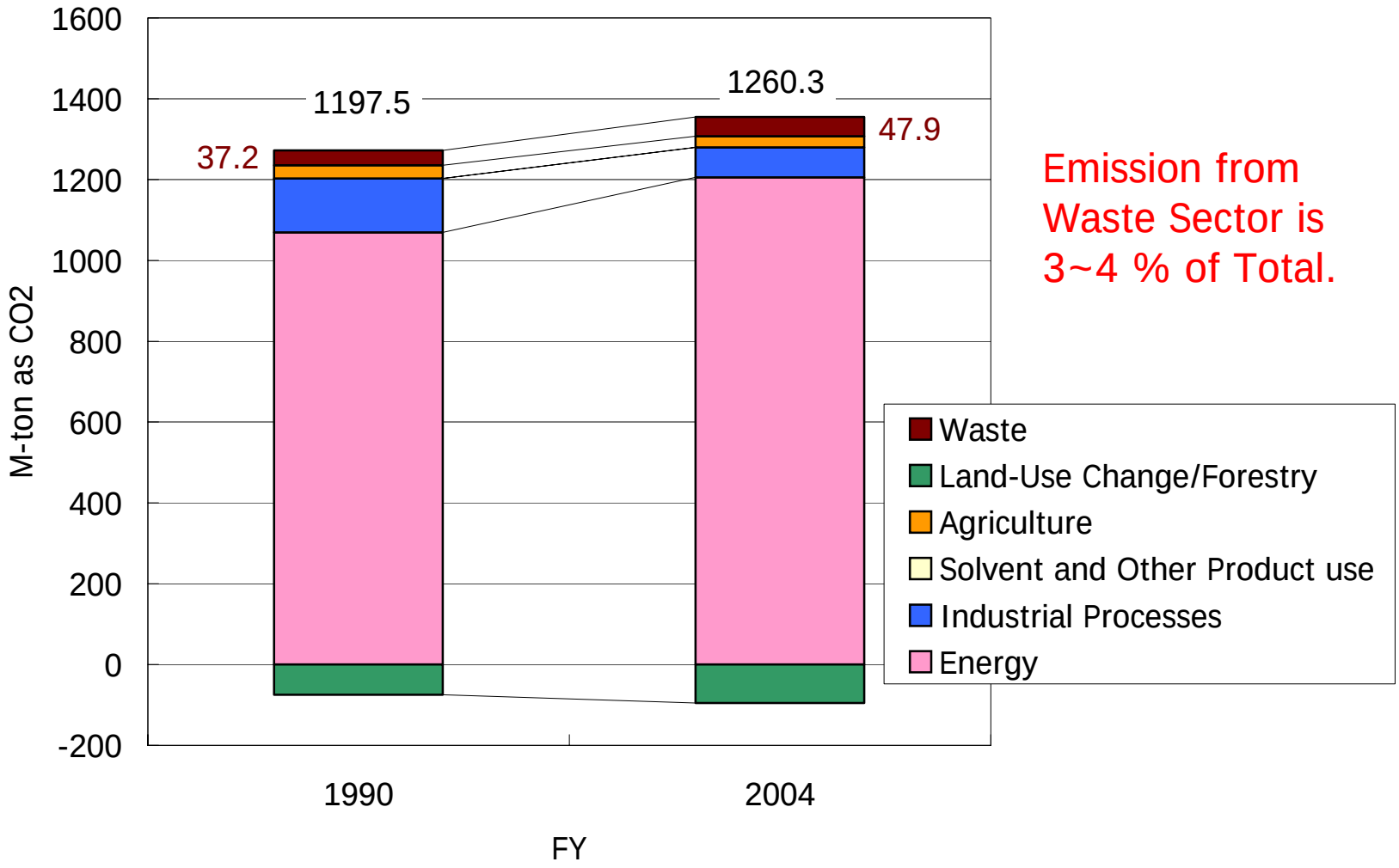
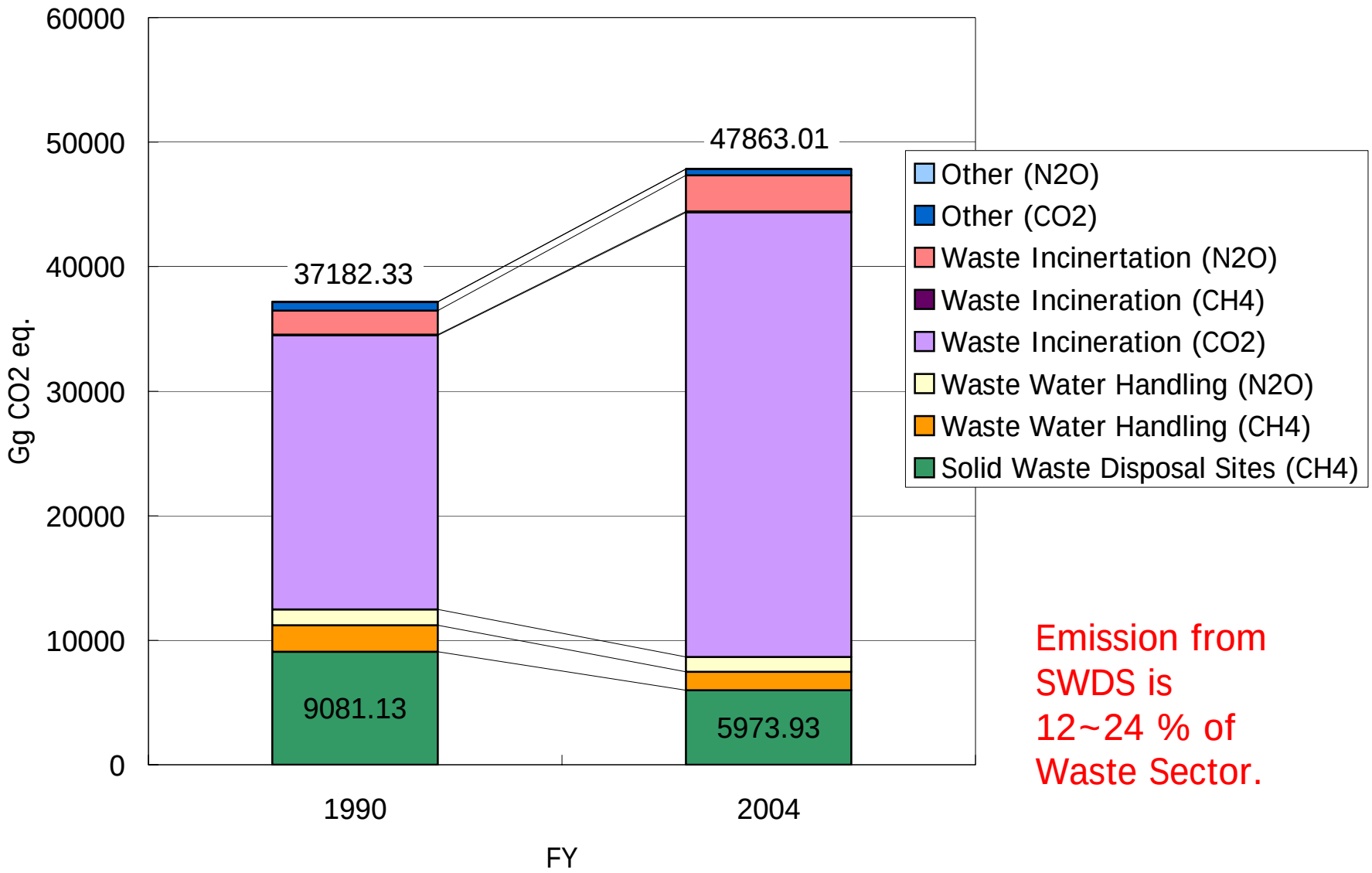
Total GHG Emission from Japan



