Refuse to Energy from Municipal Solid Waste Incineration in Taiwan

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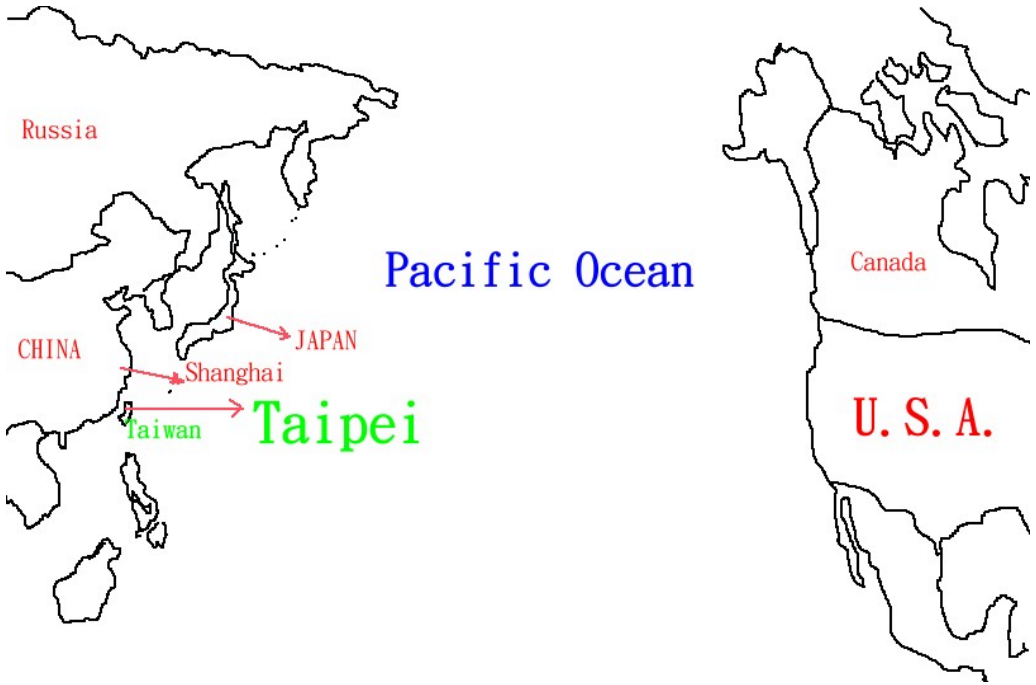
Taiwan is an Asia island with size of three hundred and sixty-one thousand (361,000) km^2 and population of about twenty three million (23,000,000).





- ✓ As developed countries in the world, Taiwan has planned Integrated Waste Management System (IWMS) to recovers valuable raw materials and energy.
- ✓ Landfllling, recycling, composting, and incineration now remain the critical elements of MSW management strategy in Taiwan.
- ✓ An array of waste management and disposal strategies have emerged over the past years in Taiwan.



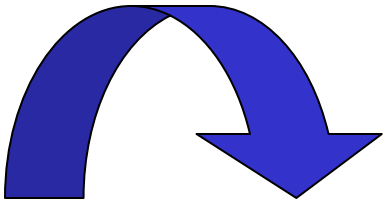
- In 2004, each person generated approximately 0.91 kilogram of refuse per day, of which about 80 percent was collected by municipalities.
- There are now approximate 20,609 tonnes of MSW generated per day in Taiwan (7.5 million tonnes per year).
- However, the amount of MSW is gradually decreasing in the last few years.



How about quantities for various disposal methods?

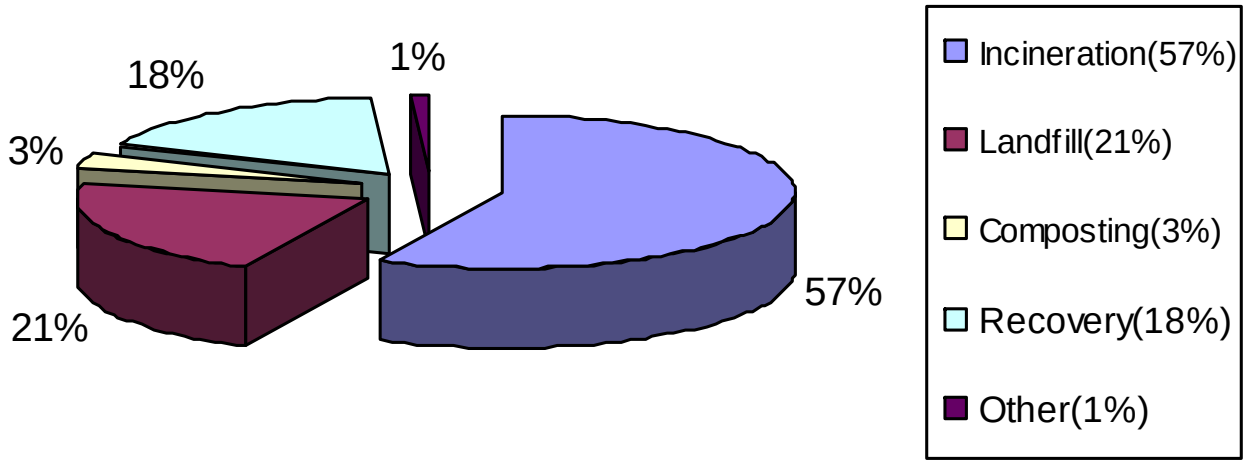
year	Quantity for Various Disposal Methods（metric ton）											Ratio of Recovered Food Waste（%） (9)	Ratio of Complete Dispose （%） (10)
	Total (1)	Incineration (2)	Sanitary Landfill (3)	General Landfill (4)	Dumping (5)	Regulated Recovery (6)	Others (7)	Recovered Food Waste(8)	utilization of food waste				
									Fertilizer	pig food	other utilization		
1995	9,529,687	1,301,036	4,362,789	2,537,556	776,863	45,128	500,033	6,282	6,282	0	0	0.07	65.12
1996	9,582,643	1,364,639	4,823,997	2,090,514	790,099	56,124	454,750	2,520	2,520	0	0	0.03	70.87
1997	9,628,644	1,691,626	5,129,676	1,536,415	649,544	98,325	508,885	14,173	14,173	0	0	0.15	77.22
1998	8,992,239	1,741,095	5,597,979	1,088,934	296,545	111,753	155,405	528	528	0	0	0.006	82.84
1999	8,715,575	2,020,634	5,366,936	857,267	245,183	149,876	56,186	19,493	19,242	251	0	0.22	86.68
2000	8,353,368	3,229,750	3,822,124	697,050	119,116	477,856	4,690	2,782	2,659	123	0	0.033	90.17
2001	7,839,175	3,736,891	2,996,805	433,330	73,040	584,333	14,560	216	216	0	0	0.003	93.35
2002	7,601,960	4,316,049	2,116,375	224,477	55,076	878,319	7,958	3,706	3,506	150	50	0.05	96.22
2003	7,355,372	4,304,574	1,700,438	113,115	20,190	1,048,981	734	167,340	22,290	139,614	5,400	2.27	98.18
2004	7,522,263	4,305,822	1,458,234	59,792	15,004	1,387,371	1,201	294,839	64,950	221,559	8,290	3.92	98.99

Decreasing!!!



Food Wsate (Kitchen garbage) recycling rate is approaching to 0.0% in 2000 increasing to 3.92% in 2004,

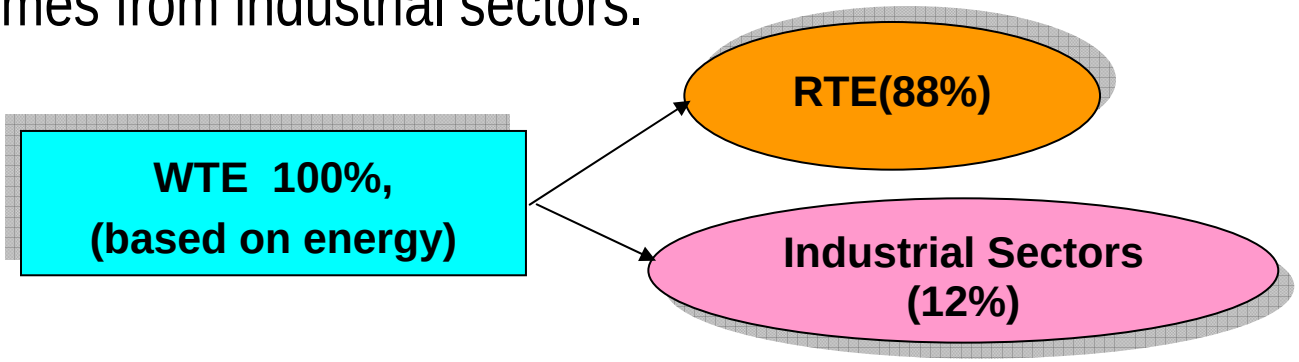
- ✓ The 7.5 million tonnes of the MSW were collected annually in 2004, including roughly 1.4 million tonnes of recycled material and 0.3 million tonnes of recovered food waste.
- ✓ The MSW incineration rate is 57.3% (=4.31/7.52).



