4th High Level Seminar on Environmentally Sustainable Cities

# Waste to Energy Technology for Clean & Recycle Society

21st March 2013

JFE Engineering Corporation

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2. Waste to Energy (WTE) Technology
   - WTE in Japan
   - WTE Technologies
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3. Recycle Business

# Corporate Profile

JFE

JFE Engineering Corporation

# JFE Group

Data in FY2011

NKK

Since 1912

KAWATETSU

Since 1951

Merged in 2003

JFE

**JFE Holdings**

100 %

45.93 %

## JFE Engineering

Net Sales(million $)

3,600

Employees

7400

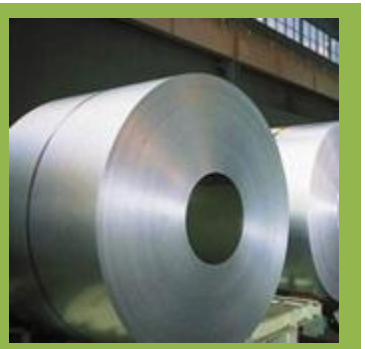
## JFE Steel

Net Sales(million $)

34,000

Employees

42,600



## JFE Shoji Trade

Net Sales(million $)

27,000

Employees

1,300

## Japan Marine United

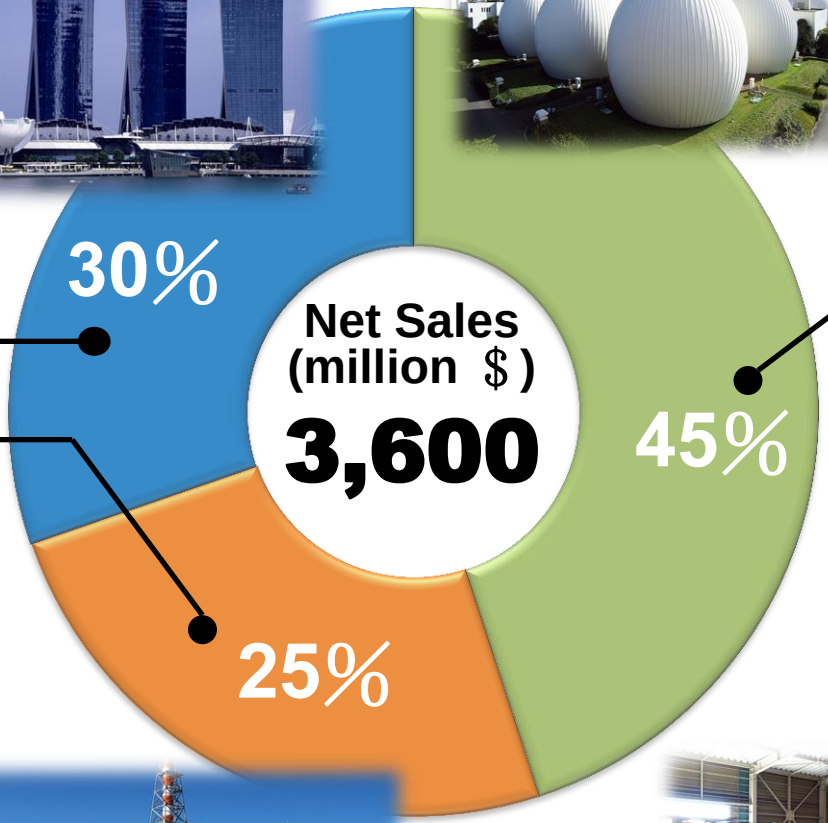
Net Sales(million $)

2,800

Employees

3,600

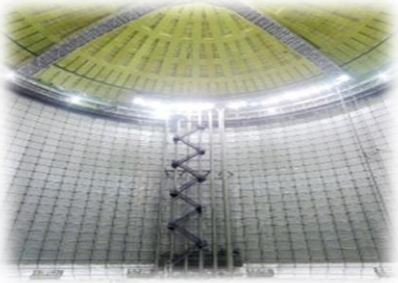
# JFE ENGINEERING




**Others**

**Energy**

**Environment**



# Global Network of JFE Engineering


**Europe / Middle East**

**Frankfurt (Germany)**
**Rome (Italy)**
**Al Khobar (KSA)**

**China**

**Shanghai**
**Beijing**
**Hong Kong**

**South East Asia & Oceania**

**Singapore**
**Kuala Lumpur (Malaysia)**
**Jakarta (Indonesia)**
**Hanoi (Vietnam)**
**Ho Chi Minh (Vietnam)**
**Yangon (Myanmar)**
**Manila (Philippines)**
**Mumbai (India)**
**Brisbane (Australia)**

Underline shows “Regional Head Office”