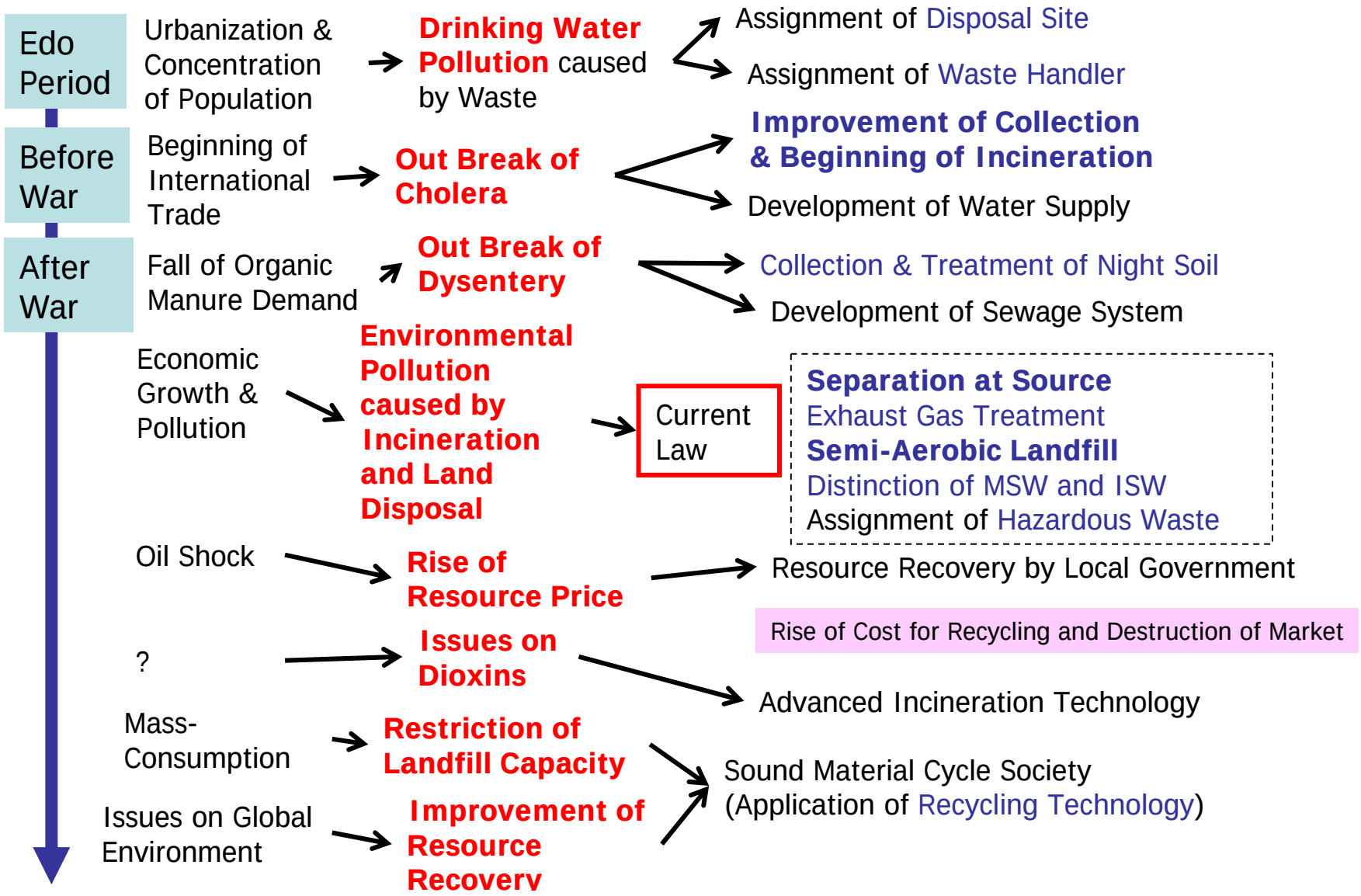
Emission from Waste Sector is 3~4 % of Total.

GHG Emission from Waste Sector



Emission from SWDS is 12~24 % of Waste Sector.

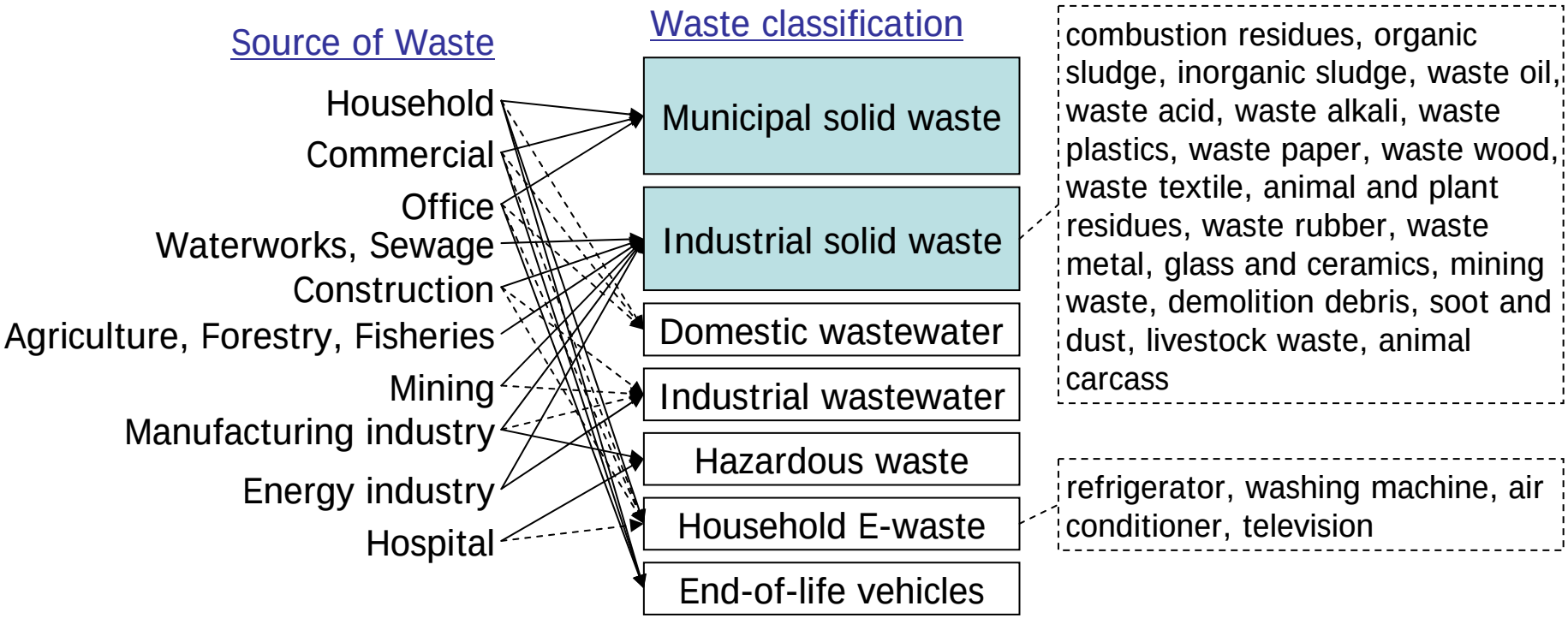
Brief History of Waste Management in Japan