- ✓ Refuse-to-energy technology is an important component of the integrated waste management system and when combined with recycling, composting, and other waste reduction processes helps minimize overall disposal costs.

- ✓ So far, Taiwan does not have a WTE plant to combust only industrial wastes.

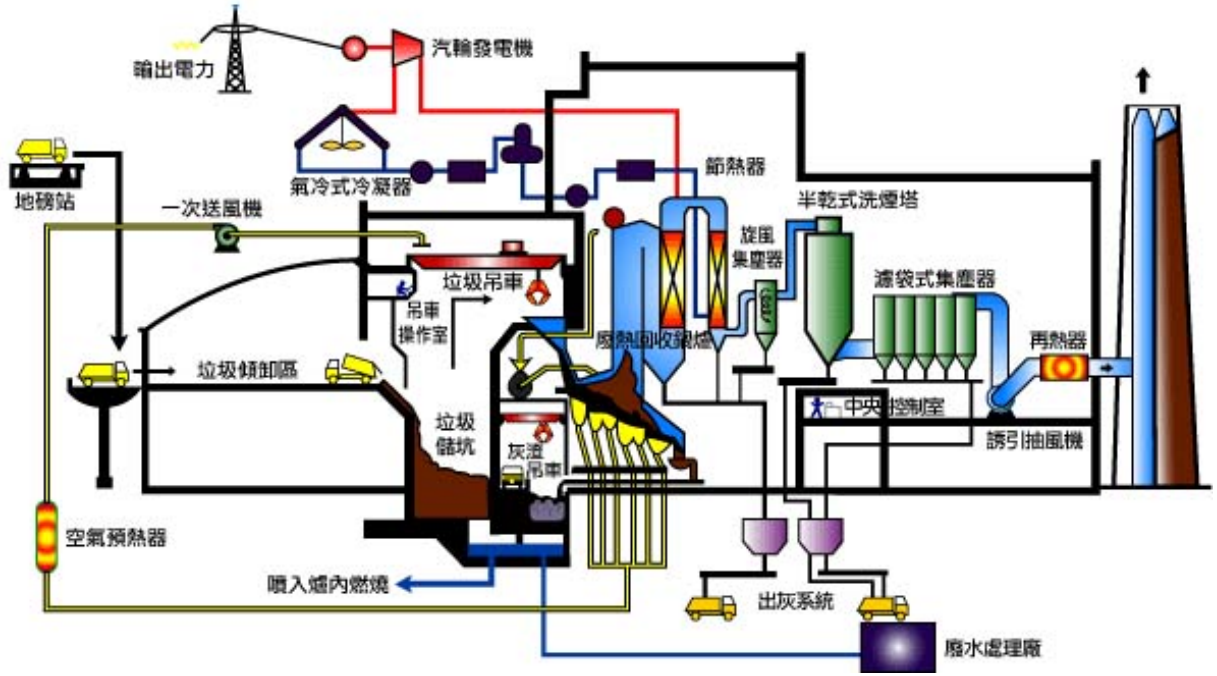
- ✓ Limited in incomplete regulations, and public concern on illegal hazardous waste and emission control (especially DXNs), only 12% WTE comes from industrial sectors.



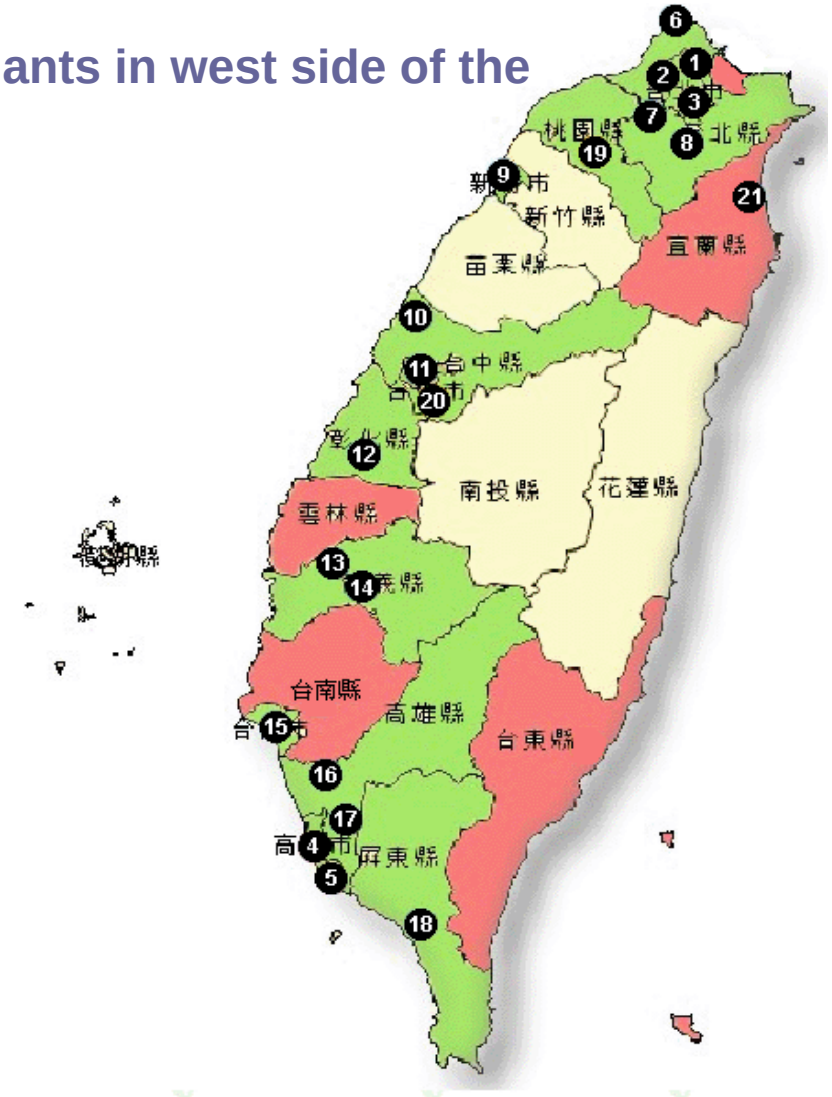
Solvent Wastes, Wastes with High-Heating Values Co-burning in Boiler or Industrial Combustors (Kiln。Calciner….)

- ✓ In terms of refuse disposal, the Taiwan EPA has adopted a strategy favoring incineration as the primary method of treatment ,and landfill as a supplement.

- ✓ According to the early project of “Construction of Refuse Incineration Plants”, Taiwan has built 21 large refuse-to-energy (RTE) facilities, and are now in good operation.



Most plants in west side of the island.



