Change of MSW Composition attributed by Ban on Direct Landfill of Foodwaste in Korea

WGIA7 Session III : Group Discussion on Sector-Specific Issues

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Ban on Direct Landfill of Foodwaste

Limited area	Seoul, metropolitan cities, small cities (District excluded)
Start Date	2005.1.1
Details	Waste generated from Seoul, metropolitan cities, and small cities should be landfilled only after incineration, fertilizing, feeding and any other disposal process required. Direct landfill is legally prohibited.
Regulation	ENFORCEMENT REGULATIONS of WASTES CONTROL ACT An attached table 4 (1997.7.19 Revision)

Keynote of Foodwaste in Korea

pH
4.5~5.2
(Acidity)

Salt
1~2.3%

Water
80~85%

foreign substance, Decay, et.

Landfill	Incineration	Recycling
- Foul odor - Leachate	- Imperfect combustion - Use of auxiliary fuel	- Feeding - Composting

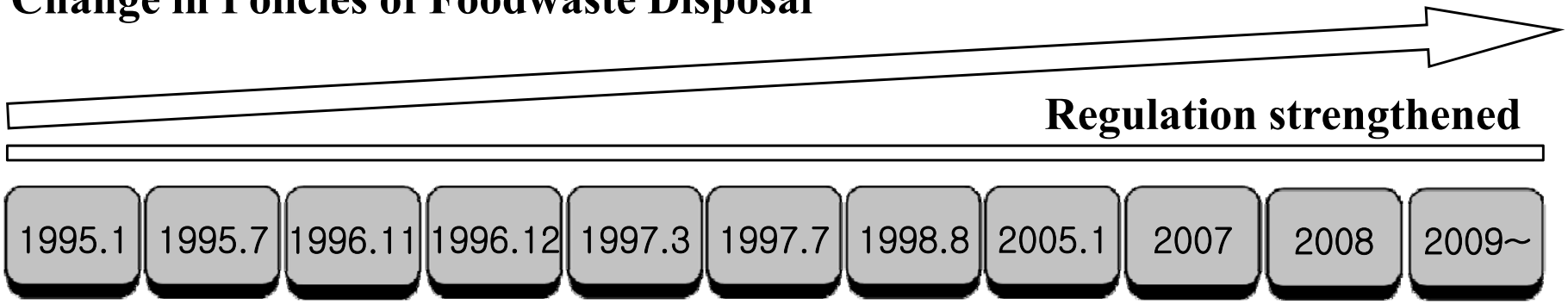
Driving process of a Policy

Background

- Among generated municipal waste, foodwaste accounts for 26%
- As food resource insufficient in Korea, generation of foodwaste result in squandering valuable resource
  - ○ Food self-sufficiency rate: 30%
  - ○ Feedstuff self-sufficiency rate : 4%
  - ○ Food resource wasted: approx. 14.7 trillion won annually
- As Korean food contains much water, it causes secondary pollution in disposal processes of landfill, incineration etc.

Progress

Change in Policies of Foodwaste Disposal



1995. 1	Enforcement of Volume-rate Waste Charge System and arising of foodwaste problems
1995. 7	8 authorities including MOEK, Ministy for Health etc. established [Committee on Foodwaste Management]
1996. 11	Sudokwon Landfill, prohibited cargos with overloaded foodwaste
1996. 12	[Comprehensive Foodwaste Reduction Plan (1997~2001)] settled
1997. 3	Sudokwon Landfill, prohibited of carrying in foodwaste in 3rd section/agreement made on Odor Control Plan
1997. 7	Revision of Enforcement on Waste Management Plan for ban on direct landfill of foodwaste in Jan. 2005, MOEK
1998. 8	[Foodwaste Reduction, Resource Master Plan(1998~2002)] conducted by MOEK
2005. 1	Ban on landfill of foodwaste generated from Seoul, metropolitan cities, small cities

Expansion of Foodwaste Disposal Facility

<Installation and Operation Status of Annual Foodwaste Disposal Facility>

(Unit : No. of facility, ton/day)

Year	'97	'98	'99	'00	'01	'02	'03	'04	'05
Total	46 (1,076)	167 (3,178)	231 (4,228)	233 (5,195)	225 (5,671)	249 (8,575)	262 (9,815)	253 (11,232)	256 (13,364)
Public	32 (547)	50 (1,007)	73 (1,223)	80 (1,905)	81 (2,099)	80 (2,598)	80 (2,945)	85 (3,239)	90 (4,198)
Private	14 (529)	117 (2,171)	158 (3,005)	153 (3,290)	144 (3,572)	169 (5,977)	182 (6,870)	168 (7,993)	166 (9,166)

◆ Public and private disposal facilities increased after 1997

○ Public disposal facility : increased 4.1 time compared to '97 level (2005)

○ Private disposal facility : increased 17.3 time compared to '97 level (2005)