# JFE Engineering

# Experiences & Capabilities

# on

# Waste Thermal Treatment

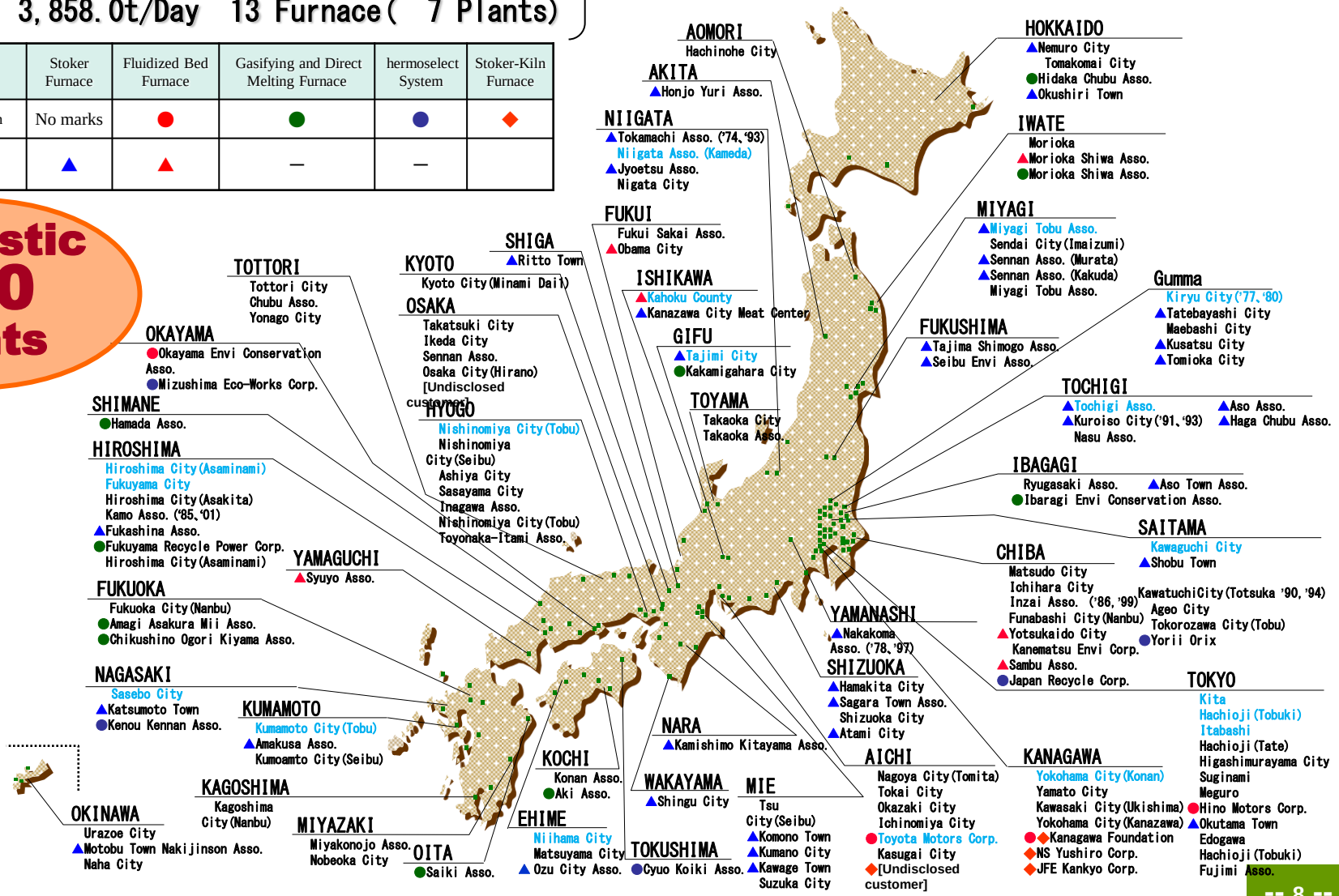
# JFE : WTE Track Records - Japan -

( - 2012.12 )

Domestics 38,427.5t/Day 336 Furnace(160 Plants)
Overseas 3,858.0t/Day 13 Furnace( 7 Plants)

| | Stoker Furnace | Fluidized Bed Furnace | Gasifying and Direct Melting Furnace | hermoselect System | Stoker-Kiln Furnace |
|---|---|---|---|---|---|
| Continuous Operation | No marks | ● | ● | ● | ◆ |
| Daily start-up and shutdown Operation | ▲ | ▲ | — | — | |

**Domestic 160 plants**



# JFE : WTE Track Records -Overseas-

Italy
Gasifier 308t/d x 1

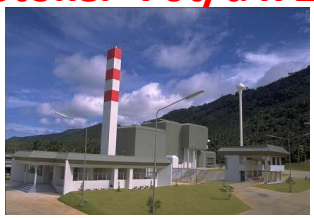
Thailand
Fluidized Bed
110t/d x 1

China
Stoker 500t/d x 3

China
Stoker 400t/d x 2

**Overseas**
**7 plants**
**(13 Furnaces)**

Thailand
Stoker 70t/d x 2



Malaysia
Fluidized Bed
240t/d x 1

Taiwan
Stoker 300t/d x 3

# International Recognition

Prime Minister Mr.Najib (Malaysia)

Deputy Prime Minister Mr.Suwankiri (Thailand)

President Mr.Hu Jintao (China)

Director Gen. of MODON, Alrabiah (Saudi Arabia)

US Navy / UCLA (USA)

# Waste To Energy Technology

JFE

JFE Engineering Corporation

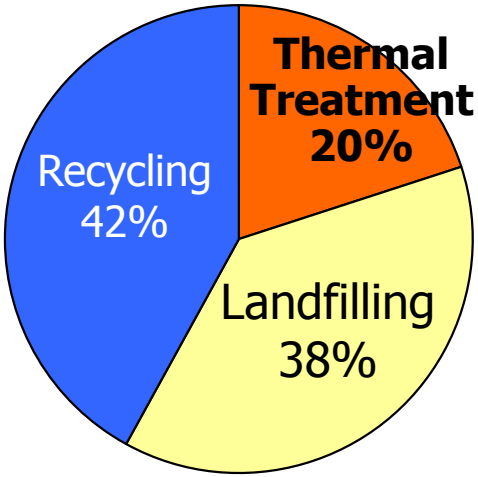
# Part 1.