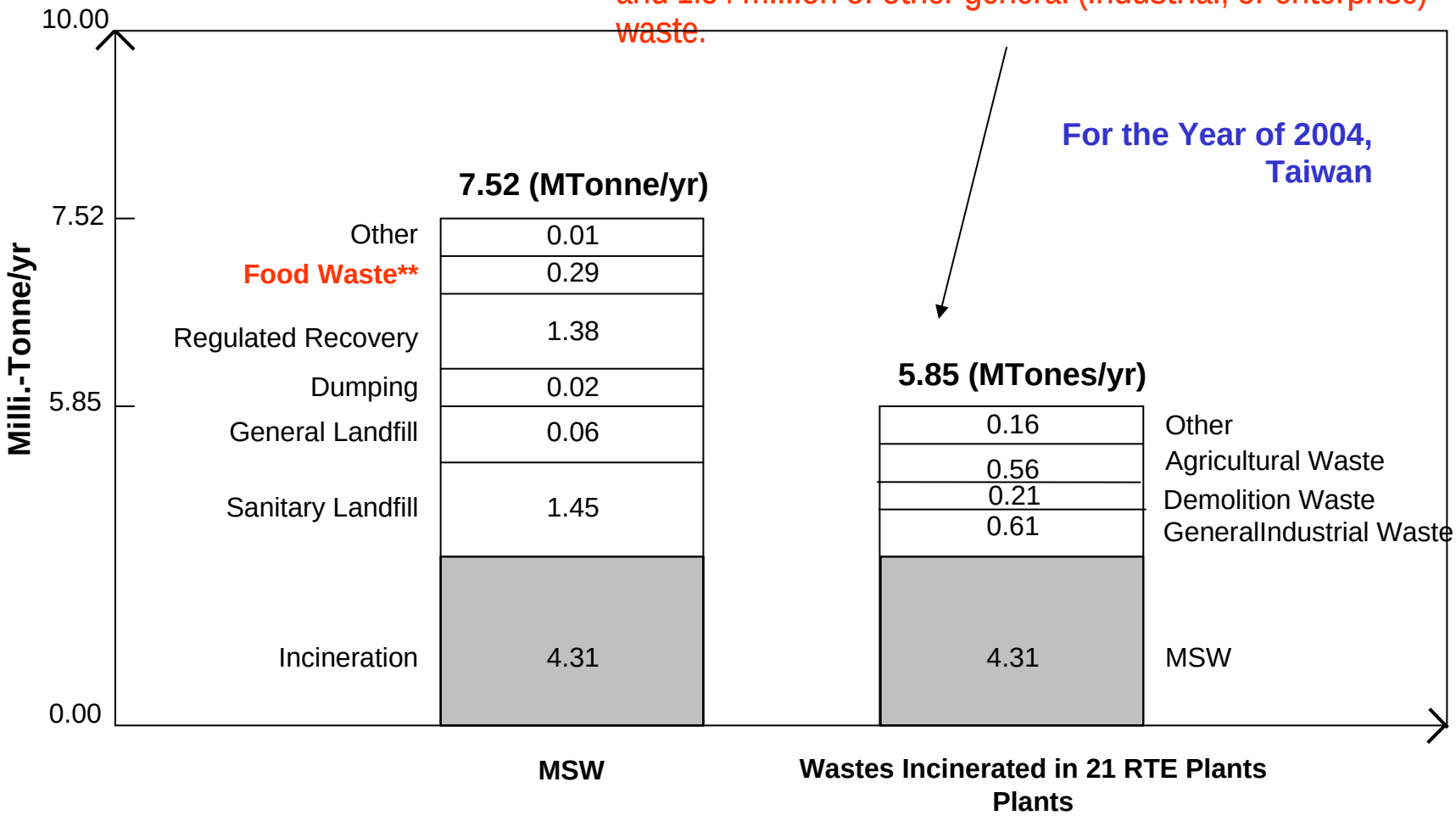
	Refuse Incinerators Plant
1	Neihu
2	Peitou
3	Mucha
4	Kaohsiung-Central Area
5	Kaohsiung-South Area
6	Bali
7	Shulin
8	Hsintien
9	Hsichou City
10	Hou-Li
11	Taichung City
12	Hsichou
13	Lutsao
14	Chiayi City
15	Tainan City
16	Kangshan
17	Renwu
18	Kandin
19	Taoyuan
20	Wujih
21	I-Lan Hsien

Fig.1. Sites of 21 RTE Plants in Taiwan.

The table lists a summary of heat and electricity generation with the location and capacities of these RTE facilities in 2004 ……

Site No.	Name of RTE plants	Quantity of Refuse Incinerated	Design Capacity	LHV	Steam Quantity	Electricity Generation	Efficiency of Heat Production	Ratio of Electricity Generation	Ratio of Power Sale	Heat Production	Electricity Generation
	unit	Ton/yr	Ton/Day	Kcal/kg	Ton/year	1,000Kw-hr/yr	%	%	%	cal/ton	Kw-hr/ton
1	Neihu	96480.0	900	1980	248,330	21062.1	99.89	9.50	47.04	1977786.804	218
2	Peitou	345223.3	1800	2219	995,623	146930.0	99.87	16.52	67.67	2216063.509	310
3	Mucha	259926.7	1500	2156	709,736	71021.8	97.32	11.20	58.72	2098134.61	284
4	Kaohsiung Mun. Central Area	242063.0	900	1921	535,993	57104.3	88.57	11.93	61.59	1701445.579	236
5	Kaohsiung South Area	478592.7	1800	2251	1,340,868	237042.7	95.64	19.79	78.00	2152818.118	495
6	Bali	458562.9	1350	2305	1,346,131	221382.1	97.86	18.41	82.75	2255670.687	483
7	Shulin	385069.9	1350	1923	942,706	166862.4	97.82	19.82	80.98	1881152.575	433
8	Hsintien	254172.1	900	2009	665,111	115968.8	100.09	19.52	78.53	2010729.315	456
9	Hsichou City	279190.7	900	2105	756,000	158475.4	98.85	23.47	79.64	2080693.949	496
10	Hou-Li	272847.1	900	2245	790,691	165717.7	99.19	23.47	82.56	2226767.25	387
11	Taichung City	289882.2	900	1565	569,331	94291.2	96.43	18.54	76.35	1509144.089	325
12	Hsichou	274840.7	900	2256	799,580	143083.4	99.09	20.04	77.24	2235467.354	375
13	Lutsao	283725.2	900	2310	804,411	164997.5	94.31	22.97	82.58	2178549.877	441
14	Chiayi City	85013.1	300	1450	154,013	20241.9	96.00	14.72	65.03	1392062.193	238
15	Tainan City	239360.9	900	1785	552,689	108951.8	99.40	22.07	76.94	1774250.704	455
16	Kangshan	330880.6	1350	2355	1,006,320	184211.9	99.23	20.50	78.52	2336964.435	557
17	Renwu	388598.7	1350	2156	1,079,137	230417.3	98.97	23.91	80.53	2133843.437	593
18	Kandin	282268.5	900	2200	799,709	140322.4	98.95	19.65	74.70	2176992.766	497
19	Taoyuan	438347.8	1350	2126	1,198,238	262506.6	98.80	24.53	86.82	2100446.256	462
20	Wujih	89458.7	900	2015	231,311	47329.5	98.60	22.91	80.75	1986830.938	529
21	Lite in I-Lan Hsien	86500.0	600	1986	219,600	35612.5	98.23	18.16	56.77	1950758.844	412
Total/Average		Total 5,851,004	Total 22?,350	Ave 2062.7	---	---	Ave 97.89	Ave 19.13	Ave 73.99	Ave 2,020,612	Ave 413
Standard Deviation		---	---	238	---	---	2.64	4.27	10.42	248,638	109

The total quantity of waste incinerated is 5.85 million tonnes per year in the 21 RTE plants, including 4.31 million of refuse and 1.54 million of other general (industrial, or enterprise) waste.



Comparison of quantities between MSW generated and Waste Incinerated in 21 RTE Plants

** separation and recovery are enforced only in a few cities

- ✓ **In general, two major technologies are available to MSW to generate steam for the production of electricity :**
  Mass-burn system
  Refuse-derived fuel (RDF) system.

- ✓ **All of the facilities in Taiwan use mass-burn system, which fires unprocessed municipal waste, and most of these use large reciprocating grate combustors.**

- ✓ **Taiwan are not interesting in RDF system , because Taiwan government considered RDFcan be used in a narrow range of combustors.**

In terms of BOT and BOO, the Taiwan EPA encourages the private sector to construct incinerators and will actively supervise and assist local governments in the bid tendering and construction-related operations necessary in order to ensure the completion of waste-to-energy (WTE) facilities.



- ✓ Air emissions control devices in these mass-burn systems include combinations of electrostatic precipitators (ESPs) or bag houses for fine particulates and spray dryer scrubbers for acid gases like hydrogen chloride, sulfur dioxides, and etc.

- ✓ In 2004, about 40% of the facilities used ESPs, and about 60% combined dry scrubbers with baghouses.

- ✓ Dioxin emission seems to be a problem only in plants of early design, although the issue of dioxin emission continues to be a major one in permission applications and public concern.

- ✓ <u>Taiwan Standard for Dioxins Emission</u>

Incineration Capacity	Emission Standard	O_2(mol%)
≥10 T/hr (240 T/D)	0.1 ng-TEQ/Nm^3	11%
Others	0.5 ng-TEQ/Nm^3	11 %

CHARACTERISTICS OF REFUSE

- ✓ Much of Taiwan MSW is simply refuse including rubbish or garbage. They include paper and plastics, wood, rubber and leather, old clothing, glass, and a few of caustic compounds for cleaning ovens, and reductants for cleaning copper.

- ✓ But in some area, a few significant quantity (about less than 0.3 wt.%) of this solid waste may be potentially hazardous.

There are 93 ±6 wt.% (dry base) of combustible components (categorized by paper, wood/leaf, cloth, plastic, kitchen garbage, rubber/leather, and other), 7 ±2 wt. %. of incombustible components (categorized by sand, glass, ceramic and metal) in Taiwan.