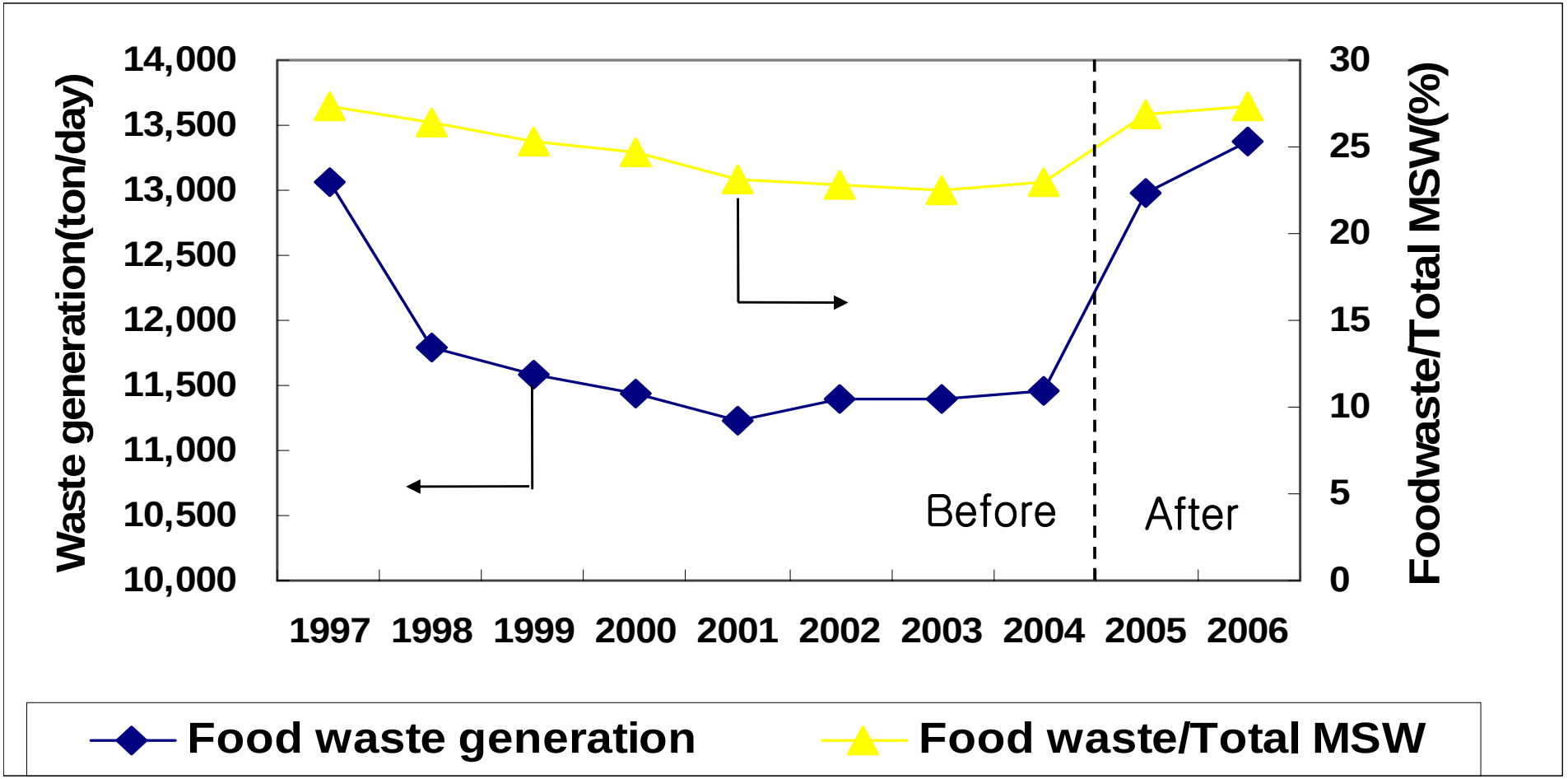
◆ Among total capacity of facilities, public facility accounts for 31.4%, private facility accounts for 68.6%

Results and Effects

Generation and Disposal of Foodwaste

Year	1997	2000	2004	2005	2006
Total MSW generation(ton/day)	47,895	46,438	50,007	48,398	48,844
Foodwaste generation(ton/day)	13,063	11,434	11,464	12,977	13,372
Foodwaste/Total MSW(%)	27	25	23	27	27
Landfill(ton/day)	10,973	5,185	1,607	356	261
Landfill ratio(%)	84	45	14	3	2
Incineration(ton/day)	815	1,088	541	516	509
Incineration ratio(%)	6	10	5	4	4
Recycling(ton/day)	1,275	5,161	9,316	12,104	12,317
Recycling ratio(%)	10	45	81	93	92

Increase in Foodwaste Generation



◆ Foodwaste generation per day : 13,028 ton
(accounts for 26% of municipal waste)

○ 13.6% increase of foodwaste generation per day (11,424ton) compared to 2004

Increase in Foodwaste Generation

(Unit : %)