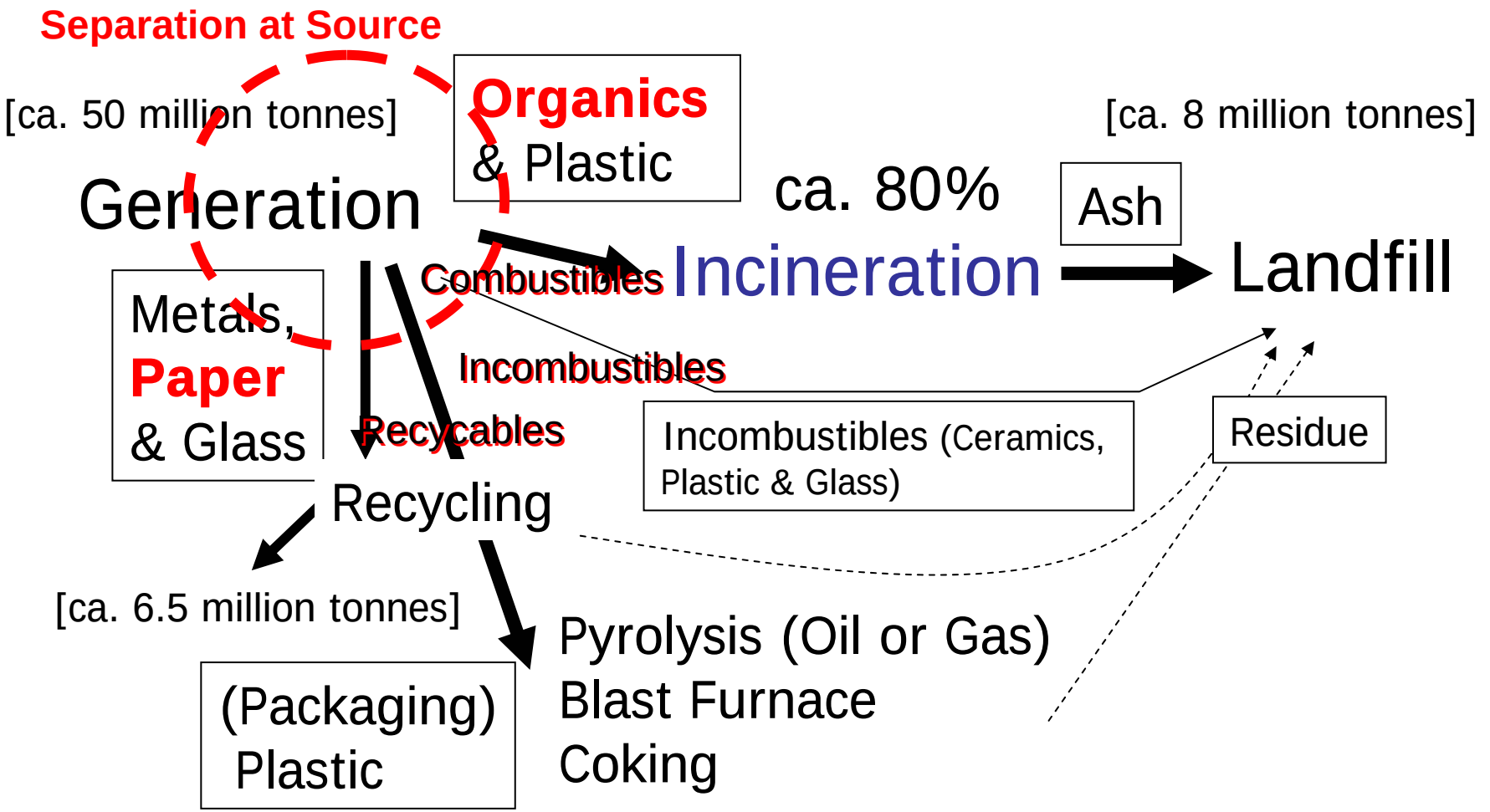
GHG emission from landfill sites has been **drastically reduced** by "Separation at Source", "Intermediate Treatment (Incineration)" and "Semi-Aerobic Landfill", which were originally introduced for improvement of public health and environment.

Waste in Japan

- ✓ Waste are classified into “municipal waste” and “industrial waste,” in keeping with Japanese regulations.
- ✓ Industrial waste contains 20 types of waste from business activities, provided for exclusively under the Waste Management Law.
- ✓ Household E-waste and end-of-life vehicles are separately treated and recycled by producers.
- ✓ Municipal waste is other waste to be treated by municipalities and is classified into “municipal solid waste,” such as garbage from households, and “human excrement (and sludge from johkasou)”.
- ✓ Wastewater and solid waste are treated separately.