Table 4-3 Properties of Municipal Solid Waste

Period	Total	Physical Composition(on Dry Base)										
		Combustibles								Incombusitbles		
		Sub-total	Paper	Textiles	Garden Trimmings	Food Wastes	Plastics	Leather & Rubber	Others	Sub-Total	Metal	Glass
	%	%	%	%	%	%	%	%	%	%	%	%
1992	100.00	82.94	24.86	3.97	5.06	25.73	19.14	1.73	2.45	17.06	7.07	7.69
1993	100.00	82.94	27.84	5.13	5.79	23.47	18.01	1.55	1.15	17.06	7.65	7.44
1994	100.00	86.99	29.98	4.81	4.69	23.50	18.90	0.80	4.31	13.01	5.78	4.94
1995	100.00	84.62	32.17	6.21	5.82	17.94	18.27	0.88	3.34	15.38	6.05	5.59
1996	100.00	84.48	30.95	5.05	5.89	18.97	17.83	1.08	4.72	15.51	6.28	5.67
1997	100.00	87.50	29.13	5.80	4.86	24.90	19.57	1.13	2.11	12.50	5.33	4.95
1998	100.00	86.58	32.77	5.27	4.81	18.29	20.14	0.83	4.54	13.42	5.66	5.84
1999	100.00	90.17	35.83	5.20	4.89	21.83	19.85	0.60	1.97	9.83	3.80	4.99
2000	100.00	87.34	26.37	6.06	3.36	27.76	22.00	1.35	0.44	12.66	3.73	7.31
2001	100.00	89.38	26.55	4.81	4.06	27.32	21.10	0.48	5.06	10.62	3.53	5.03
2002	100.00	90.43	30.01	3.65	4.43	23.34	20.23	0.60	8.17	9.57	3.07	4.11
2003	100.00	92.98	32.97	3.78	3.88	27.19	21.36	0.22	3.58	7.02	2.58	3.54
2004	100.00	93.57	31.56	4.90	4.91	29.76	20.60	0.87	0.98	6.43	1.89	3.61

Source: EPA and Bureaux of Environmental Protection.



Table 4-3 Properties of Municipal Solid Waste(Cont.1)

Period	Physical Composition(On Dry Base)			Chemical Analysis (On Moiture Base)									
	Incombustibles			Moisture	Ash	Combustibles							
	Ceramics and China	Stone & Sand	Others			Sub-total	C	H	O	N	S	Organic Chlorine	Others
	%	%	%	%	%	%	%	%	%	%	%	%	%
1992	0.83	1.48	—	51.97	16.15	31.88	16.50	2.81	11.44	0.79	0.18	0.16	—
1993	0.92	1.04	—	51.06	16.02	32.92	17.04	2.82	11.99	0.52	0.19	0.30	0.07
1994	0.98	1.32	—	53.21	12.43	34.36	19.08	2.38	12.00	0.50	0.12	0.18	0.10
1995	1.64	2.11	—	48.14	14.40	37.47	18.60	2.90	14.45	0.51	0.14	0.18	0.68
1996	1.56	2.01	—	50.60	13.79	35.61	18.99	2.82	13.06	0.45	0.12	0.16	—
1997	1.26	0.96	—	46.03	13.12	40.85	20.44	3.50	15.62	0.70	0.19	0.39	—
1998	0.71	1.21	—	51.06	12.60	36.34	18.47	2.65	14.23	0.74	0.06	0.18	—
1999	0.51	0.53	—	50.76	10.08	39.17	18.87	2.85	15.95	1.19	0.09	0.21	—
2000	0.29	1.33	—	45.02	14.07	40.91	21.12	4.01	14.81	0.59	0.14	0.23	—
2001	0.56	0.82	0.68	55.80	11.34	32.86	18.24	2.62	9.11	2.56	0.10	0.12	0.11
2002	0.58	0.98	0.83	51.24	11.01	37.75	20.45	3.04	13.04	0.57	0.10	0.25	0.30
2003	0.44	0.25	0.21	55.69	7.51	36.80	18.71	2.84	13.92	0.49	0.20	0.16	0.48
2004	0.37	0.24	0.31	51.19	7.93	40.88	20.60	3.03	14.67	0.57	0.16	0.17	1.69



In 2004, based on approximate analysis, the moisture content was 51±12 wt.%, incinerable content was 41±10 wt.%, and ash content was 8±3 wt.% in overall average for Taiwan MSW.

A typical case in Taipei……..

The characteristic of the MSW samples in Site No.8 is…….

2004 Average　　Sampling site：Hsintien (No.8)　　Bulk Density：217 kg/m^3

	Item	Physical Composition Weight Percent		Moisture	ASh		Combustible（wet base	High Heating Value(HHV)		Low Heating Value(LHV)		Chemical Element（wet base）						
		dry base	wet base		dry base	wet base		dry base	wet base	dry base	wet base	C	H	N	O	S	Org.Cl	(C/N)
	Composition	(%)	(%)	(%)	(%)	(%)	(%)	Kcal /kg	Kcal /kg	Kcal /kg	Kcal /kg	(%)	(%)	(%)	(%)	(%)	(%)	--
Combustibles	1.paper	13.57	13.38	38.84	12.69	7.76	53.40	4,235	2,590	3,561	2,178	27.59	3.32	0.74	19.83	1.47	0.44	**37.28**
	2.cloth/textile	13.67	14.76	44.13	3.92	2.19	53.68	5,193	2,901	4,359	2,435	29.17	3.73	2.78	17.97	0.00	0.03	**10.49**
	3.wood/garden trimmings	7.88	7.15	33.57	12.68	8.42	58.01	3,943	2,619	3,370	2,239	30.22	3.32	1.06	23.30	0.08	0.04	**28.51**
	4.food waste	19.78	30.54	60.93	3.01	1.18	37.90	1,879	734	729	285	15.21	1.55	1.01	20.05	0.05	0.02	**15.06**
	5.plastic	21.28	17.90	28.29	11.22	8.04	63.67	8,012	5,746	7,251	5,200	45.72	6.97	0.19	8.64	0.37	1.78	**240.63**
	6.lether/rubber	4.99	3.69	18.45	6.00	4.89	76.66	4,568	3,725	4,098	3,342	37.34	5.04	7.35	25.62	1.24	0.07	**5.08**
	7.others	7.10	5.34	20.02	6.86	5.49	74.49	3,125	2,499	2,635	2,108	39.58	5.03	2.60	26.16	0.65	0.48	**15.22**
Incombustible	8.metal	3.51	2.17	2.33	100	97.67	0	0	0	0	0	…	…	…	…	…	…	…
	9.glass	2.16	1.34	2.77	100	97.23	0	0	0	0	0	…	…	…	…	…	…	…
	10.ceramic	1.96	1.20	1.63	100	98.37	0	0	0	0	0	…	…	…	…	…	…	…
	11.sand/stone(>5mm)	4.10	2.53	2.33	100	97.67	0	0	0	0	0	…	…	…	…	…	…	…

- ✓ Paper is the largest portion of the MSW stream and is predicted to continue growing, plastic comprises the fastest growing segment.

- ✓ For example, the percentage of plastics has increased significantly in the MSW stream over the past twenty years. In Taiwan, with an increase from 2% (in 1995) to 15% (in 2004) of the MSW stream. In Taipei county, the amount of plastic in the waste stream has risen from 3% in 1990 to nearly 21% (dry base) in 2004,

- ✓ So plastic clearly reflects the changing consumer habits and life styles of the society.

- ✓ Growing populations have demanded more products and services which have resulted in the accelerated manufacture of synthetic materials.