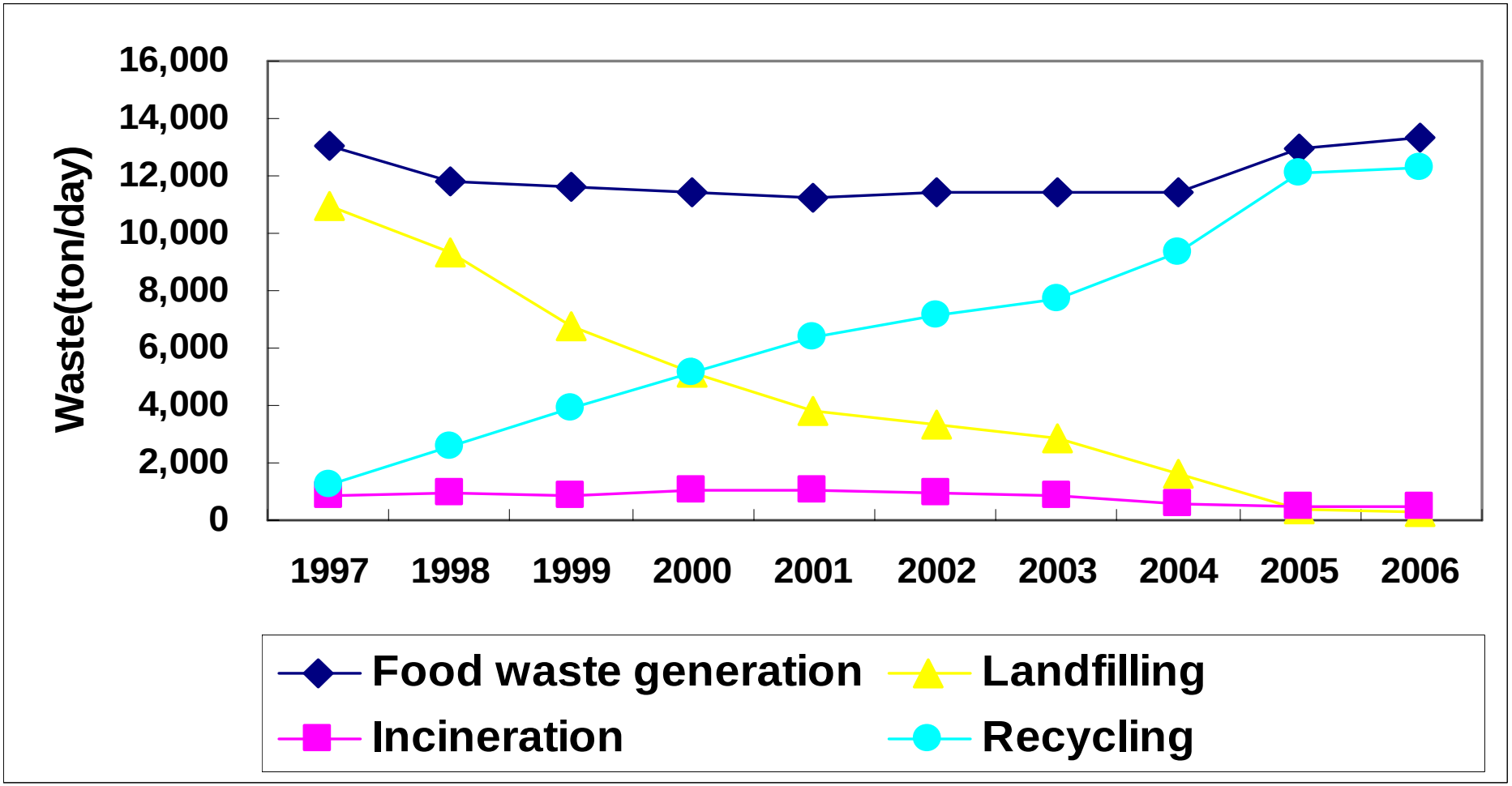
year	Household	Feeding facilities	Restaurant	Large scale store*
2002	65.9	4.2	21.1	8.8
2003	67.5	5.3	21.0	6.2
2004	71.1	5.3	17.3	6.3
2005	71.5	5.6	17.9	5.0

*** : Agriculture and fisheries market, Tourism equipment**

◆ After mass media and private organizations put effort on promoting and educating to reduce foodwaste, food culture has improved However, foodwaste generation sharply increased since the ban of direct landfill

○ As Life level enhance and concerns of health extend, consumption of fruits and vegetables increased which caused foodwaste generation from residents tend to increase