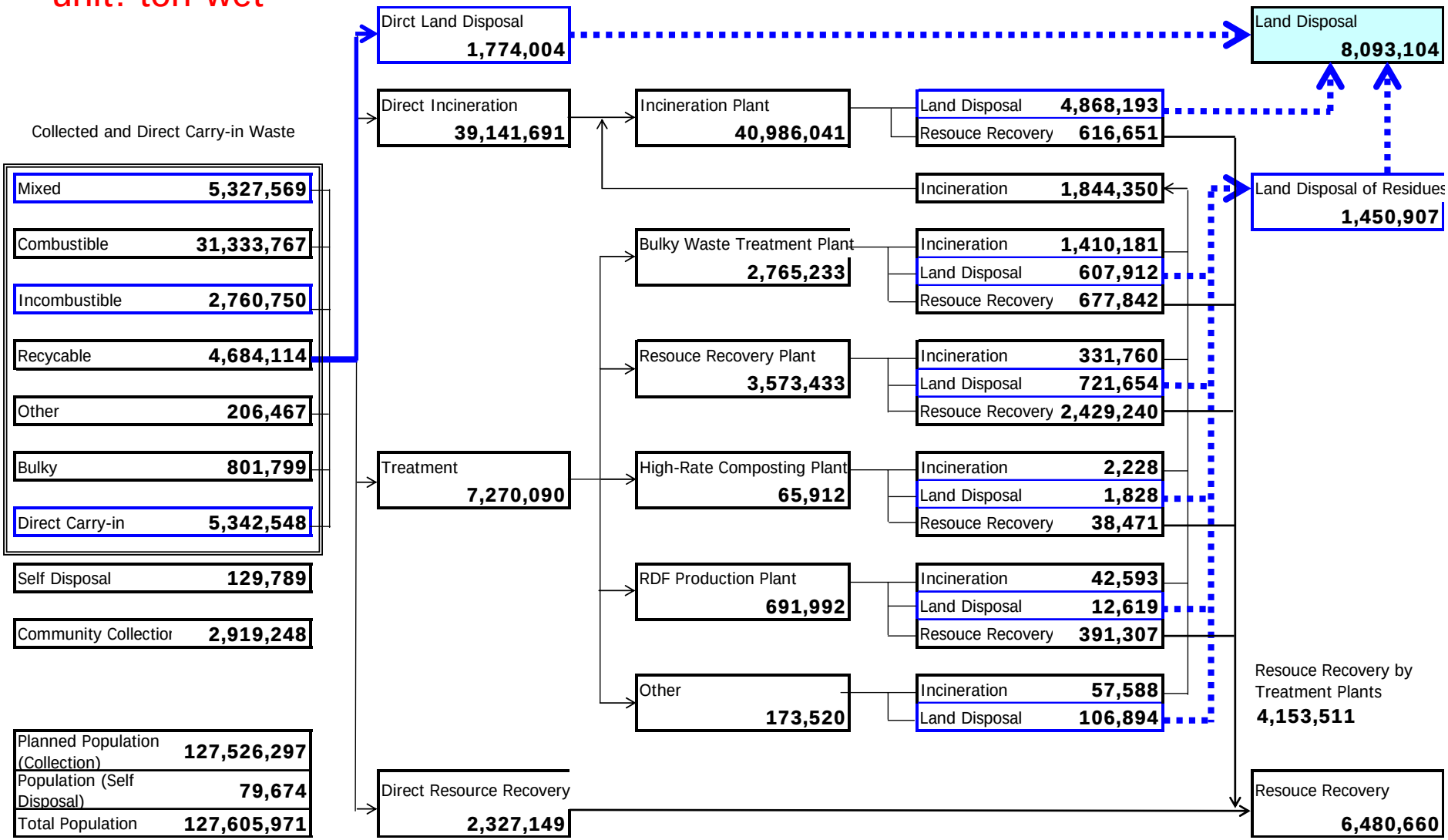


MSW Stream at a Glance

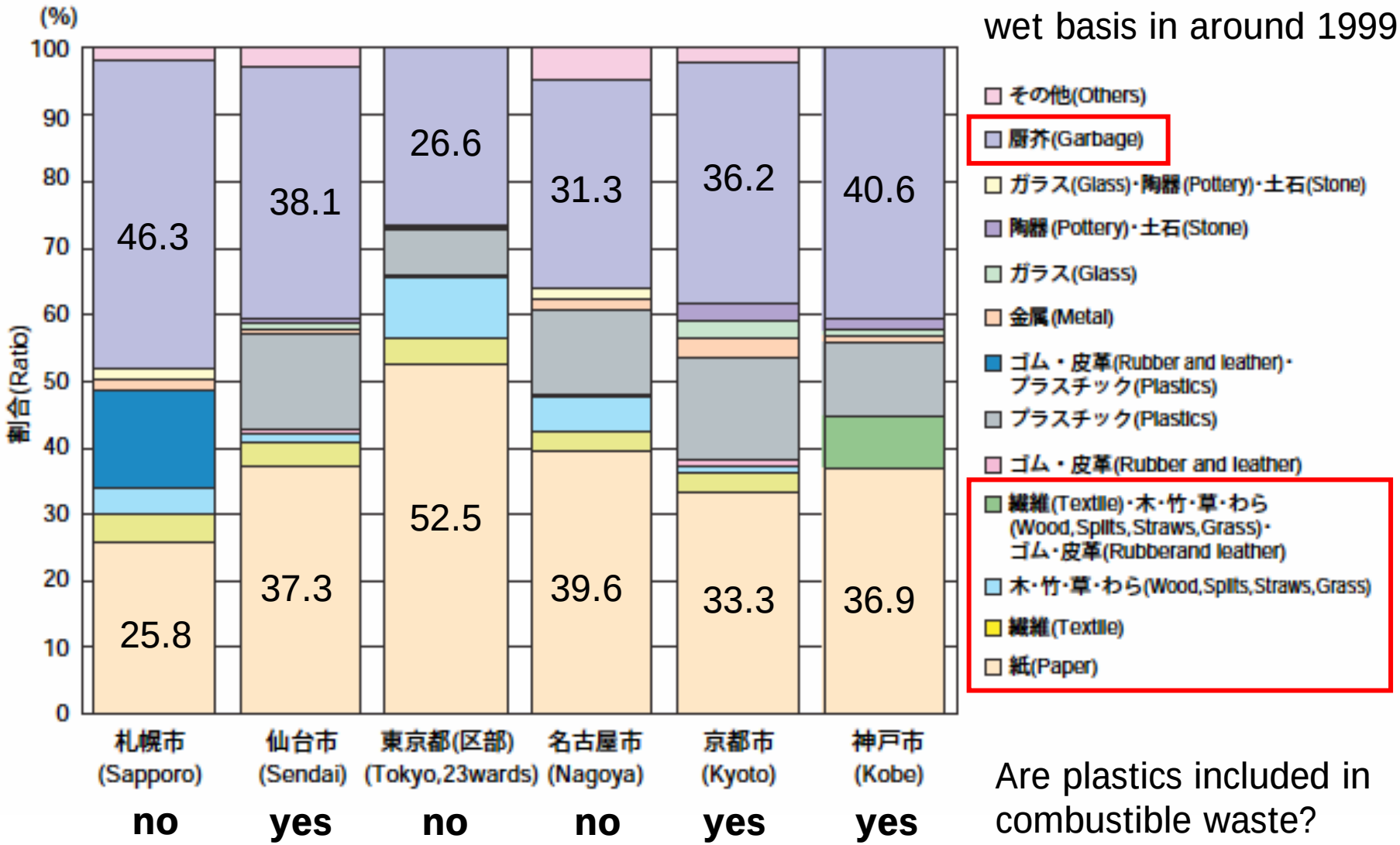


MSW Stream (FY2004)

unit: ton-wet



Composition of MSW (for combustible waste)



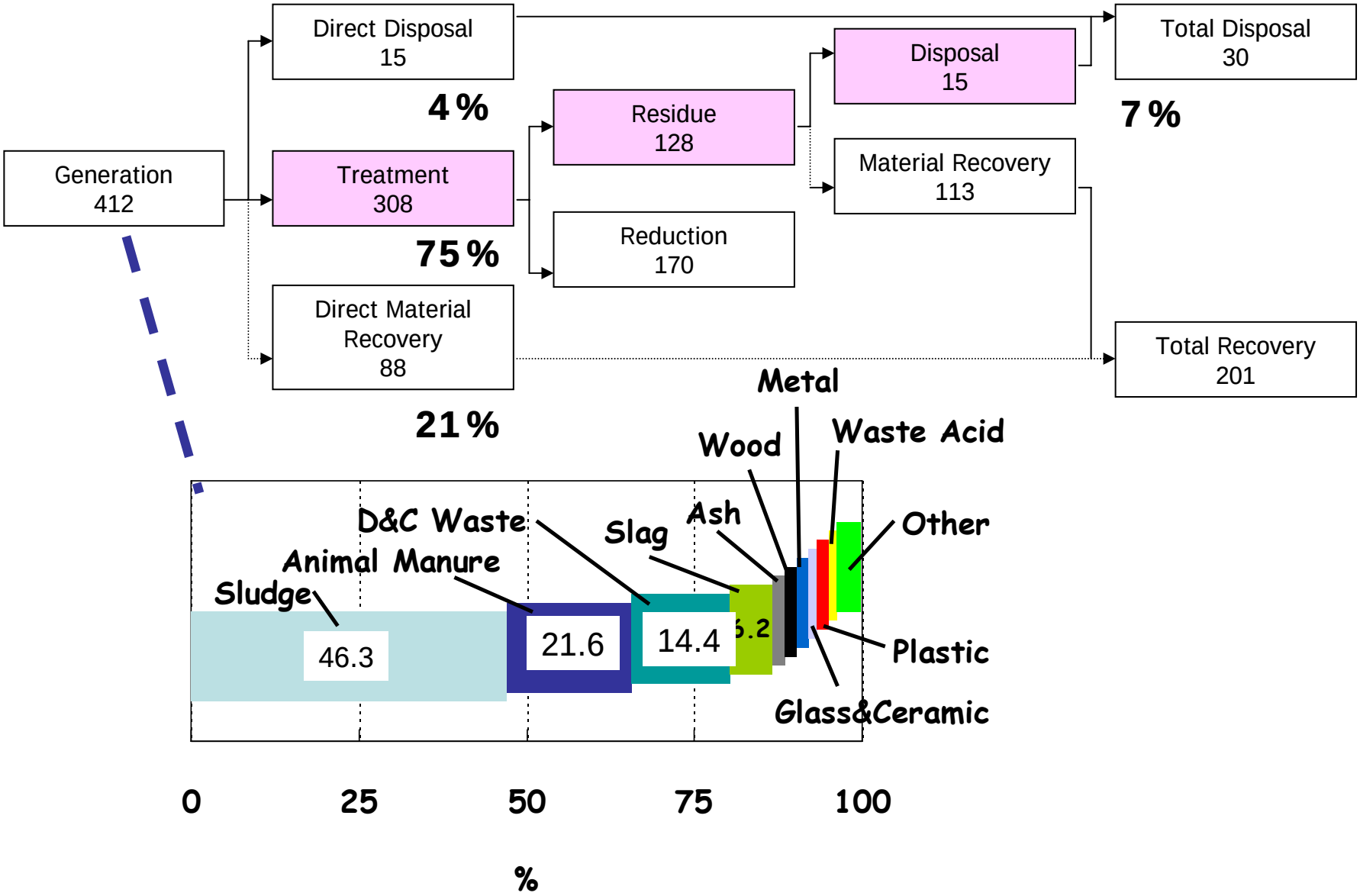
wet basis in around 1999

Are plastics included in combustible waste?

MSW Statistics

- ✓ Data is obtained by measurement of every load. Municipalities, who are responsible to disposal, measure waste, recovered materials and its treated residues at the gate of plants and disposal sites.
- ✓ This statistical survey is yearly.
- ✓ The national government request for this data to prefectures.
- ✓ Waste composition data is not demanded for national statistics. However, municipalities occasionally estimate this for operation of plants and planning of waste management.