# WTE in Japan

# World Waste Treatment

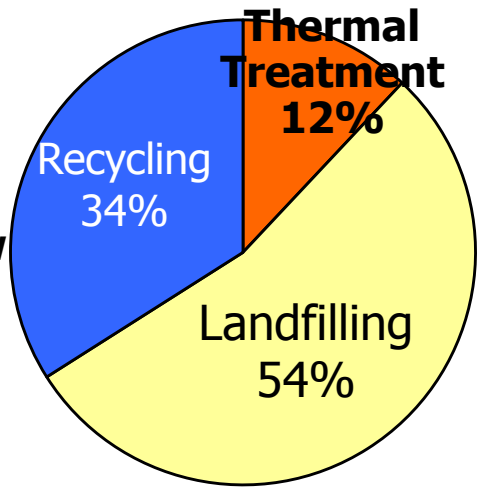
Source: CEWEP

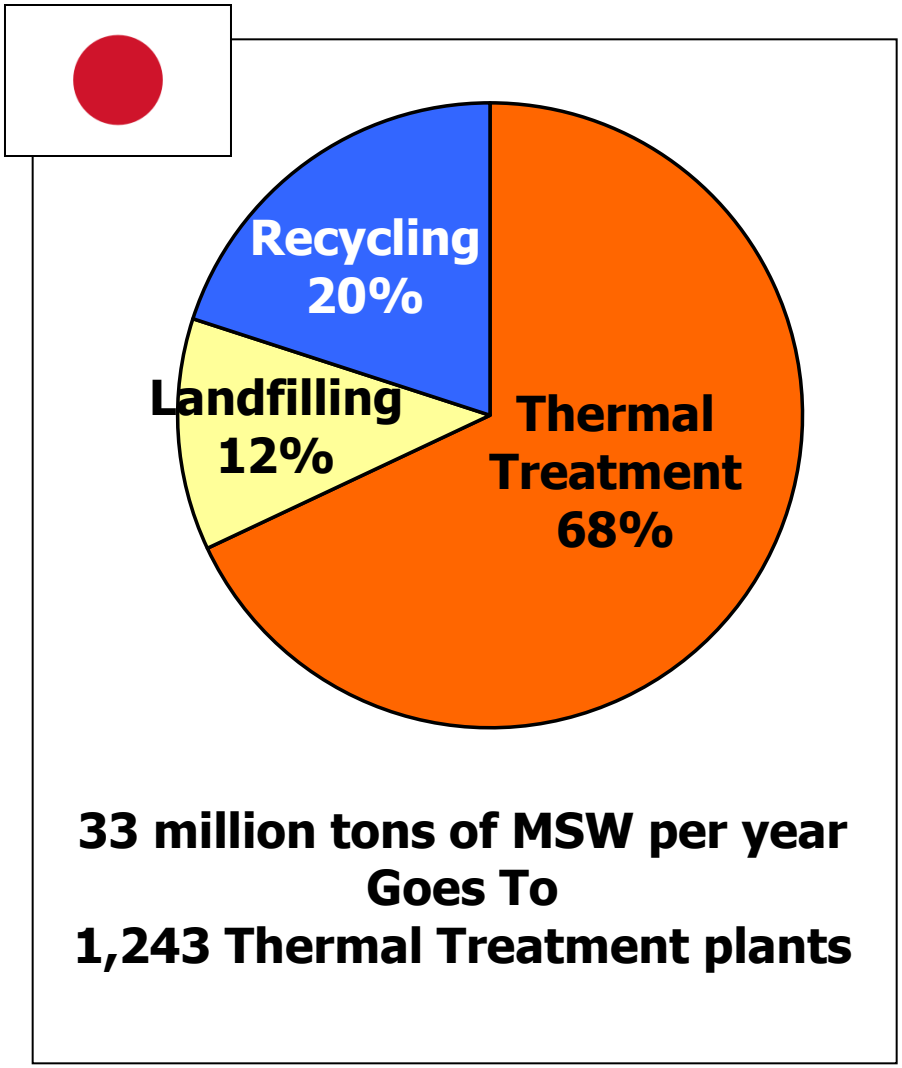
60 million ton/y - MSW
With 420 plants




Source: USEPA

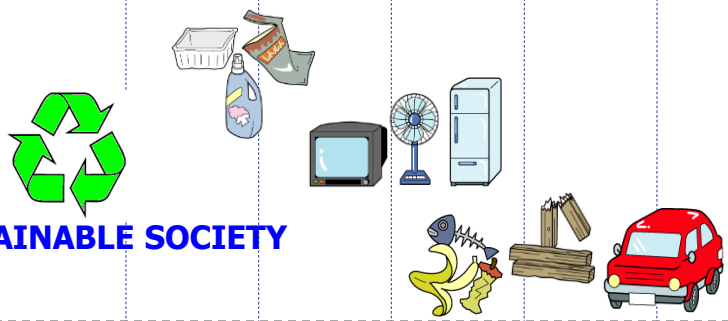
29 million ton/y - MSW
With 85 plants




Source: Ministry of Environment

# Japanese Waste Management Development



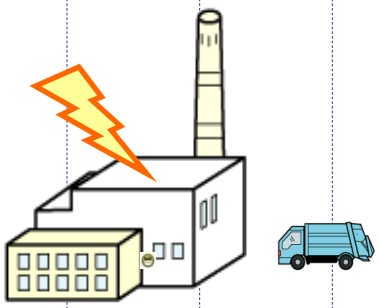
To SUSTAINABLE SOCIETY

## RECYCLE

+1991 Promotion Law
+1995 Container/Packaging
+1998 Home Appliance
+2000 Recycle Basic Law
+2000 Construction/Food/Car

THERMAL RECYCLING

EMISSION CONTROL



## MODERN WASTE MANAGEMENT

+ 1970 WASTE MANAGEMENT AND PUBLIC CLEANSING LAW
+ Waste-to-Energy Plant START
+ 1990 DIOXIN Guideline
+ 1999 DIOXIN Law

RAPID ECONOMY GROWTH brought
More Waste generation
Higher Waste Calorific Value
Improper Treatment

## START WASTE MANAGEMENT

+ 1900 WASTE CLEANSING LAW
> LOCAL GOVERNMENT RESPONSIBILITY
> Controlled INCINERATION AS PRIORITY
+ 1903 Mechanical INCINERATOR Start

PROTECT HUMAN HEALTH
from UNSANITARY ENVIRONMENT

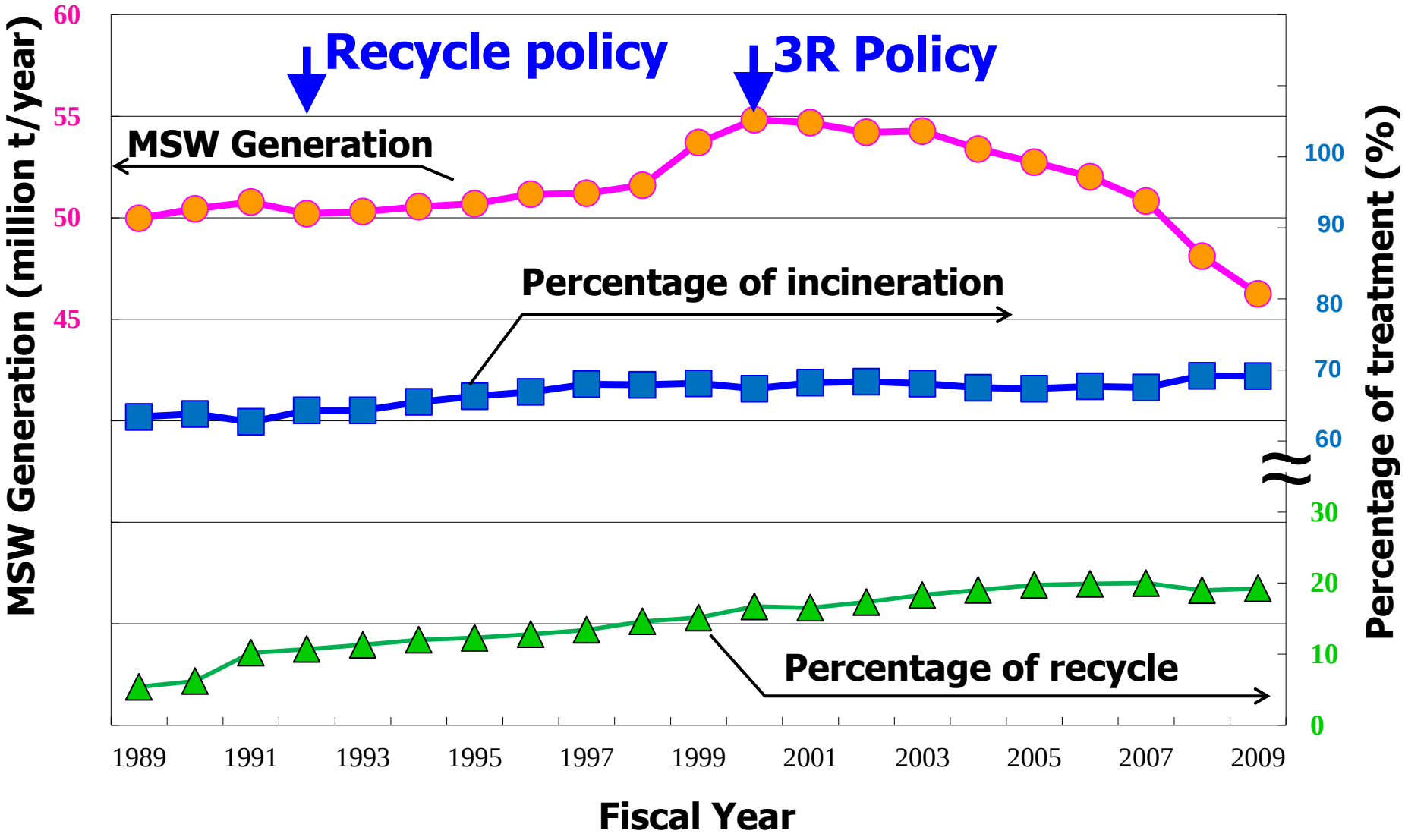
NO WASTE MANAGEMENT

+ 1880s~ PANDEMIC (CHOLERA, PEST, etc.)
+ OPEN BURNING
+ UNSANITARY ENVIRONMENT

| -1900 | 1900 | 1910 | 1920 | 1930 | 1940 | 1950 | 1960 | 1970 | 1980 | 1990 | 2000 | 2010 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

YEAR

# Trend of MSW Generation and Treatment




Source : Ministry of Environment(Japan)

# Part 2.

# WTE Technologies

# Benefit from WTE

Power Generation

Heat Utilization


Material Recovery

Slag

Metal

Go to Landfill $\frac{1}{30}$ (in volume)