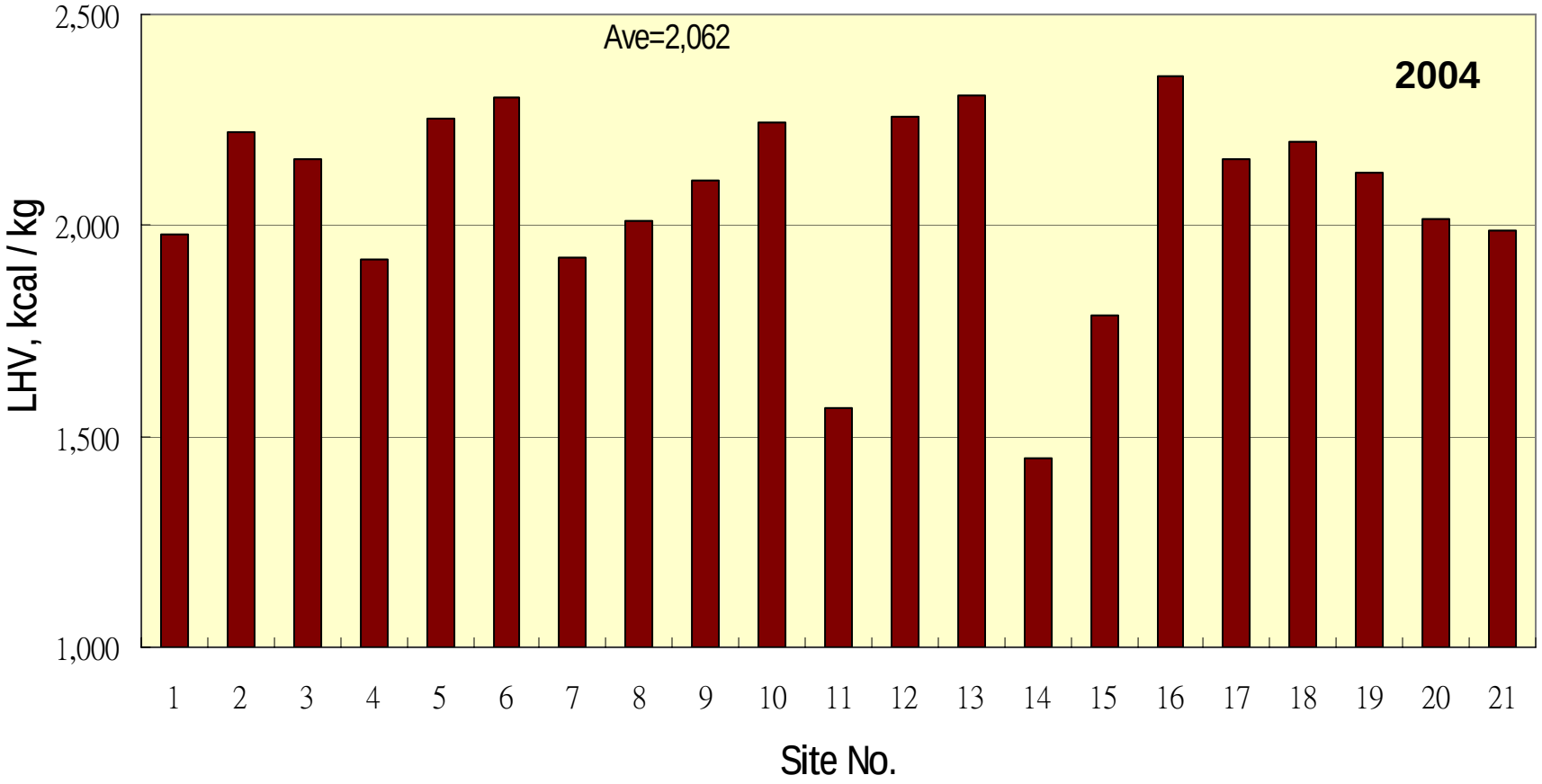
- ✓ Energy recovery in RTE plants increases due to resulting from this compositional change, including a higher portion of the waste (e.g. paper and plastics) that will be easily combustible.

- ✓ Much of the MSW is no longer directed to landfills but rather is combusted in incinerators to reduce its volume..

HOW ABOUT HEATING VALUE…..

- ✓ Mean lower heating value (LHV) for Taiwan refuse is 2,062±238 kcal/kg (wet base).
- ✓ Mean higher heating value (HHV) for Taiwan refuse is 4,155±374 kcal/kg (wet base).

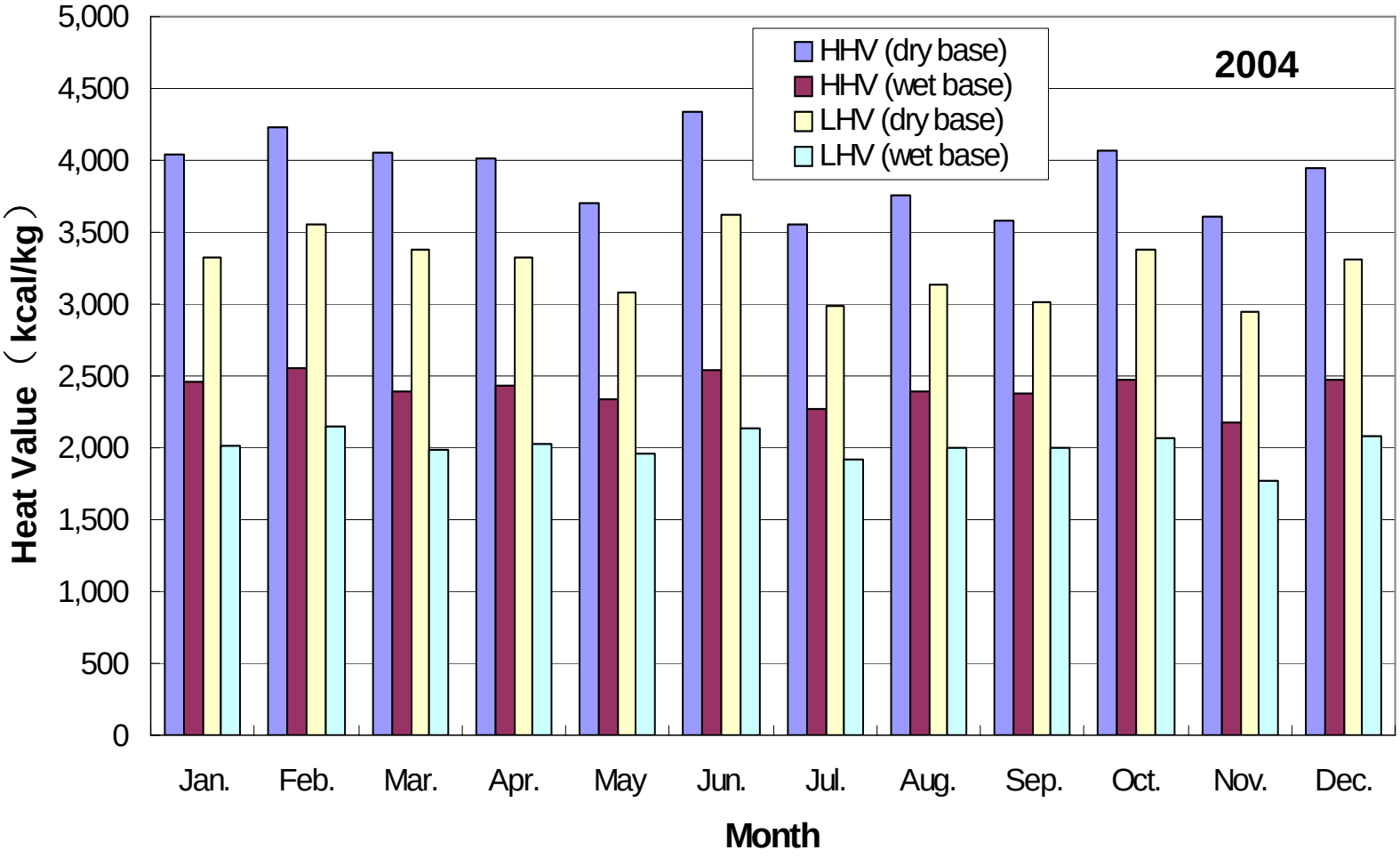
Data distribution of LHV for 21 RTE plants