Industrial Waste Stream (FY2004)



Industrial Waste Statistics

- ✓ Data is obtained by the sample method. Prefectures send questionnaires to generators who are responsible to disposal.
- ✓ This statistical survey is usually quinquennial. Timings of survey are different for prefectures.
- ✓ The national government request for summery of this data to prefectures.
- ✓ Betweenness is interpolated using generation units of 66 industrial sectors, which denominators are economic drivers, such as shipment value, number of employees, headage, etc.
- ✓ More detail mass flow of industrial waste streams is complemented by additional inquiry surveys and statistics from industries.

Sub Categories for SWDS

Category	Item		Mode	CH4	CO2	N2O
Municipal Solid Waste	Food (Garbage)		Anaerobic	O	O	
			Semiaerobic	O	O	
	Paper		Anaerobic	O	O	
			Semiaerobic	O	O	
	Wood		Anaerobic	O	O	
			Semiaerobic	O	O	
	Textile (made by Natural Fiber)		Anaerobic	O	O	
			Semiaerobic	O	O	
	Sludge	Nignt Soil Treatment and Jokasou	Anaerobic	O	O	
			Semiaerobic	O	O	
Industrial Solid Waste	Food		Anaerobic	O	O	
	Paper			O	O	
	Wood			O	O	
	Textile (made by Natural			O	O	
	Sludge	Swage Treatment		O	O	
		Water Supply		O	O	
		Manifacture		O	O	
		Cattle Manure		O	O	
Other	Illegal Dumping		Anaerobic	O	O	
	Composting		Composting	O		O

Method for Estimation

- First Order Decay (FOD) Model with Domestic Parameters (Tier. 3)

$$E = \{\Sigma(EF_{i,j} \times A_{i,j}) - R\} \times (1 - OX)$$

E: CH4 Emission from managed disposal sites (kg-CH4)
$EF_{i,j}$: Emission factor of degradable waste, i disposed to site with structure, j without incineration (kg-CH4/t)
$A_{i,j}$: Degraded waste of degradable waste, i degradable waste disposed to site with structure, j without incineration in a inventory year (t-dry)
R: CH4 recovery (t)
OX: Fraction of CH4 oxidation in cover soil (-)

Emission Factor

- EF=[Carbon Content] x [Fraction of Gasification] x [Methane Correction Factor] x [CH4 Fraction in Landfill Gas]
  - Carbon Content →
  - Fraction of Gasification (DOC_f): 50%
  - MCF: anaerobic=1.0, semi-aerobic=0.5
  - CH4 Fraction: 50%

Item		%-dry
Food (Garbage)		43.4
Paper		40.9
Wood		45.0
Textile		45.2
Sludge	Sawage	40.0
	Night Soil Treatment and Jokasou	40.0
	Water Supply	7.5
	Manifacture	45.0
	Cattle Manure	40.0

Carbon Content

Set by the 9 types of waste

- Kitchen garbage, Waste paper, Waste Woods
  - Data sources: Result of analyses for MSW conducted by 5 cities in Japan
  - Set by averaging all data between1990-2004
  - MSW data have been used for also ISW
- Waste natural fiber textile
  - Data sources: Carbon content of each natural fiber products data and domestic demand of each fiber
  - Set by averaging of carbon content in each year from 1990 to 2004
- Sewage sludge
  - Use the upper limit of default value presented in GPG2000 on ground of Japan's domestic research results
- Human waste sludge, Livestock waste
  - Use the sewage sludge's value in consideration with properties of waste
- Waterworks sludge
  - Intermediate results of measurements at several water purification plants in Japan has been used
- Organic sludge from manufacturing industries
  - Use papermaking industry's value in view of data limitation
  - Paper sludge is the main organic sludge under papermaking industry and the carbon content were calculated by the cellulose's carbon content

Landfill Types in Japan

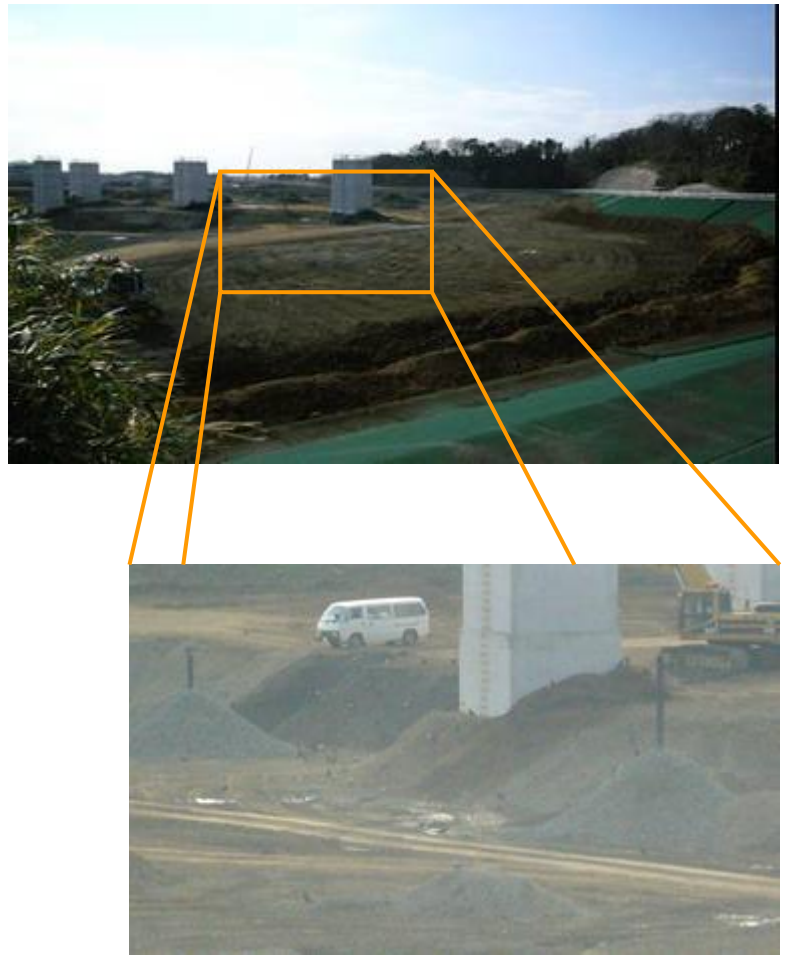
Emissions from SWDS have been calculated under two types of landfill; semi-aerobic landfill and anaerobic landfill.

- Semi-aerobic landfill

  Regarding as semi-aerobic those sites which have leachate treatment facilities and subsurface containment structures.

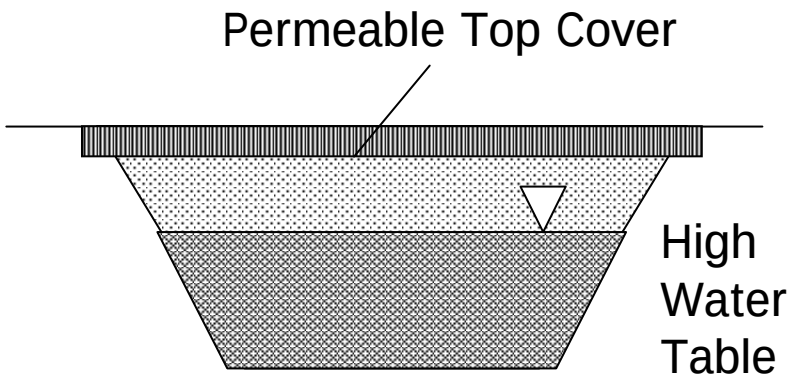
- Anaerobic landfill

  Disposal sites where landfilling started before the 1977 joint order, and all coastal and inland water landfills are treated as anaerobic disposal sites.