$CH_4$ Greenhouse Effect $\frac{1}{21}$ $CO_2$

Odor

# WtE Technology Trend (Japan)

1970 1980 1990 2000 2010

▲Modern Mechanical Incinerator

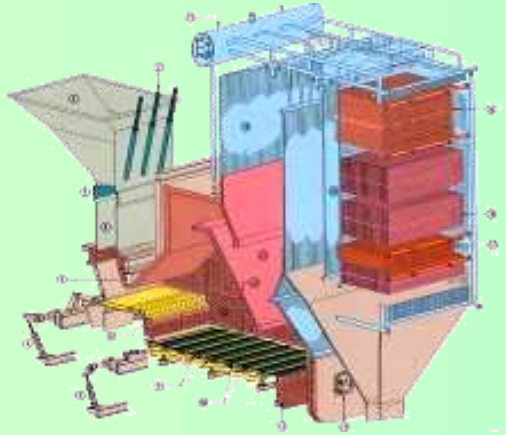
▲Waste-to-Energy start

▲Dioxins issue & RDF emerged

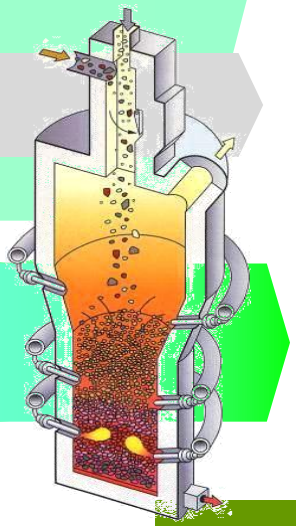
▲ Dioxin Laws& Regulations
(98% Reduction achieved
from ’97 to ‘03)

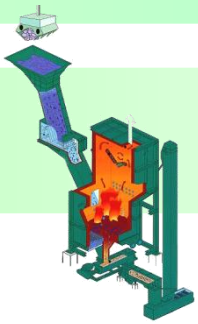
▲Guideline to Melting Furnace

## Stoker Furnace



Stoker +Ash Melting

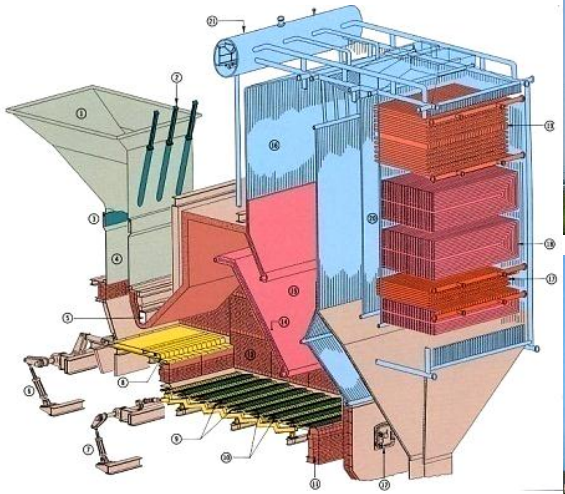




Fluidized Bed

## Gasifying & Melting Furnace

# JFE Stoker Furnace



## (1) Proven Track Record

130 plants since 1968

## (2) Advantages :

### 1) Minimum Discharge

Advanced Combustion Control

High standard Air Pollution Control

Prevention of Dioxins emission

### 2) Large Capacity

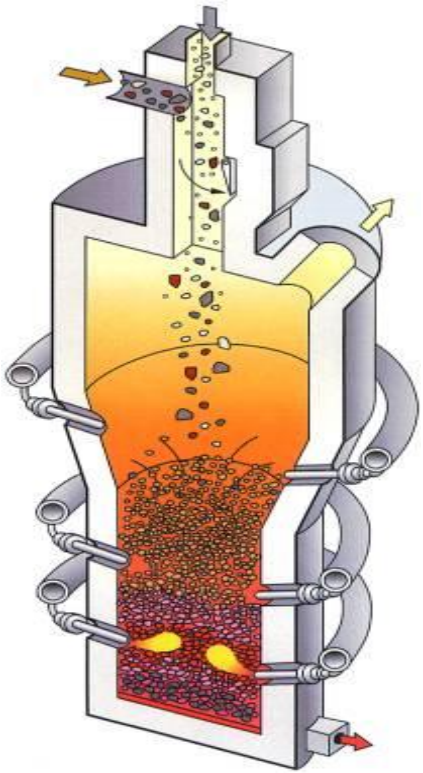
Many track records of Large capacity

### 3) Safe and Easy operation

Highly Developed Control System

Stable combustion

# JFE Gasifying and Direct Melting Furnace



## (1) Proven Track Record

10 plants (20 furnaces) since 2003

## (2) Advantages :

### 1) Applicable to Various Wastes

MSW, RDF, Sewage Sludge, ASR,
Hazardous (medical) wastes,
Excavated landfill wastes, etc.