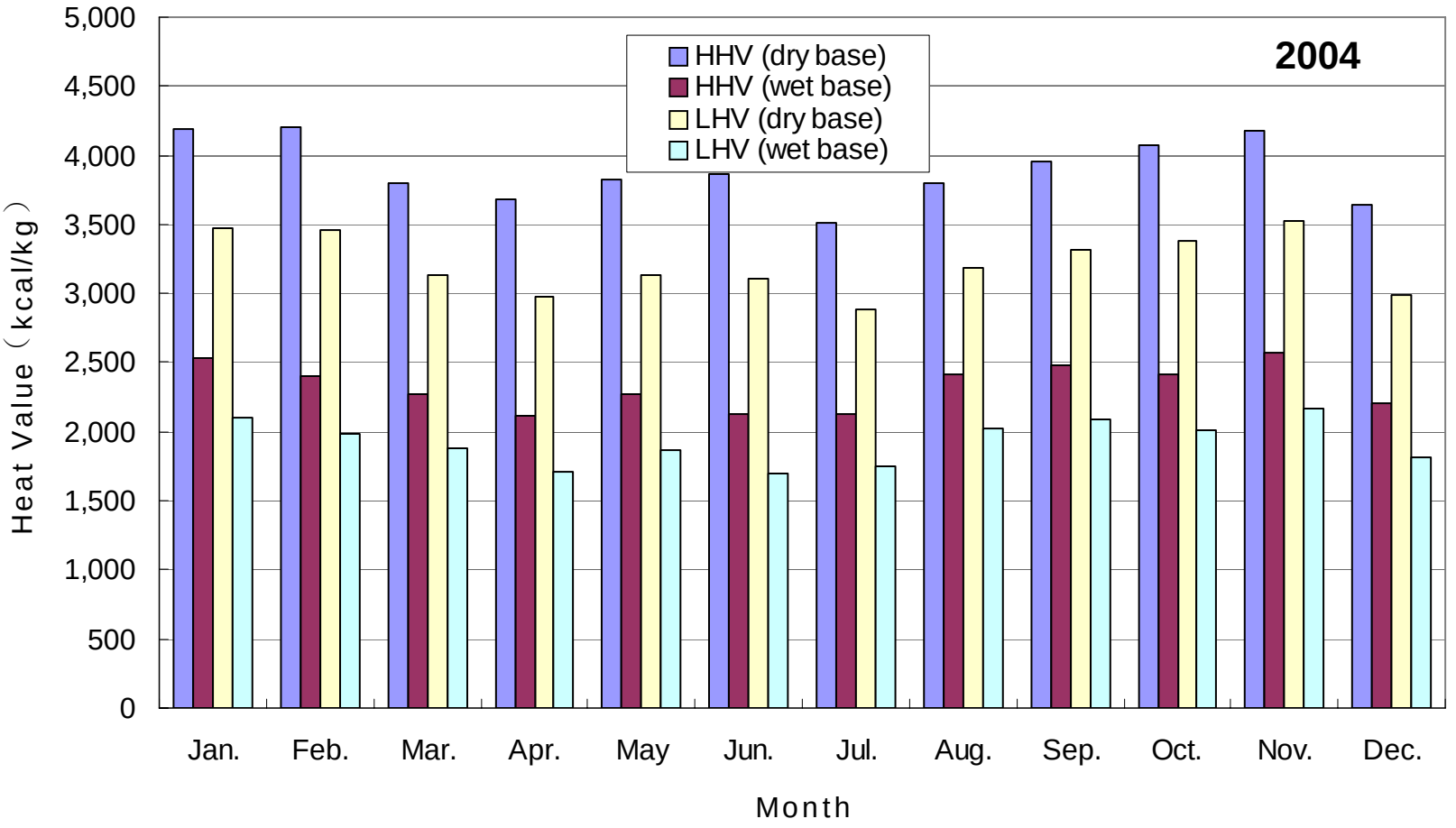


For the typical case……..:

Hsin-Den Plant (Site No.8, in Taipei county): 2,100±255 kcal/kg (LHV, wet base)



Shu-Lin Plant (Site No.7, in Taipei county) :1,850±275 kcal/kg (LHV, wet base) .





ABOUT HEAT RECOVERY…….

For most RTE plants in Taiwan……

- ✓ Combustion conditions associated with mass-burn system include the use of 80% excess air and a distribution of 60% underfire, 40% overfire air.

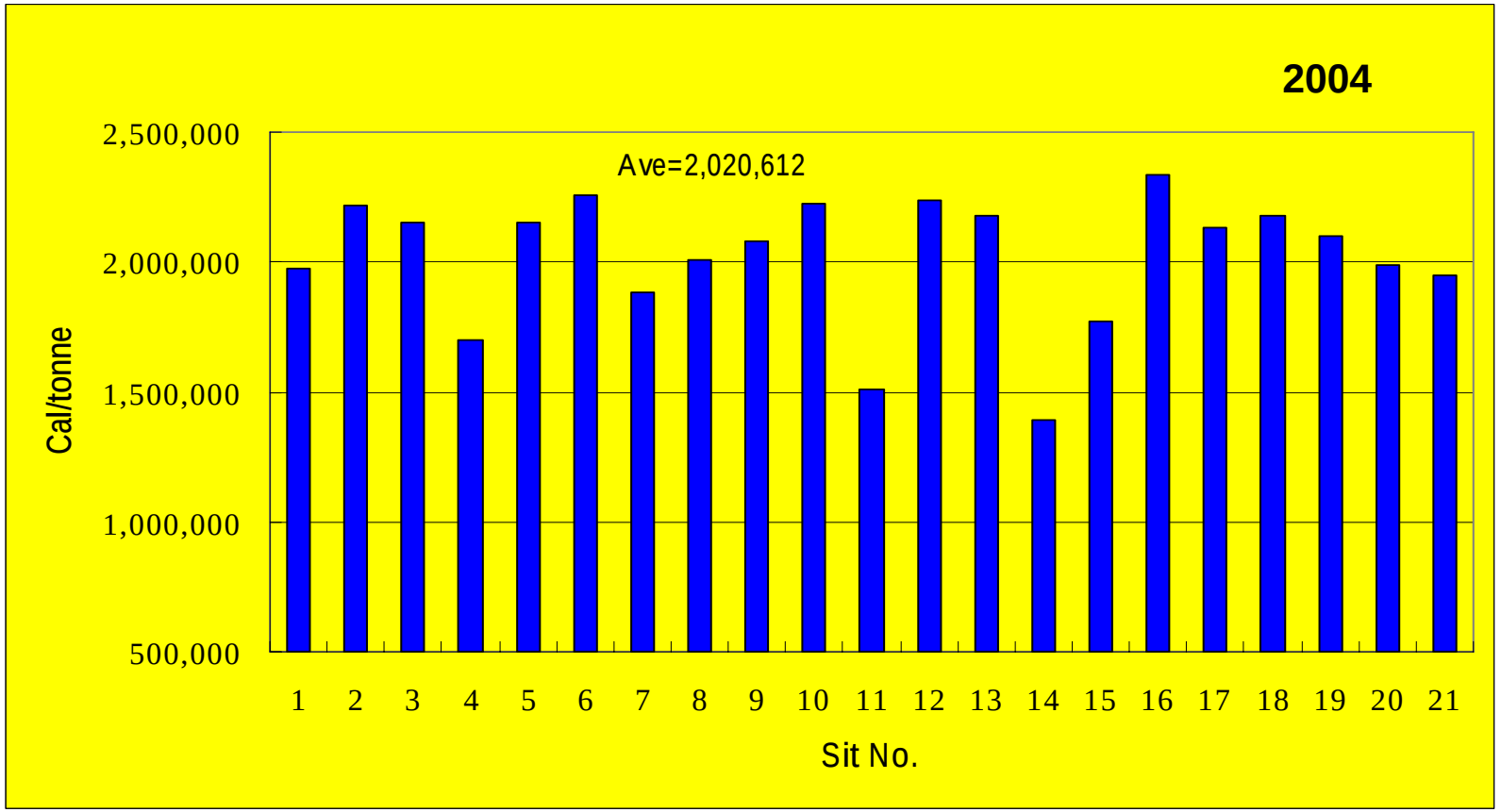
- ✓ Combustion air is preheated only when required for waste drying, otherwise ambient air is usually used.

- ✓ For most cases in Taiwan, the approximate temperature profile of the mass-burn system includes a combustion temperature of 950 to 1,150℃ or so, and a combustor exit temperature of 400℃, and economizer exit temperature of 200℃
- ✓ These combustions yield an approximate thermal efficiency of 68-72%. It is dependent on both heating values of feeding refuse and combustion efficiency.

Estimated by the temperatures of flue gas and combustion



Each tonnes waste can produce about 2 million cal. heat……

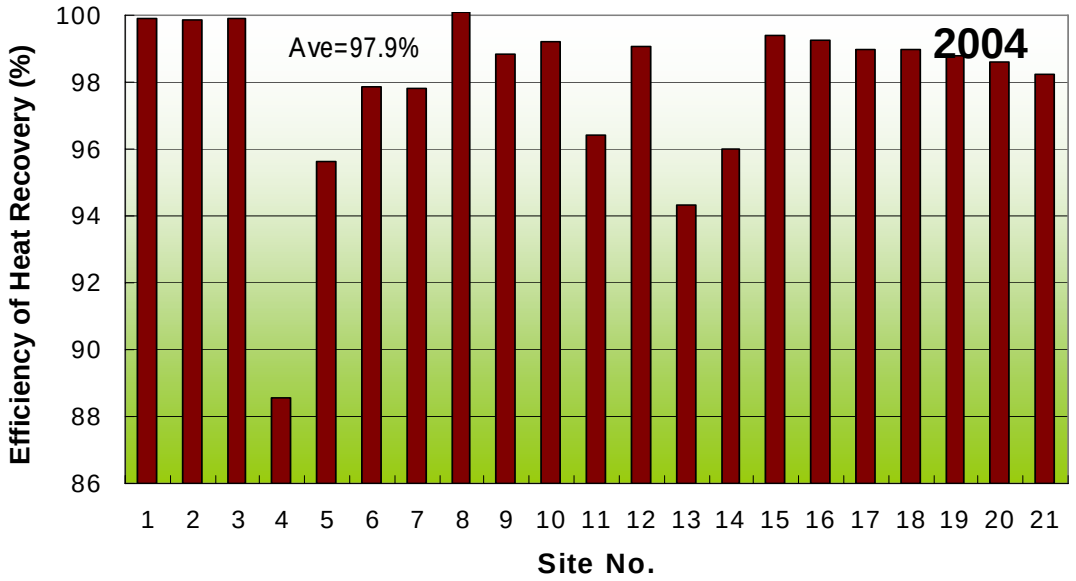




Factors to cause the fluctuation of heating value affecting stability of electricity generated …… .