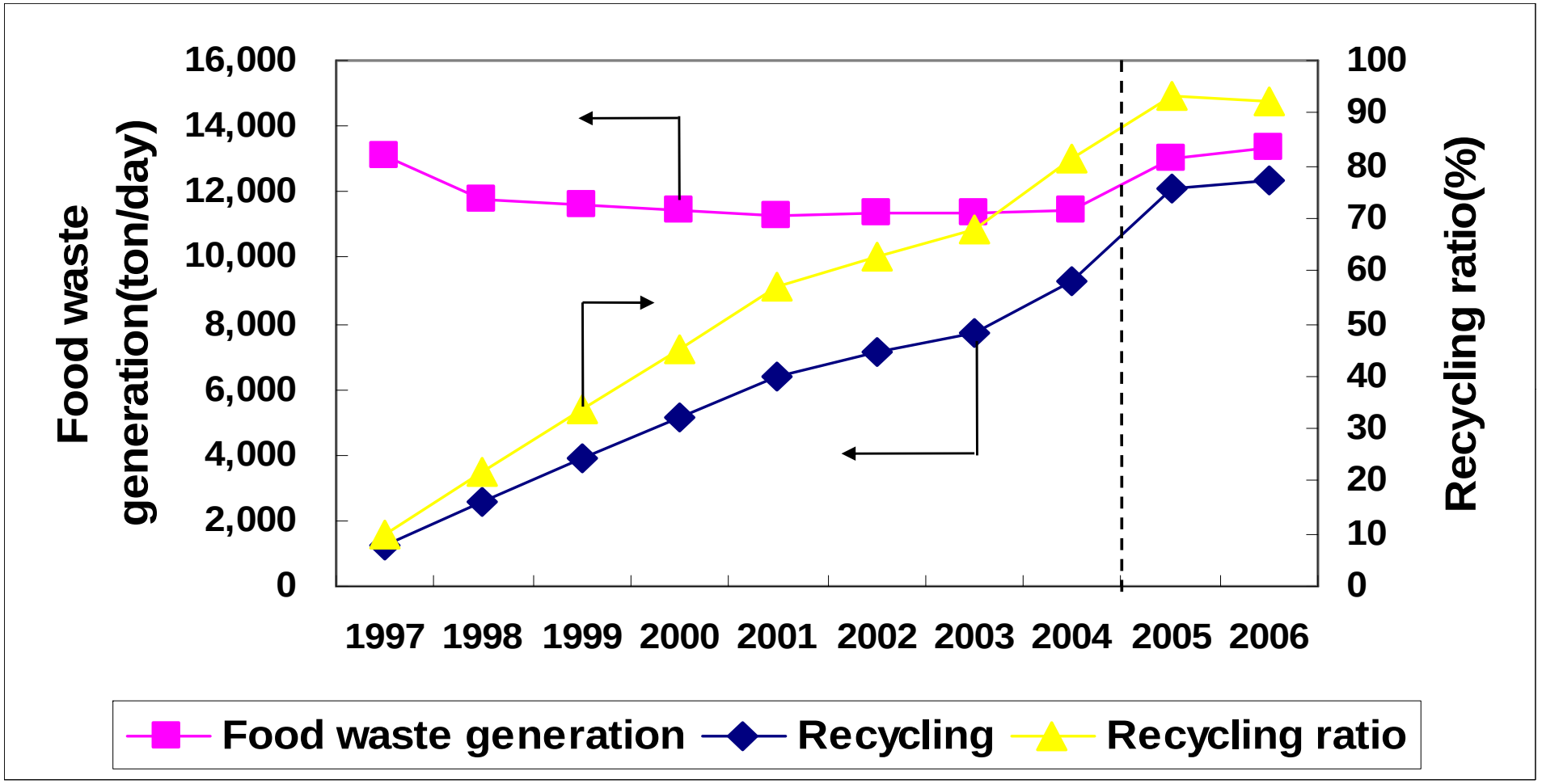
Change of Foodwaste Disposal Method



◆ Since 1997, landfill decrease, recycling increase

○ Recycling increase (10% -> 92%)
Landfill decrease (84% -> 2%)

Increase in Foodwaste Recycle



◆ After enforcement of volume-rate waste charge system in ’95 and ban on direct landfill of foodwaste in ’05.1, recycling rate sharply increased to 93% by late ‘05

Influence of MSW Composition

Target and Method for the Survey

Sampling	Location : 1 city	Chungbuk Jecheon city (Population : 140,000)			
	Points : 10 ea	APT (3)	Detached (3)	Shopping (2)	Outskirts (2)
	Dates : 3	Aug-04	Nov-04	May-04	
Analysis	Physico-chemical properties	Conical quarter dividing method, 3-Composition(ASTM)			
	Gas generation estimates	Scholl canyon model (First order decay model)			

Change of MSW Physical Composition

Components unit : wt % / Sampling time		Combustible						Incombustible		Misc.
		Food	Paper	Vinyl /Plastic	Textile	Wood	Leather	Metal	Glass	
2004	August	35.9	30	13.7	1.7	2	0.8	2.1	5.6	8.2
	November	32.2	25.7	15.9	2	0.6	0.5	1.1	4.6	17.4
	Average	34.1	27.9	14.8	1.9	1.3	0.7	1.6	5.1	12.8
2005	May	27.3	37.6	16.8	4.5	1.7	1.5	1.8	3.1	5.6

Results

- Foodwaste : At about 12% decrease
- Paper : At about 10% increase
- Ratio (Component/Total MSW) : Paper > Foodwaste > Vinyl/Plastic

Change of MSW Physical Composition

Components unit : wt % / Sampling time		Food	Paper	Vinyl /Plastic	Textile	Wood	Leather	Metal	Glass	Misc.
2004	Apartment	31.18	36.3	14.03	1.83	0.83	0.7	0.85	3.72	10.55
	Detached house	44.53	18.52	14.4	2.5	0.4	0.6	2.12	4.48	12.42
2005	Apartment	24.66	47.56	13.94	3.47	1.71	1.51	0.77	1.35	5.04
	Detached house	28.67	32.55	20.02	2.54	2.1	1.92	0.72	2.67	8.82

Results

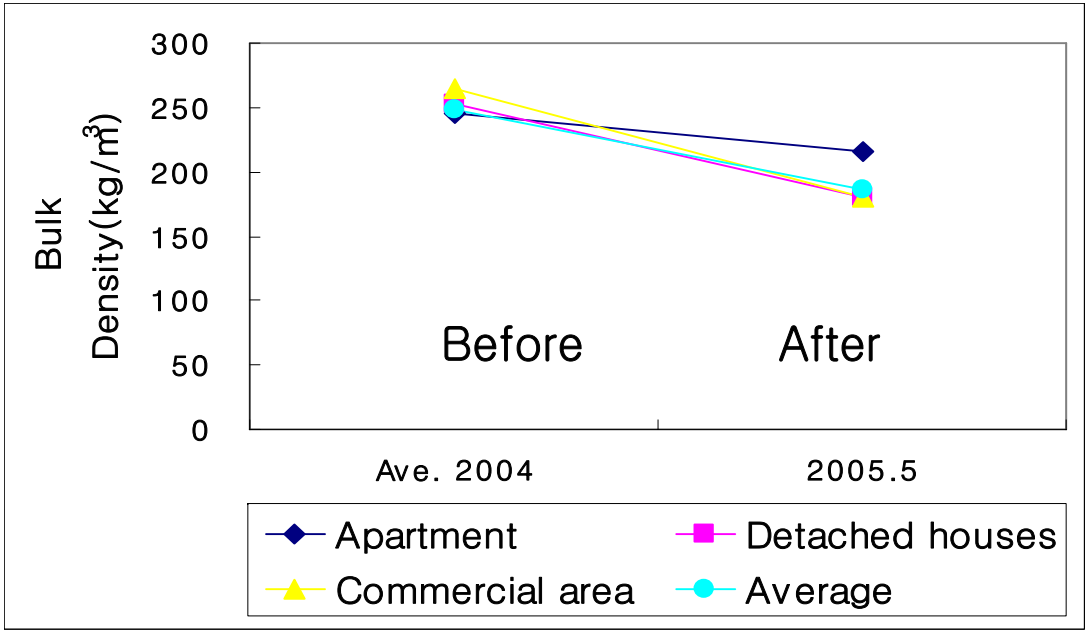
- Apartment : At about 6.5% decrease
- Detached house : At about 11.8% decrease