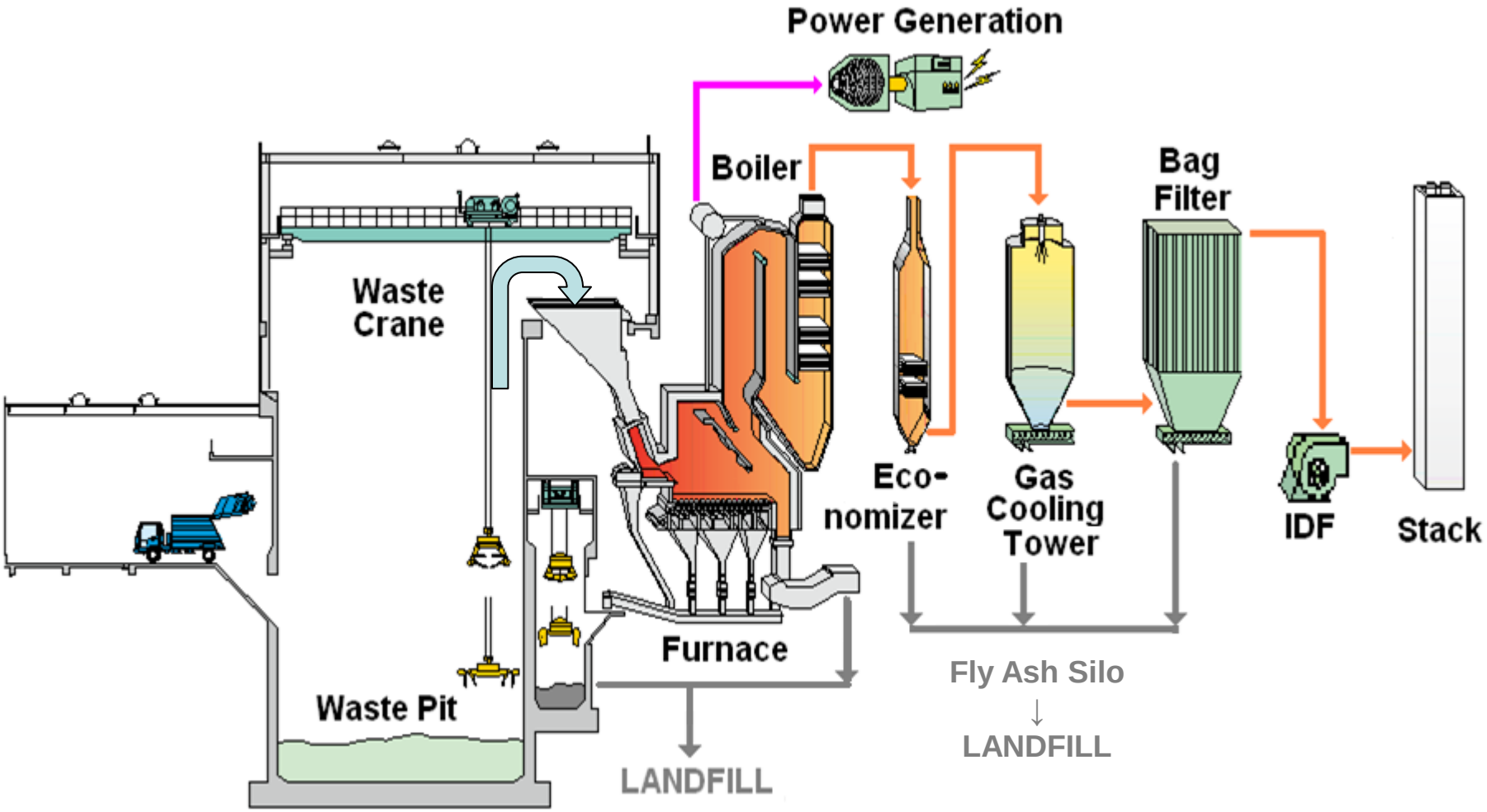
### 2) Minimum Discharge

- extended life of landfills
- prevention of dioxin emission

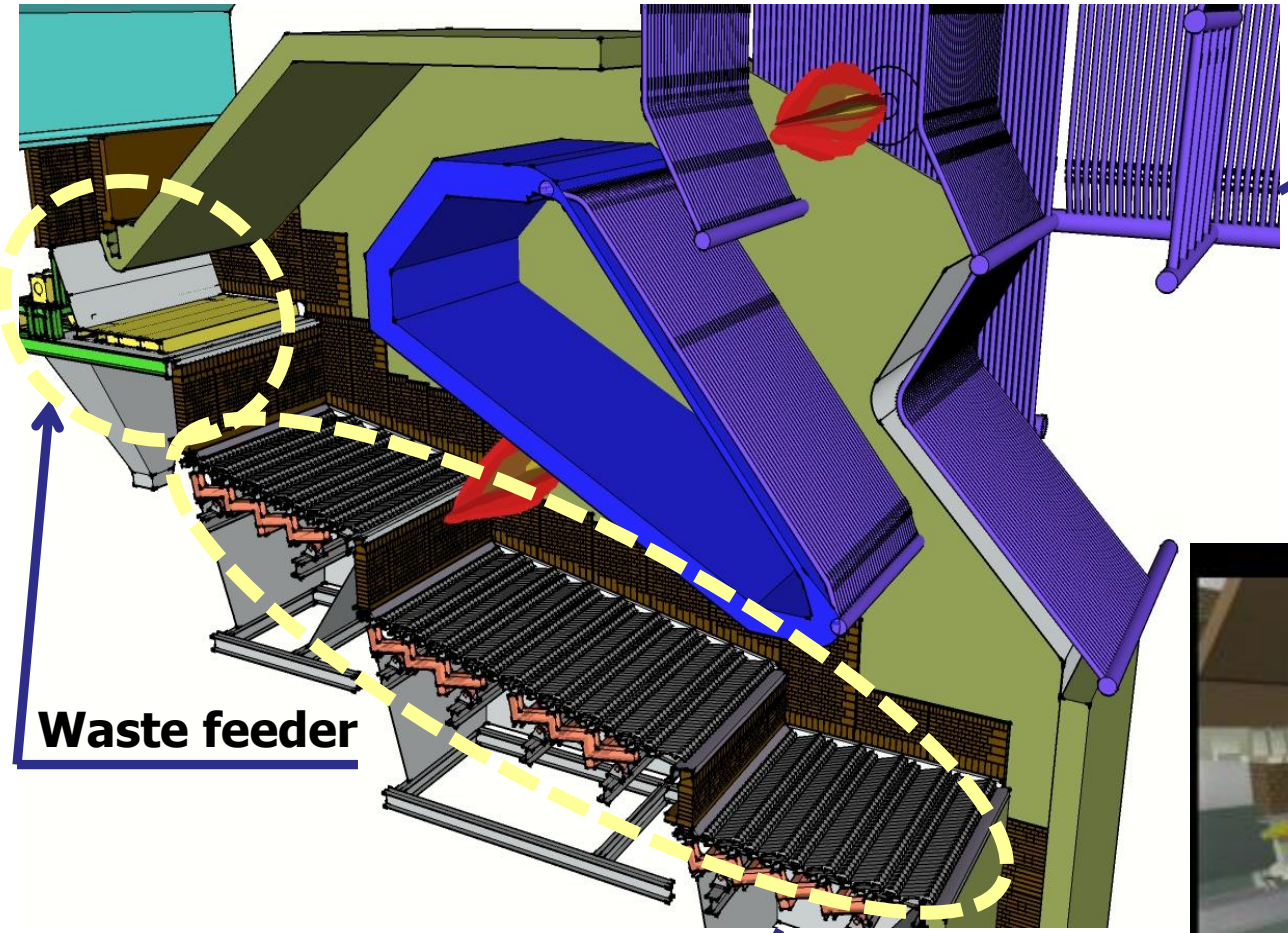
### 3) Safe and Easy operation

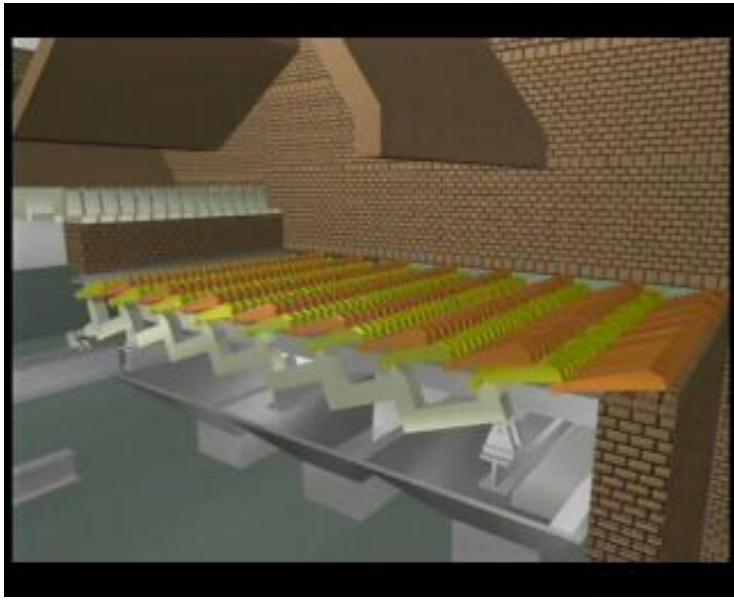
- no explosion/gas leakage risk
- continuous slag extraction