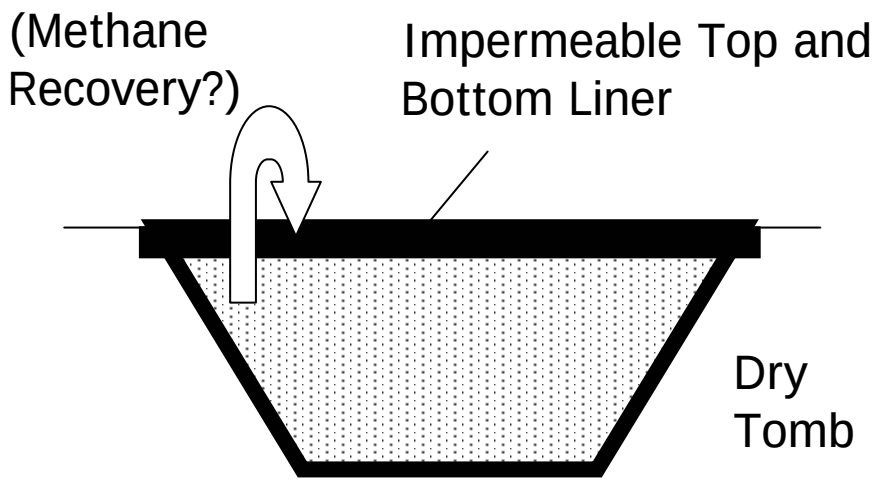
Landfill types in IPCC GL

The “managed” landfill in Guidelines is classified to the “anaerobic landfill”.



No or Incomplete Leachate Drain

Traditional Sanitary Landfill

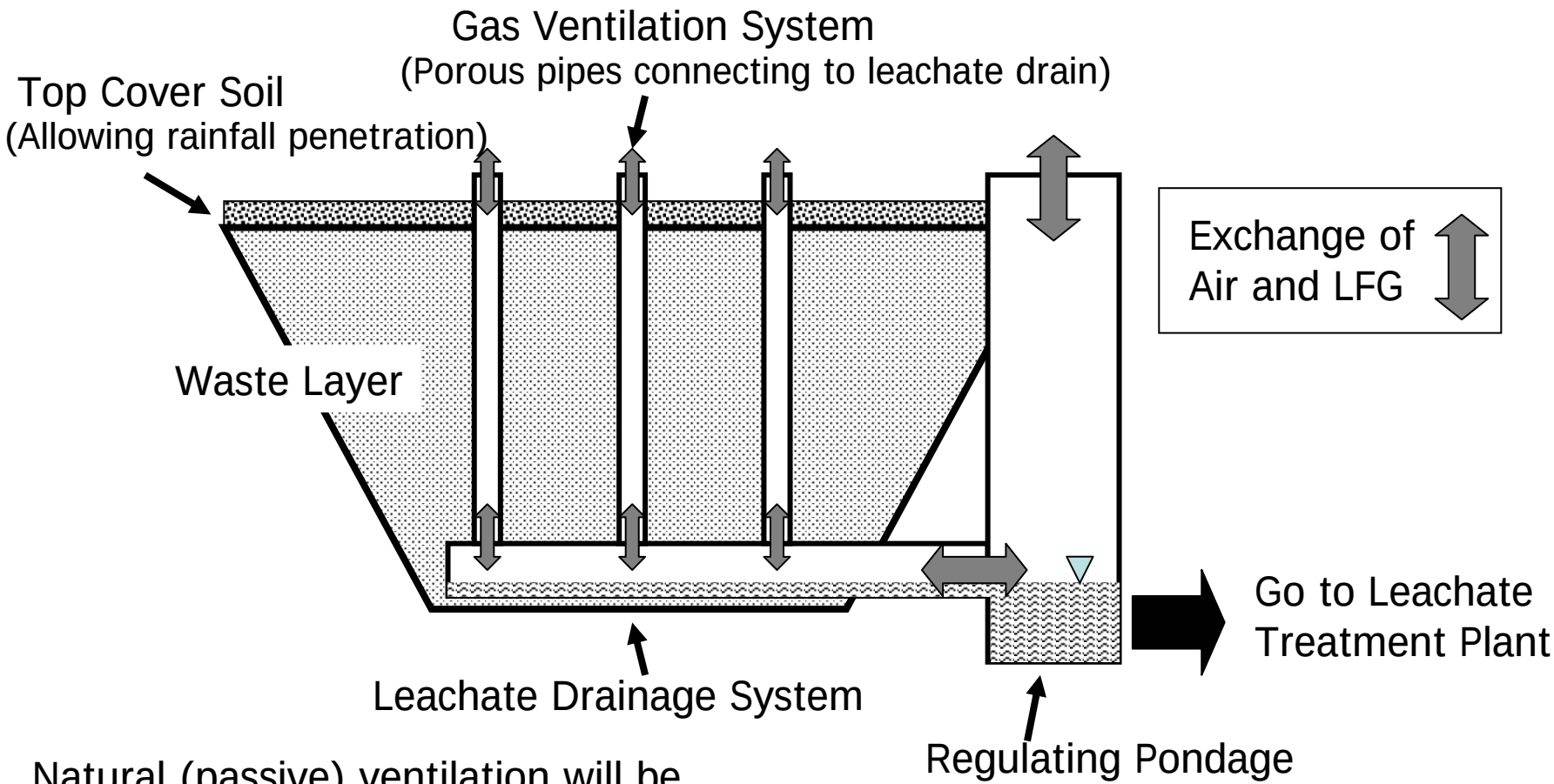


Minimize amount of Leachate

Western Landfill

Emission of polluted leachate will be extend over a long period of time.

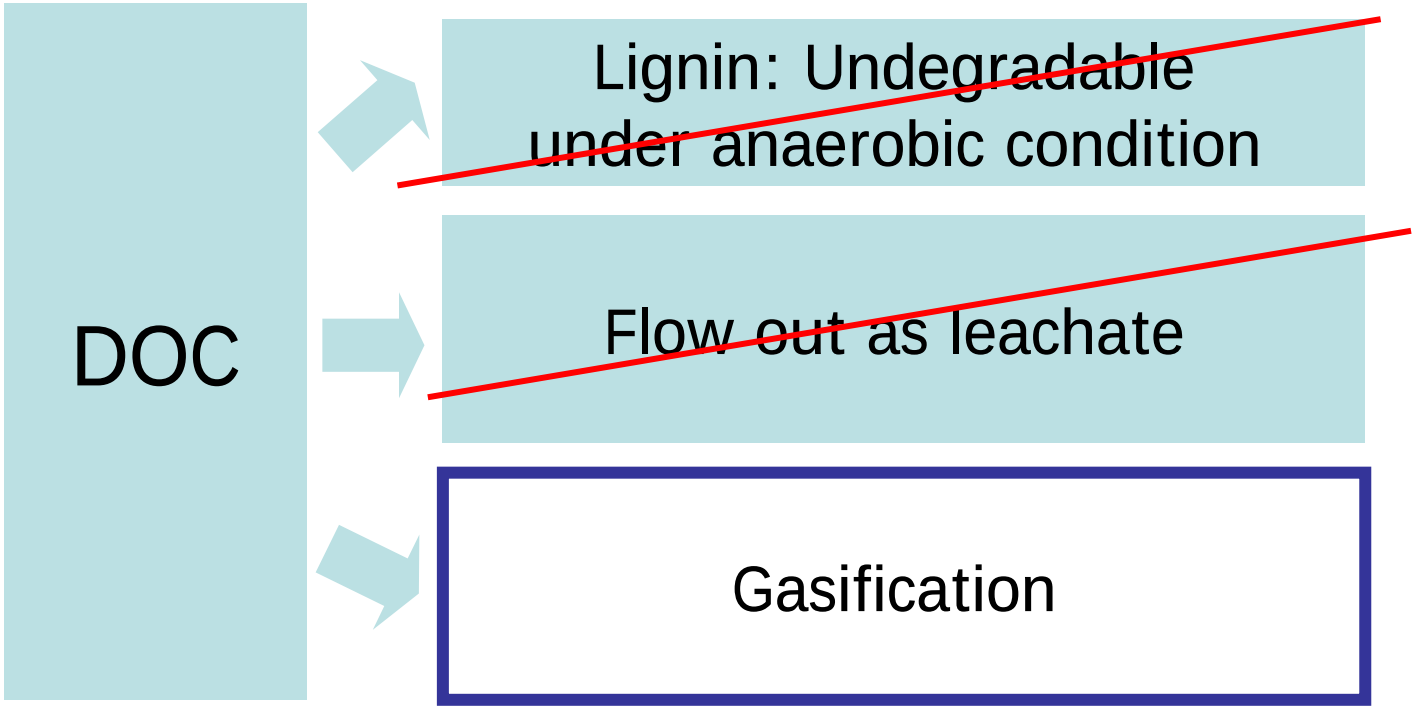
Semi-Aerobic Landfill



Natural (passive) ventilation will be occurred by temperature difference between waste layer and outside air.