Change of Bulk Density of MSW

	Before and after landfill ban of Foodwaste			
	Before			After
	2004.8	2004.11	Ave. 2004	2005.5
Apartment	217.6	274.0	245.8	216.5
Detached houses	224.2	282.6	253.4	179.6
Commercial area	273.1	256.7	264.9	179.9
Average	226.4	270.9	248.7	186.7

Results

- **Bulk density : 25% decrease**

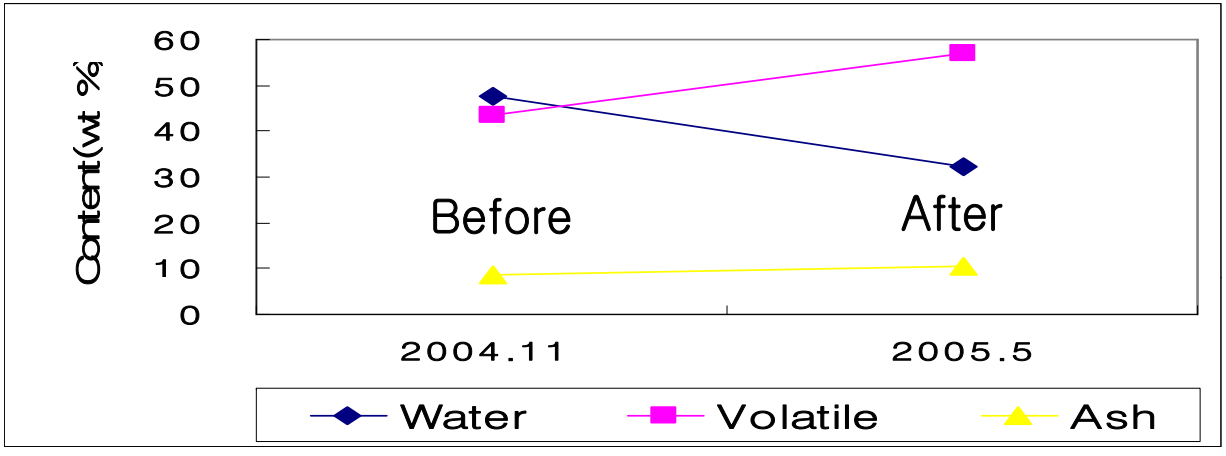


Change of 3-composition of MSW

Sample	3-Components	Food	Paper	Vinyl /Plastic	Textile	Wood	Leather	Misc.	Average
2004.8	Water	69.82	34.68	8.30	25.78	35.40	21.15	54.84	45.10
	Volatile	24.62	55.43	84.98	68.31	60.17	71.01	31.96	46.68
	Ash	5.56	9.89	6.72	5.92	4.43	7.84	13.20	8.22
2004.11	Water	78.03	25.84	12.52	25.97	36.67	11.02	62.15	47.63
	Volatile	16.28	61.33	82.43	67.61	55.48	75.89	27.68	43.60
	Ash	5.69	12.83	5.04	6.42	7.86	13.09	10.17	8.77
2005.5	Water	70.80	18.54	4.91	18.52	43.71	5.22	49.81	32.31
	Volatile	20.58	67.50	90.41	73.66	49.44	72.24	34.27	57.04
	Ash	8.62	13.95	4.68	7.82	6.85	22.54	15.93	10.65

Results

- Water : 14% decrease
- Volatile : 11.9% increase
- Ash : 2.2% increase
- LHV increase factor



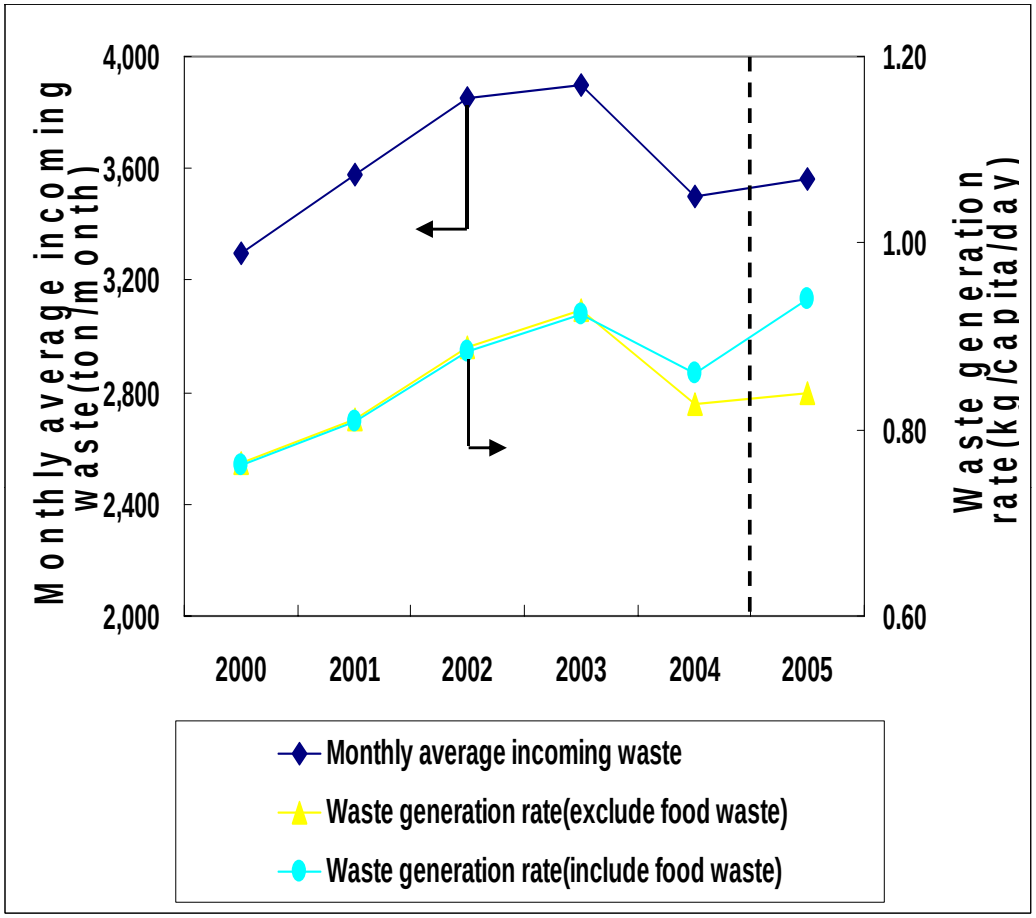
Increase of LHV (Low Heating Value) of MSW