# Typical Flow of Stoker Plant

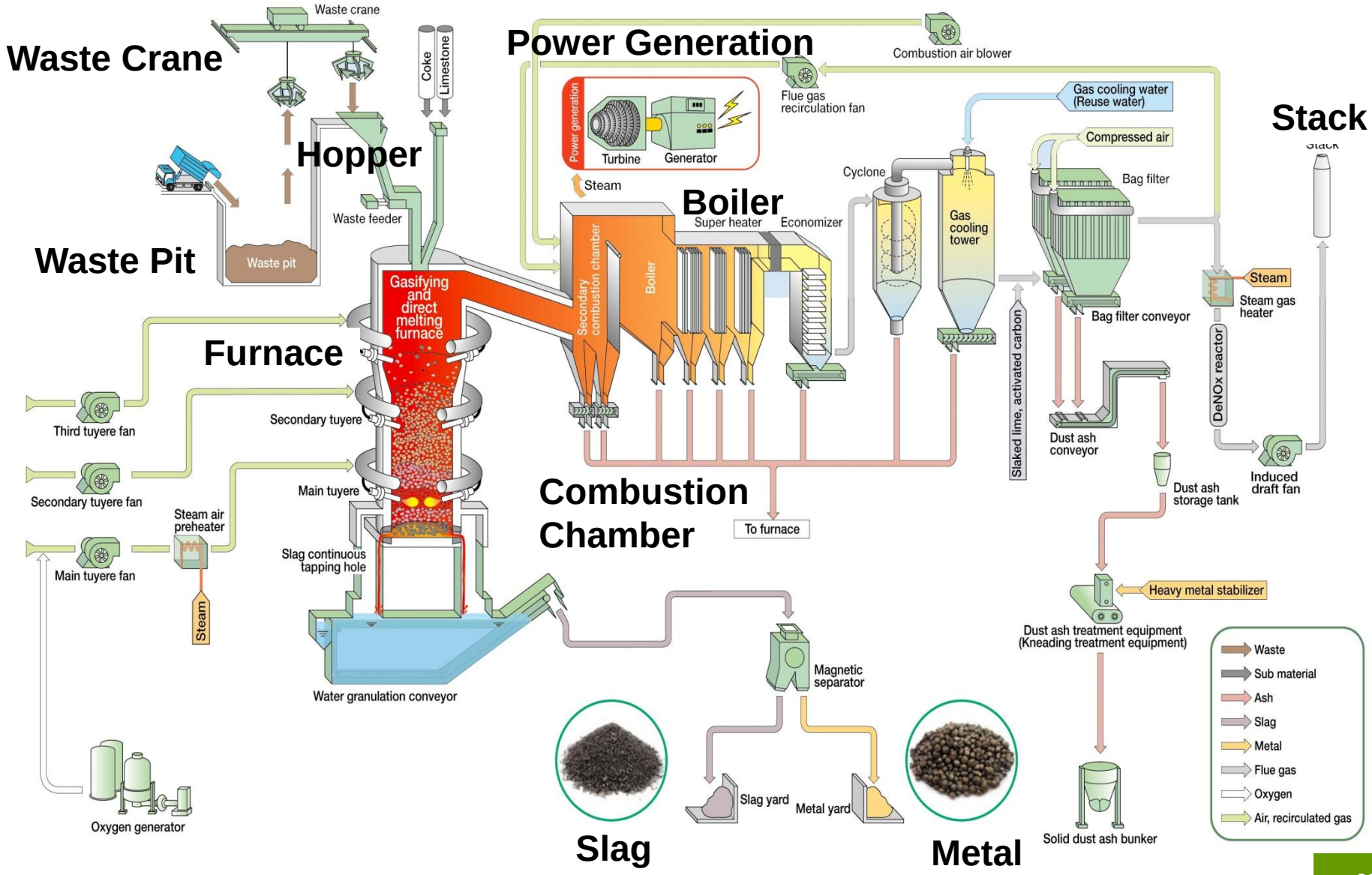


# Structure of JFE Hyper Grate System



# Typical Flow of Gasification



# JFE Gasification : Advantages

## Various Type of Waste


MSW


Waste tire

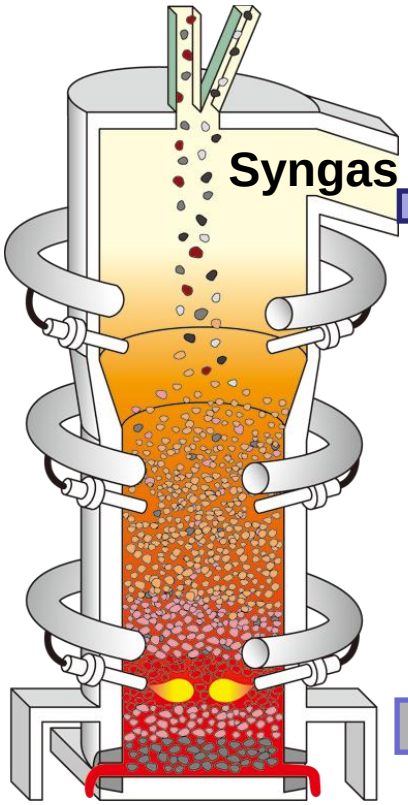

RDF


Hazardous waste


Sewage sludge


Landfilled Waste

## Volume Reduction ≧ 97%




Power

Boiler → FGC

Fly Ash to Landfills (less than 3%)

## Recyclables


Slag


Metal

# Slag & Metal Recycle

## SLAG

### Slag Leaching Test

| Items | | Standard | Test Result |
|---|---|---|---|
| Cd | (mg/ℓ) | ≦ 0.01 | < 0.005 |
| Pb | (mg/ℓ) | ≦ 0.01 | < 0.005 |
| $Cr^{+6}$ | (mg/ℓ) | ≦ 0.05 | < 0.04 |
| As | (mg/ℓ) | ≦ 0.01 | < 0.01 |
| Hg | (mg/ℓ) | ≦ 0.0005 | < 0.0005 |
| Se | (mg/ℓ) | ≦ 0.01 | < 0.005 |

Recycle

### Back-filling Material

### Asphalt Aggregate

### Concrete Product

## METAL

### Metal Leaching Test

| Items | | Standard | Test Result |
|---|---|---|---|
| Cd | (mg/ℓ) | ≦ 0.01 | < 0.005 |
| Pb | (mg/ℓ) | ≦ 0.01 | < 0.005 |
| $Cr^{+6}$ | (mg/ℓ) | ≦ 0.05 | < 0.04 |
| As | (mg/ℓ) | ≦ 0.01 | < 0.005 |
| T-Hg | (mg/ℓ) | ≦ 0.0005 | < 0.0005 |
| Se | (mg/ℓ) | ≦ 0.01 | < 0.005 |