Aerobic decomposition of waste can improve quality of leachate and LFG emission.

Fraction of DOC that can decompose



Generally the amounts of DOC lost with the leachate are low (less than 1%) and can be neglected in the calculations. (2006 IPCC Guideline)

Is this explanation realistic in Asian Countries?

Activity

$$W_i(T) = W_i(T-1) \times e^{-k} + w_i(T)$$

$$A_i(T) = W_i(T-1) \times (1 - e^{-k})$$

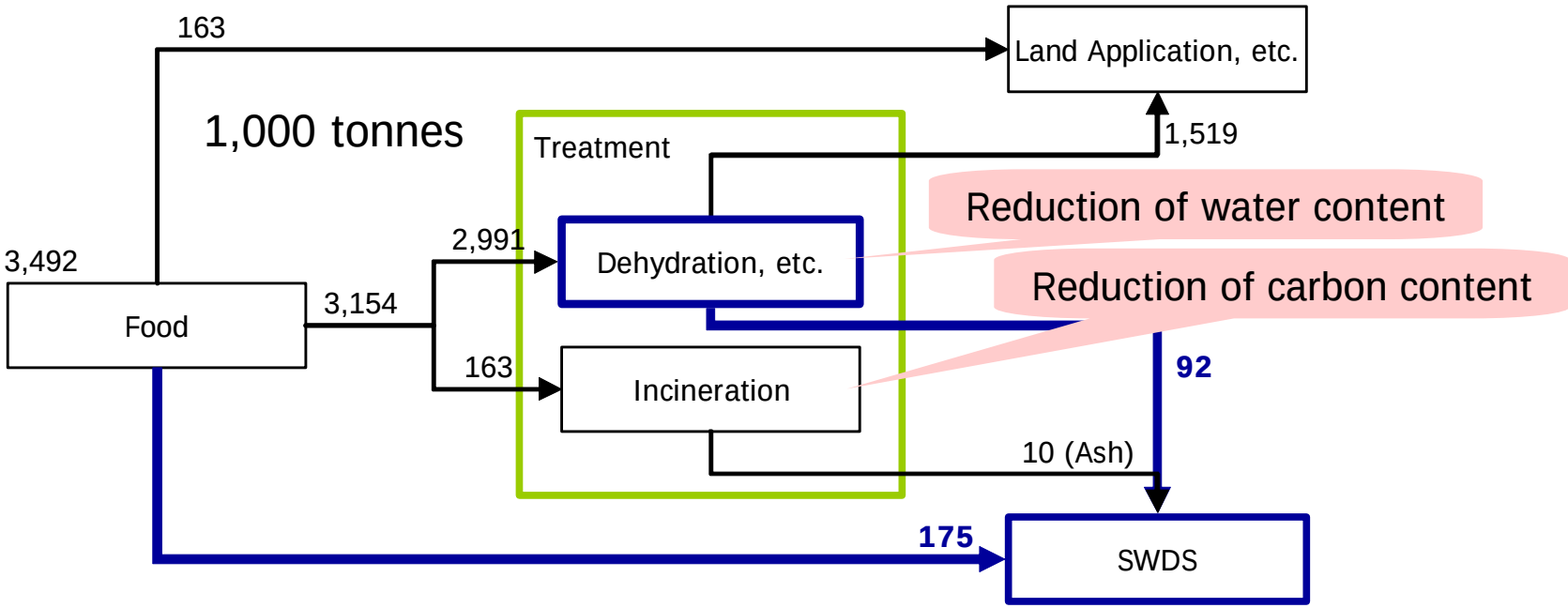
$$k = \ln(2) / H$$

$A_i(T)$: Degraded waste, i in a inventory year, T
$W_i(T)$: Remained waste, i at disposal site in a inventory year, T
$w_i(T)$: Disposed waste, i in a inventory year, T
k: Degradation rate (1/yr)
H: Half life of waste, i

w_i = [Degradable waste disposed] x
[Fraction of waste disposed to site with different structures] x
[Fraction of dry matter in waste, i]

Activity

- Degradable waste disposed
  - Accounting amount of disposal waste other than flowing stream with incineration



Activity

- Fraction of dry matter in waste

Item			Dry matter content %
Food			25
	Pre-Treated		30
Paper	MSW		80
	ISW		85
Textile (Natural)	MSW		80
	ISW		85
Sludge	Swage Treatment		specific for each plant
	Nignt Soil Treatment and Jokasou	Direct Disposal	15
		Pre-Treated	30
	Water Supply		original data is dry basis
	Cattle Manure	Direct Disposal	16.9
		Pre-Treated	30
	Manifacture	Food Processing	77
		Chemical	57
		Pulp and Paper	closed

Activity

- Fraction of waste disposed to site with different structures

Category	Structure	%-wet		
		1977	1990	2004
MSW	anaerobic	100	64.2	45.3
	semi-aerobic	0	25.8	54.6
ISW	anaerobic	100	100	100

- Half Life
  - Food: 3 years, Paper: 7 years, Textile (natural): 7 years, Wood: 36 years, Sludge: 3.6 years (default)
- Delay Time
  - 6 month

Activity

- Activity for Emission from managed SWDS

Item		Degraded waste in a inventory year: 1,000 tonnes/year			
		1990	1995	2000	2004
Food		517	511	444	335
Paper		1246	1175	995	840
Textile (natural)		73	65	56	47
Wood		344	377	373	359
Sludge	Swage Treatment	297	277	223	158
	Nignt Soil Treatment and Jokasou	51	52	52	50
	Water Supply	192	185	157	130
	Manifacure	363	292	182	133
	Animal Manure	251	240	200	232
Total		3336	3175	2682	2285

Other

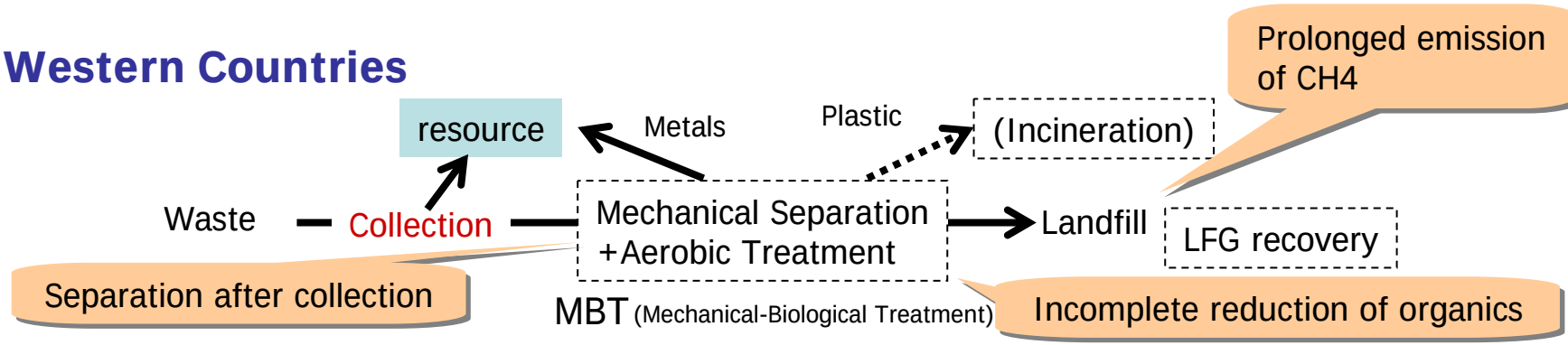
- CH_4 Recovery
  - For one site

	unit	1990	1995	2004
LFG Usage	km3N	1985	2375	1561
CH4 Conc.	%	53.3	42.2	40.0
CH4 Usage	km3N	1059	1003	624
	GgCH4	0.76	0.72	0.45