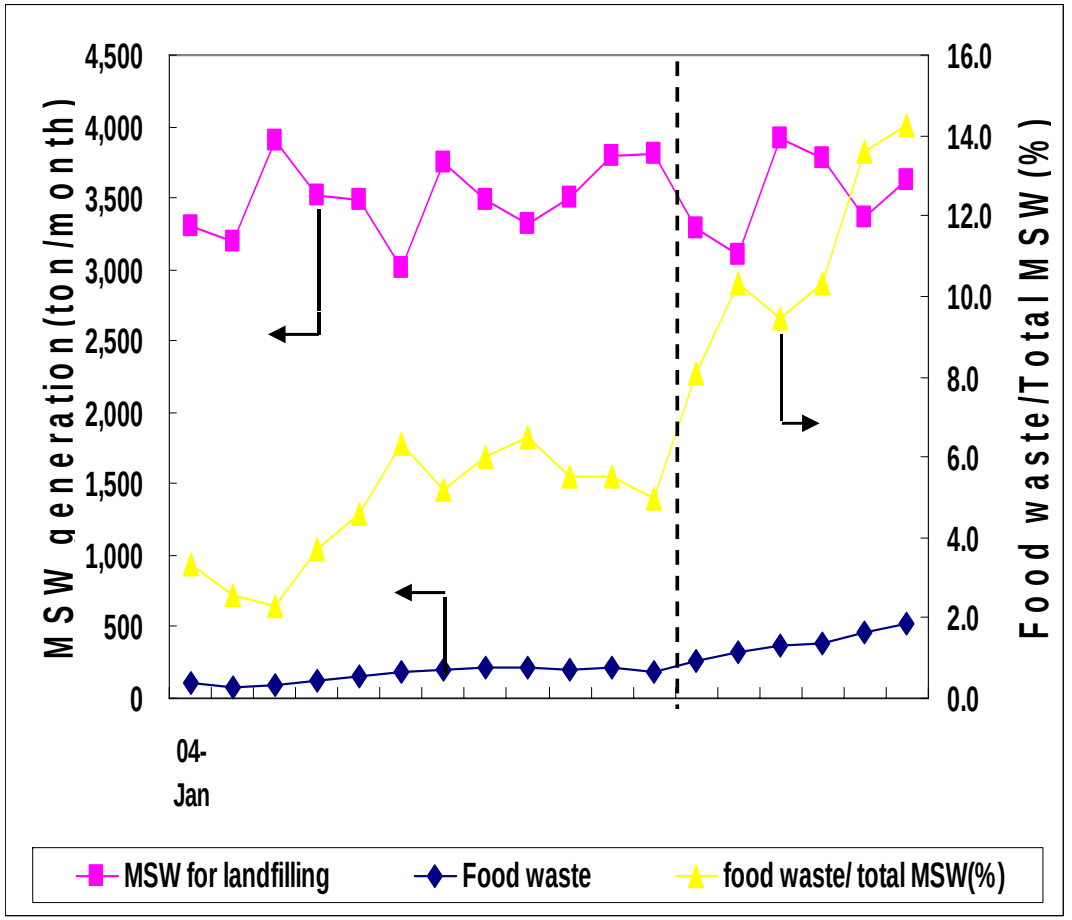
	Contribution to LHV in 1kg wet MSW							Low heating value of MSW (kcal/kg)
	Food	Paper	Vinyl /Plastic	Textile	Wood	Leather	Misc.	
'04.8	260.6	679.4	1,088.1	45.0	60.9	36.1	99.9	2,270.1
'04.11	94.3	660.2	1,183.9	55.2	18.1	25.8	168.8	2,206.4
'04 ave	177.5	669.8	1,136.0	50.1	39.5	30.9	134.3	2,238.2
'05.5	189.2	1,085.9	1,380.1	138.0	45.8	70.1	82.2	2,991.4

Results

- LHV : 753.2 kcal/kg increase
- LHV increase factor
  - Water content decreased while paper & vinyl/plastic materials relatively increase
  - Paper which absorbs water easily, its water content decreased which increased the calorific value