- ✓ The major possible reason would be the weather variability.
- ✓ Taiwan has many rain days in spring and summer.
- ✓ The average annual rain quantity is 2,800 mm, but 3,900 mm and 4,500 mm in spring and summer respectively.
- ✓ Moisture content and plastic composition are the key points to affect the heating values of refuse for local area in Taiwan.

- ✓ The heat recovery from the incinerated refuse is estimated in the range of 1.4 ~2.3 millions cal/ton (mean 2.02 millions cal/ton), if based on the heat of steam (generally 400℃ @ 38.5 psig).
- ✓ The efficiency of heat recovery (EHR) is also estimated in the range of 88 ~100% (mean 97.9%), if based on the heat of steam divided by lower heating value of feeding refuse.
- ✓ The EHRs is high for most RTE plants in Taiwan, possibly because of boiler and economizer systems can be maintained well.

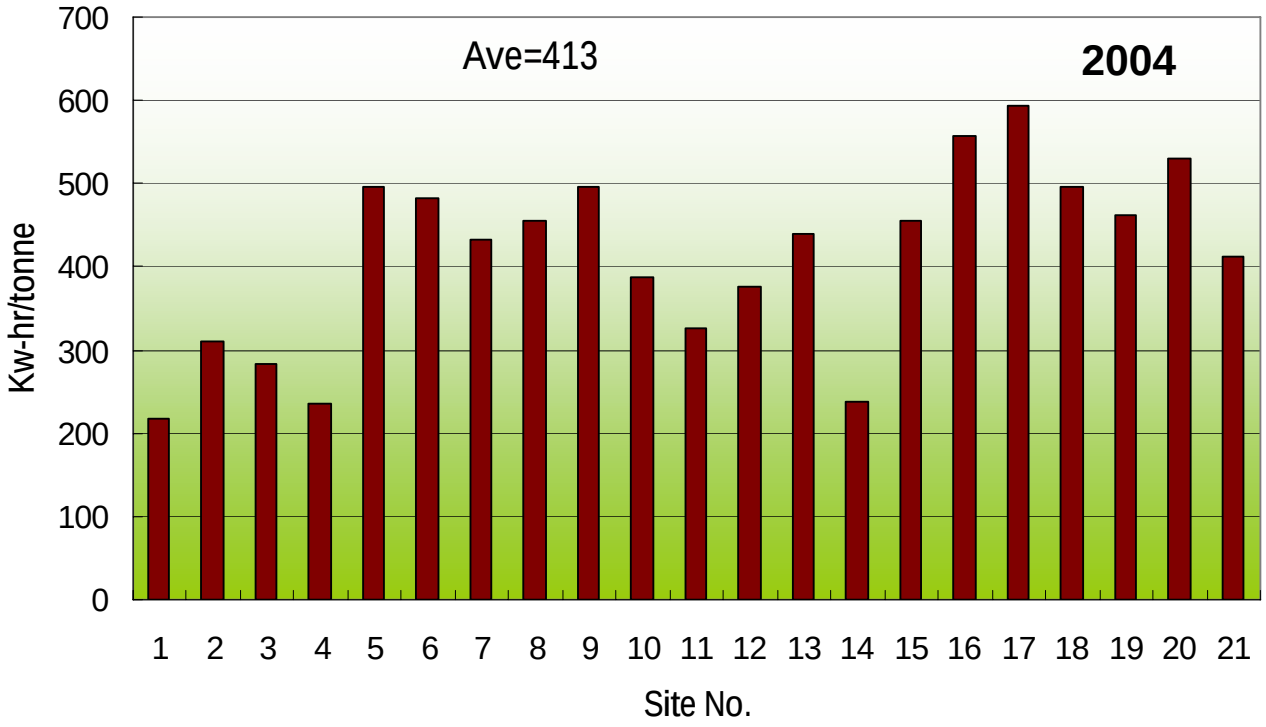


- ✓ It is noted that the heating value of refuse increases gradually a little, because the reutilization strategy of food waste in kitchen garbage is being popularized recently in whole Taiwan area.

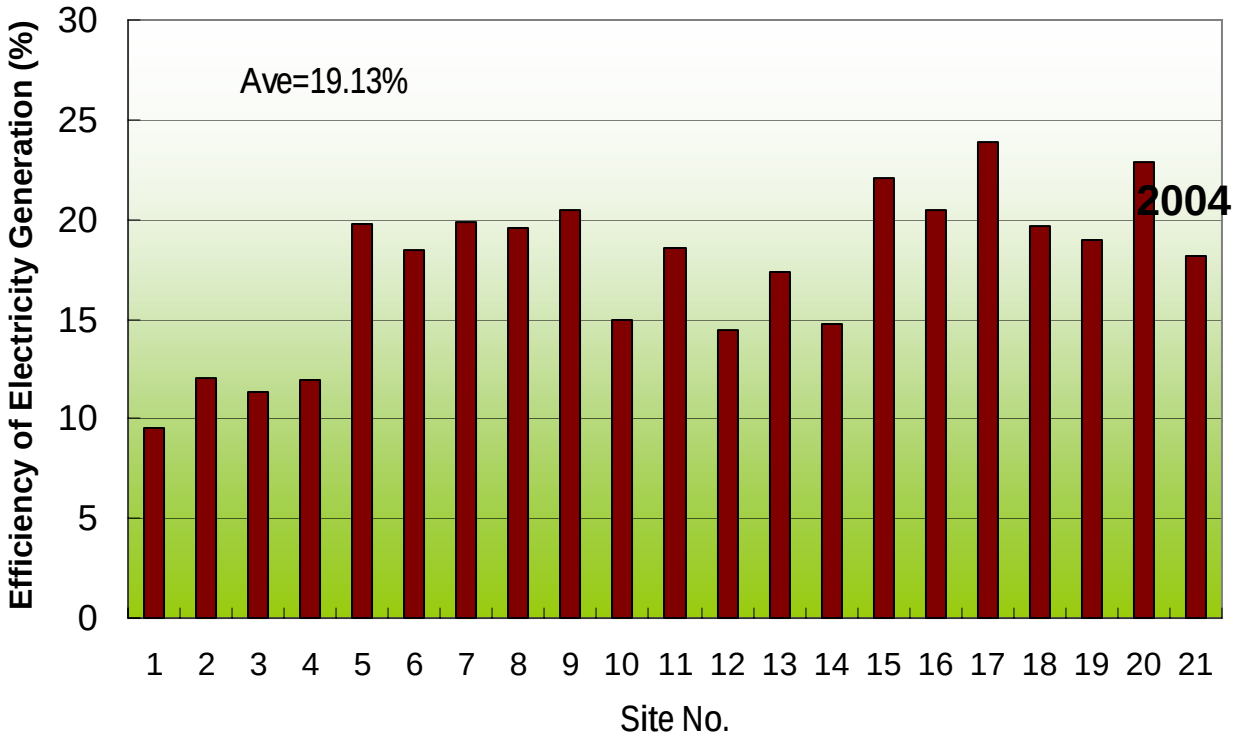
- ✓ The operation conditions in RTE facilities are also been adjusted to avoid damage on the heat recovery systems designed originally in the existent RTE plants.

ABOUT ELECTRICITY GENERATION……..

- ✓ Mean rate of electricity generation from feeding refuse is 413±109 kWh/tonne.
- ✓ The entire refuse can generate about 2.53 billion kWh annually, or about 1.2% of annual Taiwan electricity generation.
- ✓ But the amount of electricity generated from RTE plants is gradually decreasing with an decrease of the MSW quantity due to recycling policy.



- ✓ Mean efficiency of electricity generation for cogeneration system is 19.1±4.3 % (based on kWh/kcal-steam).

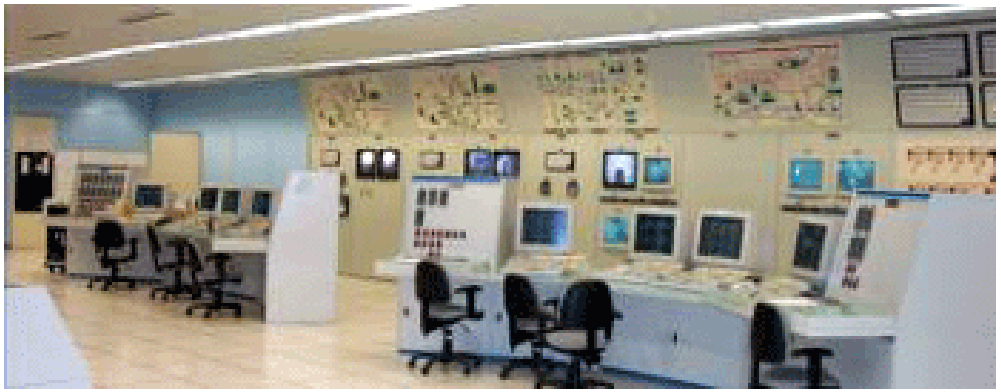


- ✓ According to Taiwan relative regulations, the electricity generated by private or public cogeneration systems must be purchased by Taiwan Power Company (TPC).
- ✓ The sale price of electricity generated from RTE was 1.6-1.8 NTD/kWh (in 2004).
- ✓ Taiwan DOE also enforces the incineration plants to improve the generation efficiency of electricity through some incentive policies like increase of sale price and combustor/generator performance.