Recycle

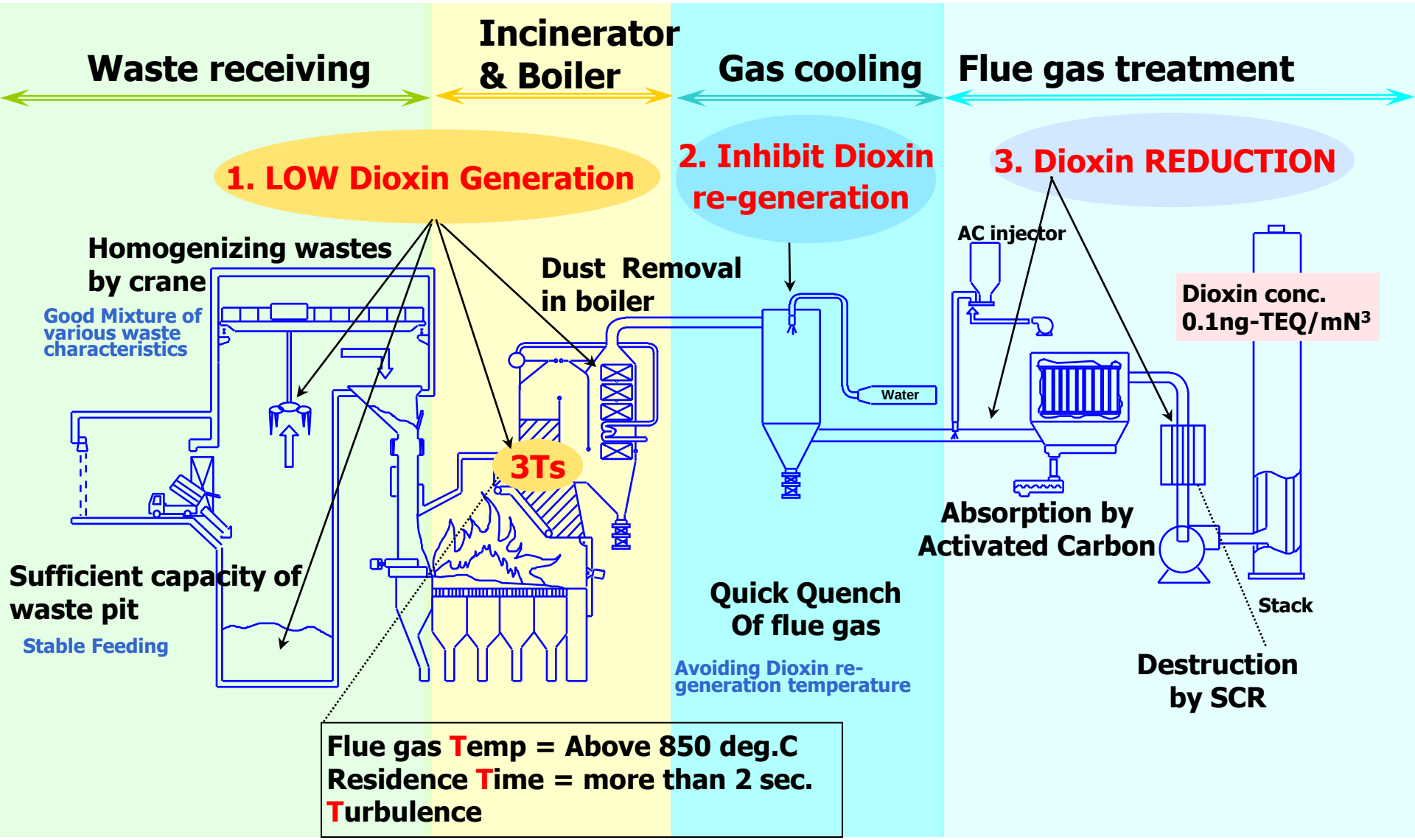
### Counter Weight

### Copper Recovery

# Part 3.

# Pollution Control

# Reducing DIOXINs

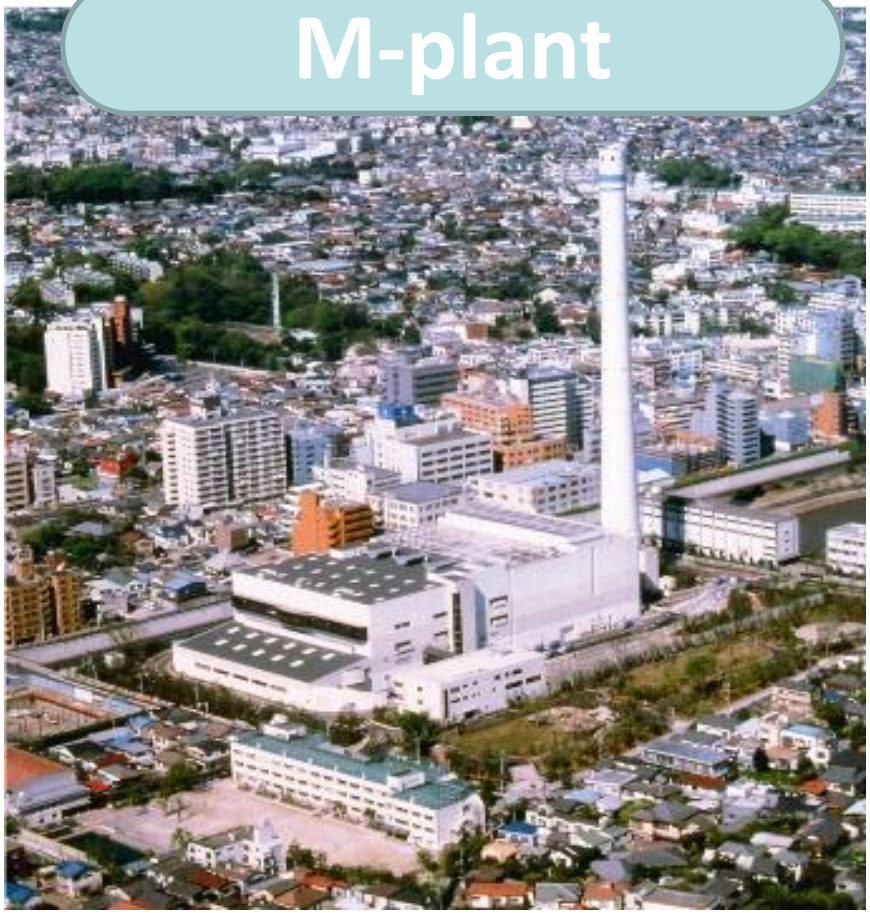


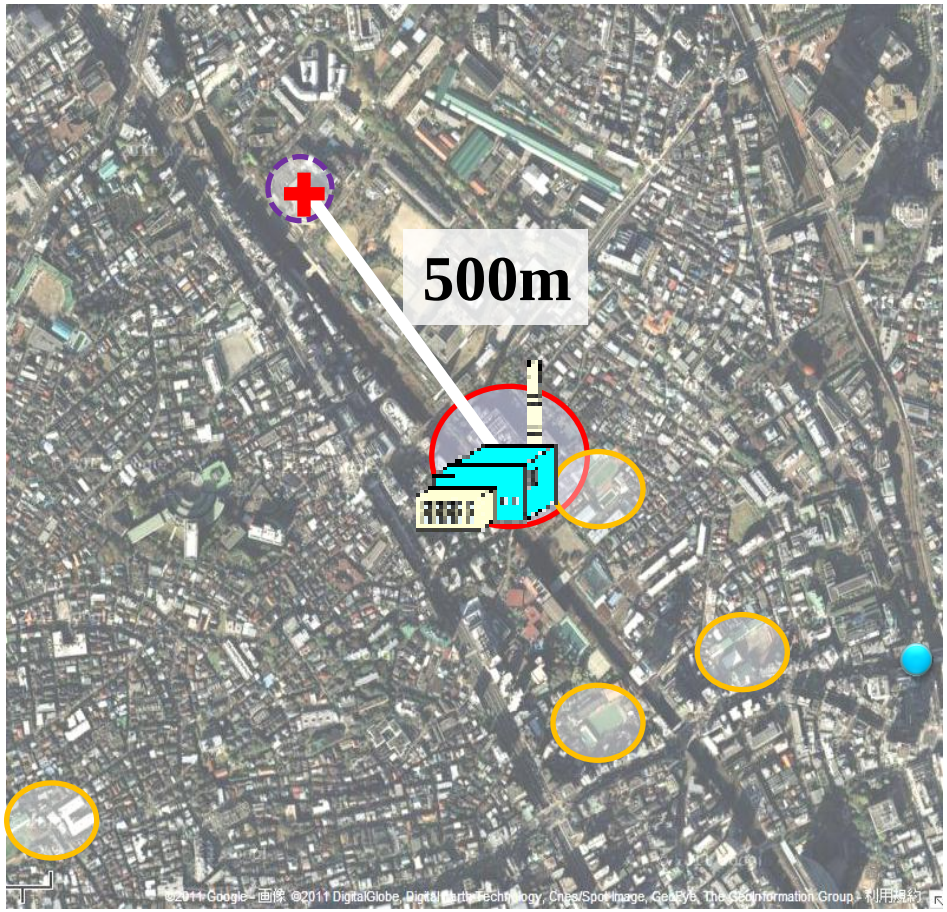
# Dioxin Measurement

| No. | Facility | DXN Reduction Technology | | | | | Emission Standard ng-TEQ/Nm$^3$ | **Measured Result ng-TEQ/Nm$^3$** ( Standard **0.1**000) |
|---|---|---|---|---|---|---|---|---|
| | | Two-way Flue Gas Furnace | Hybrid ACC | Boiler + Gas Cooling Tower | Activated Carbon Injection | SCR | | |
| 1 | S-City 90 t/d × 3 | ○ | ○ | ○ | ○ | ○ | 0.1 | **0.00043**<br>**0.00043**<br>**0.0027**0 |
| 2 | K-City 140 t/d × 2 | ○ | ○ | ○ | ○ | ○ | 0.05 | **0.0087**0<br>**0.0027**0 |