- Fraction of CH4 oxidation in cover soil
  - 0

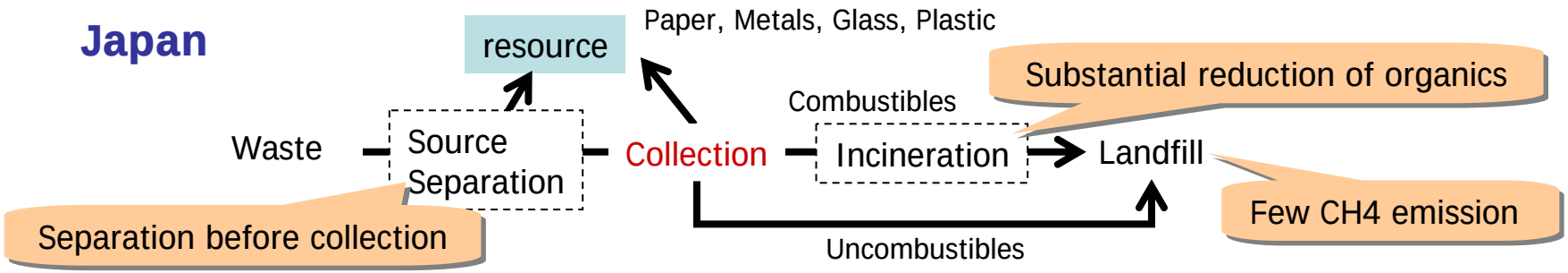
Structures of MSW Stream

Western Countries



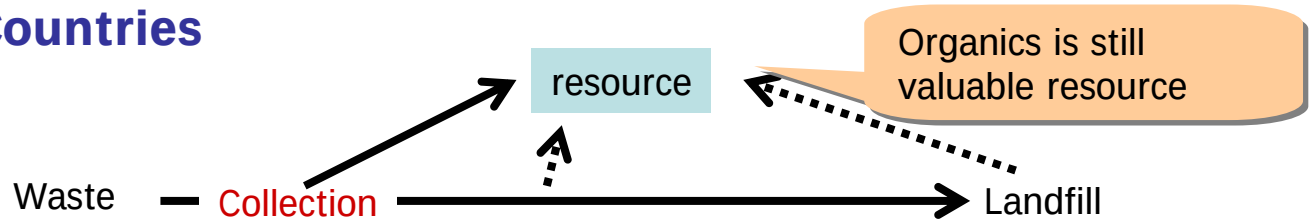
"Mechanical Separation" should be applicable to waste with low water content.

Japan



"Incineration" has been selected due to sanitation of waste with high water content.

Asian Countries



"Resource" includes organic materials with high water contents for composting.

Issues on Estimation of MSW stream

- ✓ Waste mass data on authorized management stream can be estimated from account (monetary) data.
  - ✓ Uncertainty will be depended on conversion from truck road to weight.
  - ✓ Installation of treatment and resource recovery facilities before disposal will improve quality of SWDS and waste statistics.
- ✓ 3R activities including unauthorized resource recovery can significantly be change mass and composition of MSW.
  - ✓ “How to estimate the unauthorized stream” is important research issue.
  - ✓ “How to incorporate unauthorized activity to waste management” is important political issue.
- ✓ Better waste management will lead to better estimation and environment.

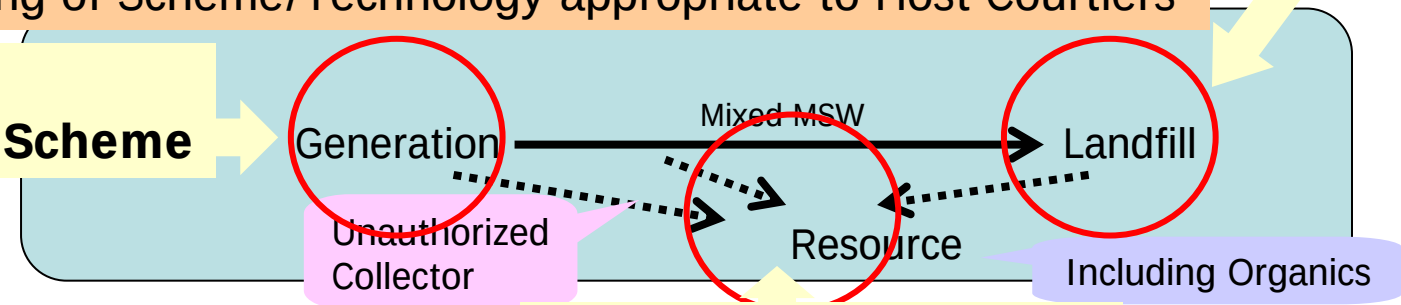
Co-benefit in Waste Stream Management

Future economic development will change the level of applicable technologies.

Final Disposal Technology

Stepwise Introducing of Scheme/Technology appropriate to Host Courtiers

Resource Recovery Scheme

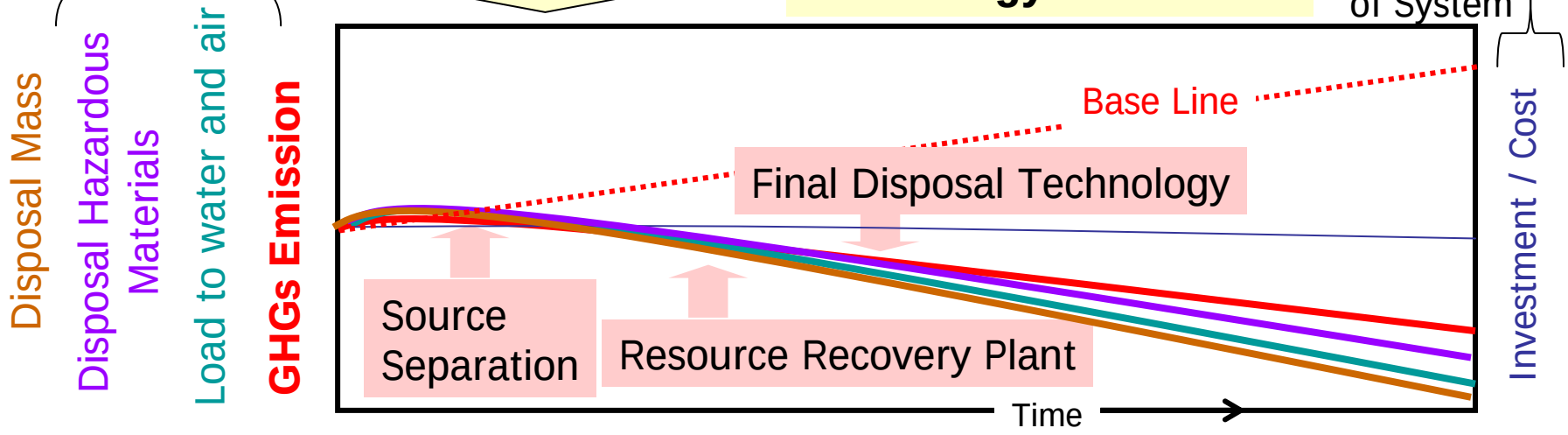


Real and substantial merit for developing countries are;

Win-Win Situation

Appropriate Treatment Technology

Sustainability of System



Thank you for your attention

The 1st workshop on “Improvement of solid waste management and reduction of GHG emissions in Asia (SWGA)” on 18, January 2007 at Yokohama.

The 2nd workshop will be held at Fukuoka in next year.