Change in Amount of Landfill

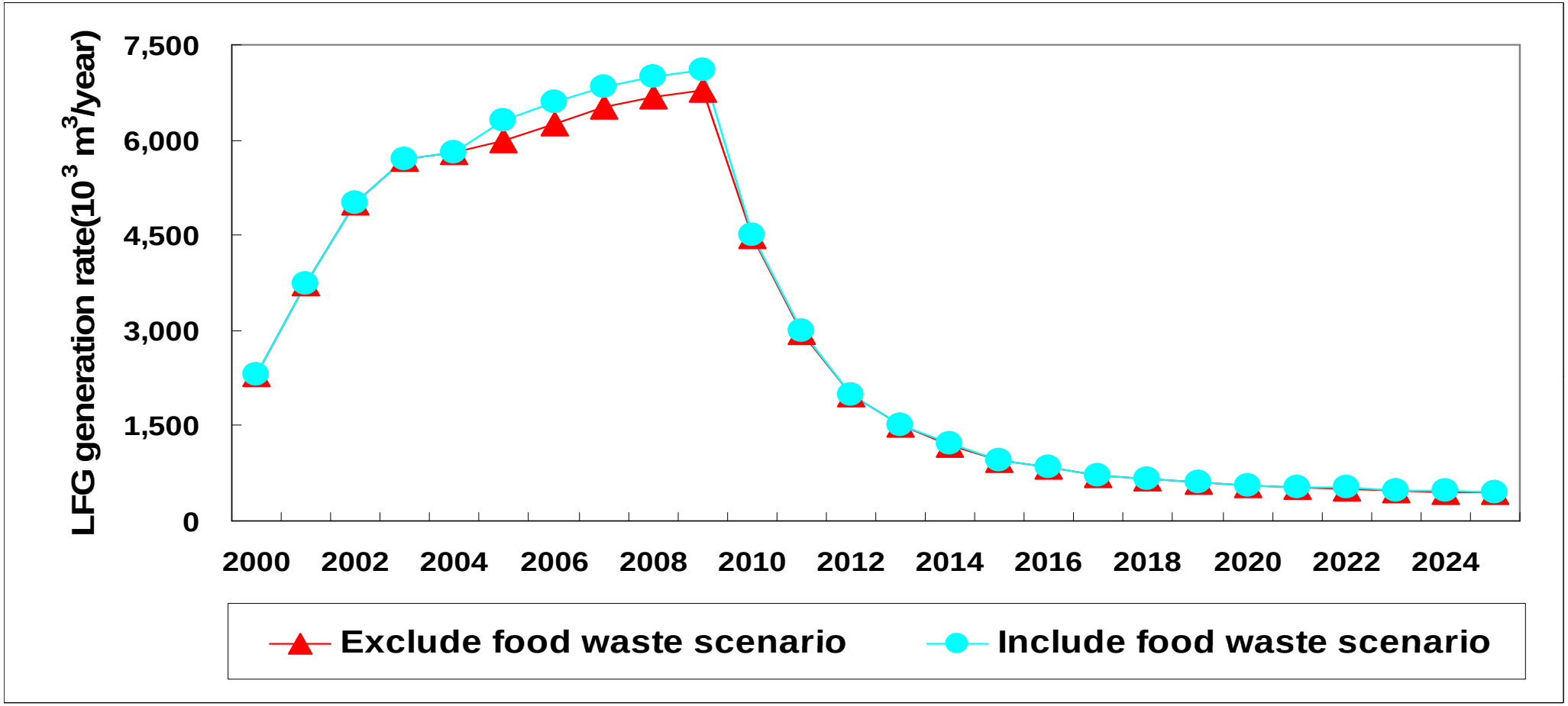




Results

- Generation of waste from 1person per day decreased:
  8% decrease compared to 2003 level (2005 data)
- Generation of foodwaste from 1person per day: 0.1kg

Prediction of Landfill Gas Generation Rate Change



Results

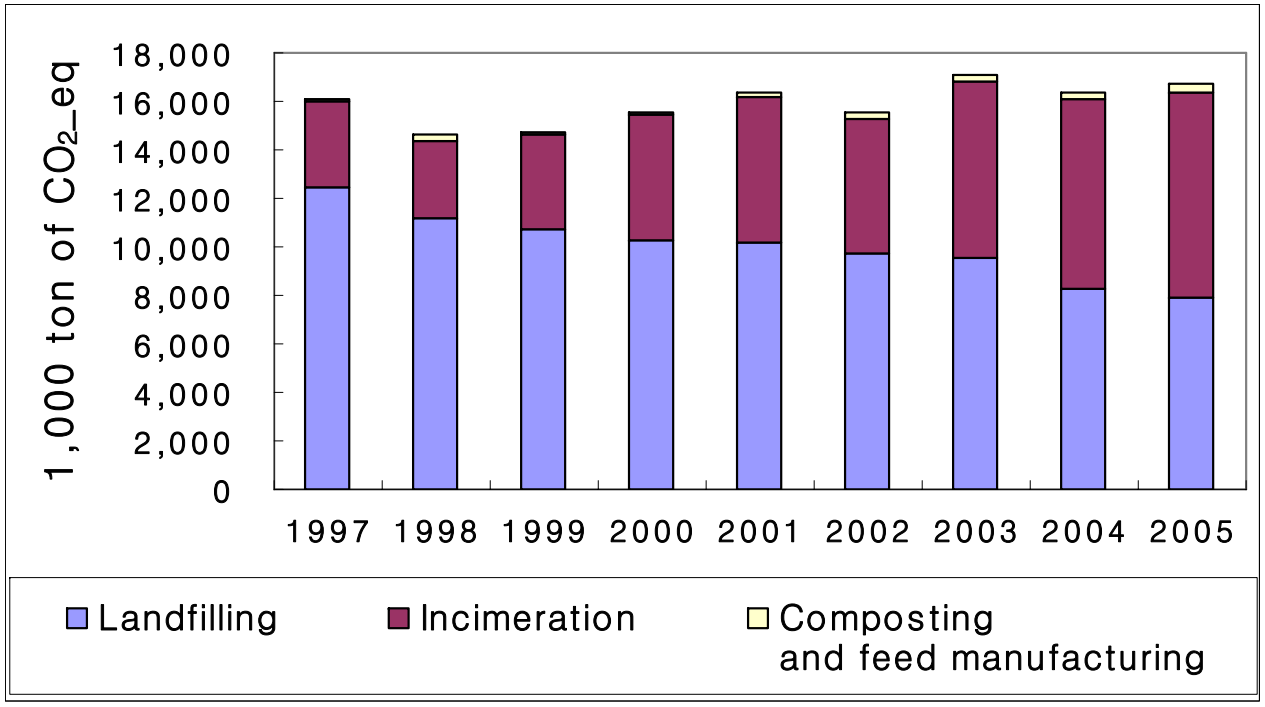
- Compared with primary landfill :
  methane generation decreased by maximum 5%, 340,000 m^3/yr