- ✓ Since the 1990s, waste-to-energy technology has approached maturity, as a result Taiwan waste-to-energy facilities is now significant growing.

- ✓ Most new facilities operate as planned. Taiwan and their communities can use the Government policies to assess the status of various waste-to-energy technologies in planning new integrated waste management systems.

- ✓ However,the Taiwan government pays more attention on refuse treatment rate and emission control than electricity production efficiency.



STRATEGIES OF MSW MANAGEMENT…….

Major recycling initiatives being implemented in Taiwan. They will influence performance of RTE for MSW management ……..

1. Recycling Fund Management
2. Pay-As-You-Throw
3. Producer Responsibility
4. Zero-landfill and Total Recycling for Kitchen Garbage
5. Ash Separation and Recovery

1. Recycling Fund Management (RFM)

- ✓ Recycling fees paid by manufacturers/importers are distributed to Recycling Management Fund (RFM), which comprises a segment of EPA's budget and are administered by the Recycling Fund Management Committee.

- ✓ The total budget of year 2004 for the RFM was NT$62 billions (roughly US$2 billions). Seventy percent of the funds are distributed to trust funds. The remaining 30 percent are distributed to non-enterprise revolving funds, which are dedicated to education, research and development, and administration.

- ✓ Taiwan EPA uses the recycling funds to subsidize collection and recycling.

- ✓ Currently, the RFM, administered by the Taiwan EPA, asks the manufacturers or importers of listed items, e.g. batteries, cars, motorcycles tires, televisions, refrigerators, air conditioners, washing machines, computers, and etc. should pay recycling fees to government recycling funds.

2. Pay-As-You-Throw (PAYT)

- ✓ Prior to July 2000, refuse collection and treatment fees collected by Taiwan governments were based on the volume of water consumed by a household, but now collects the fees based on the volume of refuse.

- ✓ The current fee rate is NT$0.45 (approximately US$0.013) per liter of refuse.

- ✓ Taipei City promulgated "The Municipal Waste Cleaning Fee Collection Ordinance" on Aug. 2000. According to the Ordinance, citizens must pay for and use special trash bags for refuse to be collected by Taipei City.



- ✓ Those counterfeiting the special refuse bags will be fined between NT$30,000 to NT$100,000 (approximately US$857 to US$2,857) and be subject to criminal penalties.

- ✓ Most cities in Taiwan , like Taichung City and Kaohsiung City enforce mandatory sorting schemes. Citizens face penalties if they don't separate recyclables from the trash before pick-up.

- ✓ Fines of between NT$2,000 to NT$6,000 (roughly US$52 and US$170) will be imposed on illegal dumpers.

…..This PAYT program has resulted in a significant reduction in municipal waste……

3. Producer Responsibility

- ✓ The strategy asks some producers/manufacturers to recover their spent goods, when users discard.

- ✓ The producer responsibility have promoted recovery and reuse rate for a lot of goods, and thus to reduce refuse, which is estimated roughly 2-5 % of reduction rate of MSW every year.

- ✓ Targeting a 10% recycling rate for municipal wastes in 2005 and 15% in 2006, the Taiwan EPA expands the scope of producer responsibility with developing new recycling techniques, and strengthening recyclable collection programs.

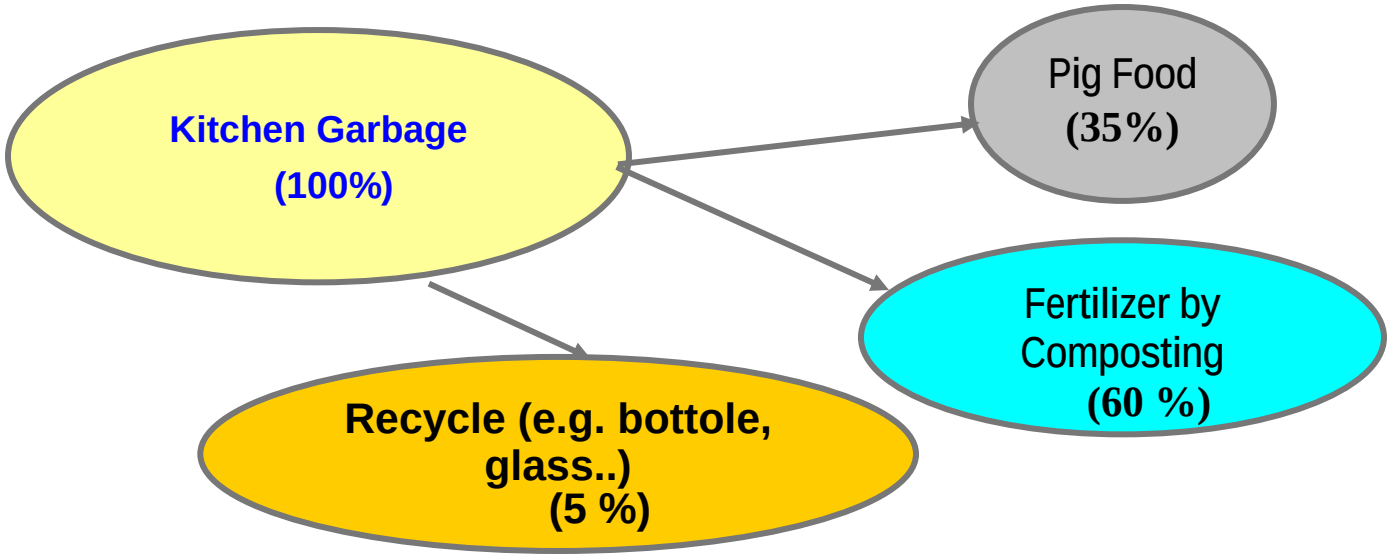
- ✓ With respect to strengthening collection systems, the Taiwan EPA will keep providing local governments with grants to establish collection and sorting facilities, and offer training courses for employees engaged in waste collection..

4. Zero-landfill and Total Recycling for Kitchen Garbage

- ✓ This program is based on some physical pretreatments.
- ✓ MSW classifications and recycling prior to Incineration through jumbo size waste recycling, like waste furniture or waste electronics, and proper garbage sorting done by separation plant.
- ✓ MSW after these programs can be separated out :
  - recyclable (repairable)and reusable,
  - Incinerable
  - non-incinerable.



Incinerable refuse is sent to incinerator plant while recyclable waste is sent to resource recycling plant. Non-incinerable material is sent to forest plantation or forest ground filling. As a consequence, kitchen garbage is regulatedly separated from MSW.



- ✓ Taiwan hopes that whole food waste can be reused as either pig food or fertilizer by composting, and thus no longer landfilling.

- ✓ At local government levels, food waste has been the focus of recycling programs in recent years. For instance, Taipei City is now undertaking such a collection system as well.

5. Ash Separation and Recovery

- ✓ To avoid the siting problem caused by the final disposal of incinerated ash, Taiwan has built up some ash separation and recovery plants (ASRP).

- ✓ In these plants, bottom ashes are categorized into different classes by their particle sizes. Classified bottom ashes are the supplemental materials for cement production.

- ✓ Bottom ashes can also added as base layer of the road. Micro sized particles with potential harm will be reused along with fly ashes. Metal substances will be recycled. Large sized substances or other miscellaneous substances will be either sent to refractory plant or landfill for final disposal.

- ✓ Through the plan of detoxification treatment, fly ashes become construction materials or some other reusable materials.

- ✓ With the execution of this ASRP plan, the expecting goal of resource recycling throughout Taiwan region will be achieved through bottom or fly ash recycling and reuse.

CONCLUSION

1. Incineration with RTE and waste minimization have become priorities in Taiwan's municipal waste management strategies over the past 10 years.

2. Approximately 7.5 million tons of MSW were collected in 2004 in Taiwan, including roughly 1.4 million tonnes of recycled material and 0.3 million tonnes of kitchen garbage.

3. There are now 21 large refuse-to-energy (RTE) facilities in good operation.

4. To promote recycling, the Taiwan EPA regulates and administers some strategies like producer responsibility, pay-as-you-throw programs and etc. by the new law of "Resource Recycling and Reuse Act"(promulgated in 2002, Waste Disposal Act promulgated in 1974).

5. All the programs or strategies conducted recently in Taiwan for MSW management are worth to pay attention on their influence to RTE .

6. The amount of electricity generated from the RTE plants is gradually decreasing with a decrease of the MSW quantity due to recycling policy.

Thanks for Your Attention……..



Beautiful Photographs in Taiwan