Impact of Green House Gas Emission

Trends in GHG Emissions of Waste Sector

Unit : 1,000 ton CO2_eq

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005
Landfilling	12,486	11,146	10,685	10,242	10,205	9,705	9,584	8,316	7,919
Incineration	3,480	3,228	3,930	5,176	5,979	5,591	7,244	7,769	8,422
Composting and feed manufacturing	159	261	75	164	166	237	225	255	354



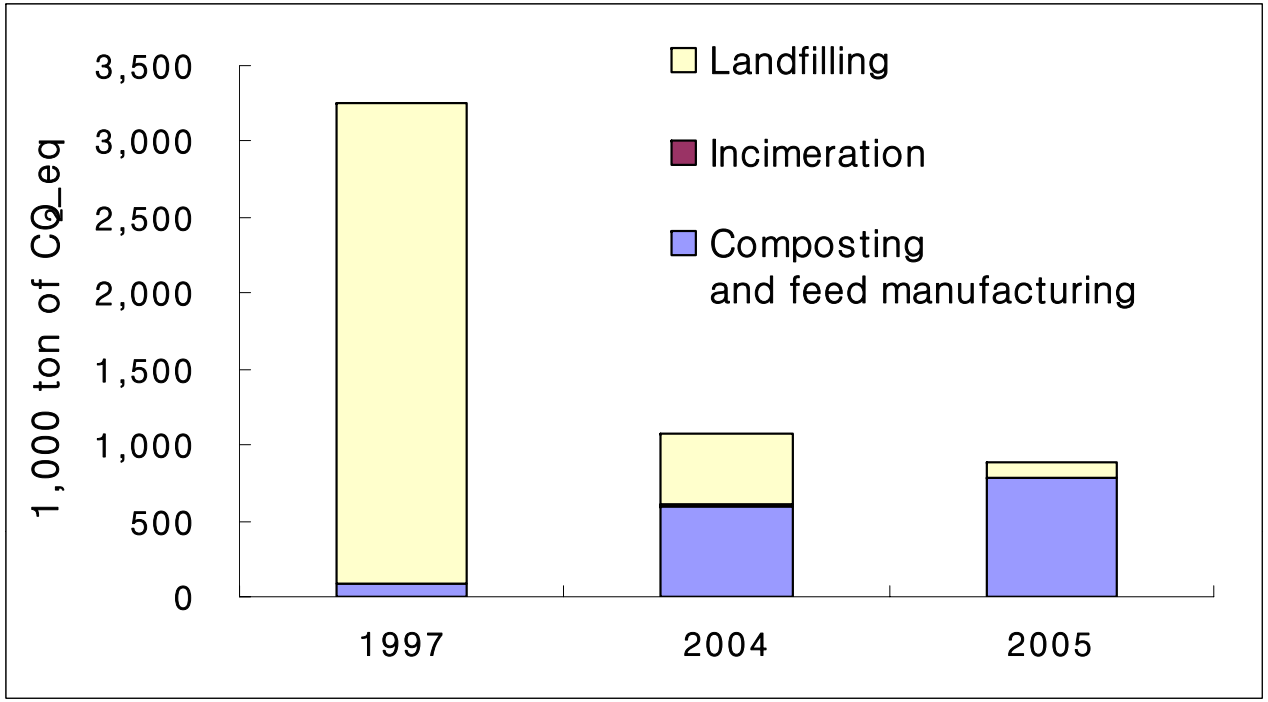
Trends

- **Landfill : Decrease**
- **Incineration : Increase**
- **Compositing : Increase**

Trends in GHG Emissions by Foodwaste Disposal

Unit : ton/day

Year	Foodwaste Generation rate	Foodwaste disposal		
		Landfill	Incineration	Composting and feed manufacturing
1997	13,063	10,973 (84%)	815 (6%)	1,275 (10%)
2004	11,463	1,607 (14%)	540 (5%)	9,316 (81%)
2005	12,976	356 (3%)	516 (4%)	12,104 (93%)



Trends

- **Disposal method**

  Landfill → Composting

- **GHG emission (Foodwaste/Total waste)**

  20% (1997) → 5% (2005)

Thank you

Reference

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- SukHui Lee et al., Evaluation of environmental burdens caused by changed of food waste management systems in Seoul, Korea, Science of the Total Environment, 387, pp 42-53, 2007