| 3 | O-City 450 t/d × 2 | ○ | ○ | ○ | ○ | ○ | 0.1 | **0.0000065**<br>**0.0008**0 |
| 4 | K-City 150 t/d × 1 | ○ | ○ | | ○ | | 0.1 | **0.017**00 |
| 5 | R-City 90 t/d × 2 | ○ | ○ | ○ | ○ | ○ | 0.1 | **0.016**00<br>**0.028**00 |
| 6 | Y-City 400 t/d × 3 | ○ | ○ | ○ | ○ | ○ | 0.1 | **0.00026**<br>**0.00021**<br>**0.00045** |
| 7 | M-City 135 t/d × 3 | ○ | ○ | ○ | ○ | ○ | 0.1 | **0.0027**0<br>**0.03**000<br>**0.0028**0 |

# WTE Plant Harmony with Town

## M-plant



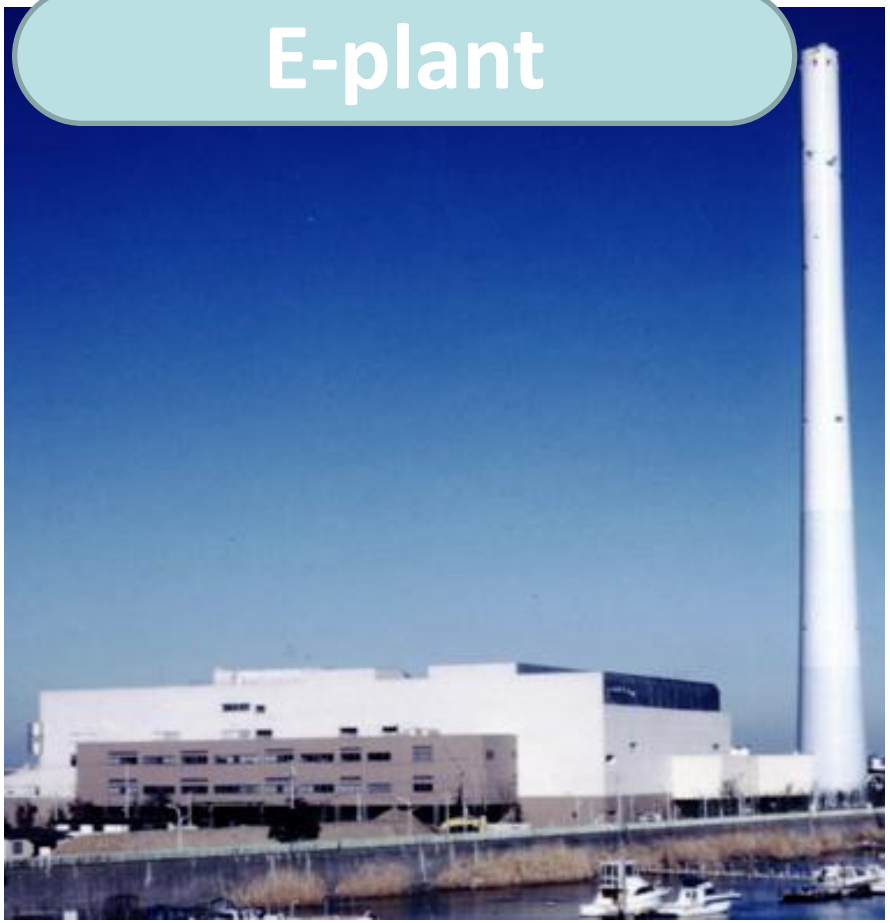


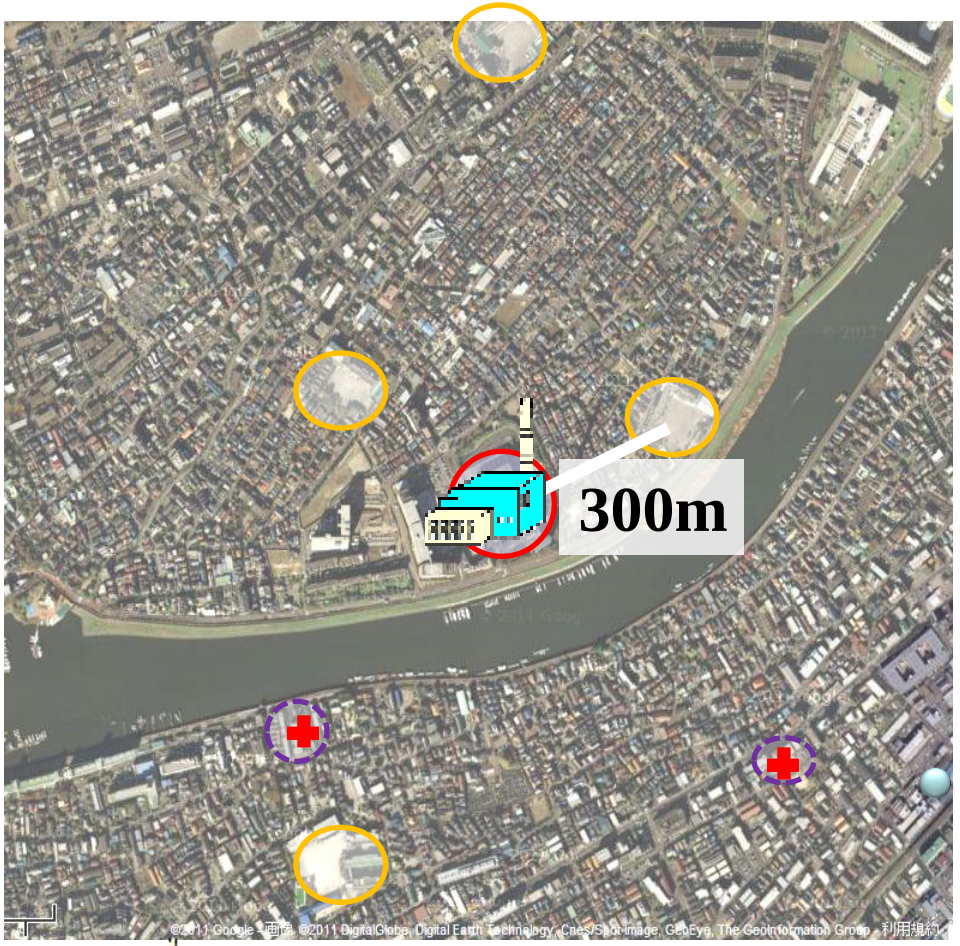

**Completion : March 1991**
**Capacity : 300ton/day x 2 lines**
**Power Output : 11,000 kW**

**WtE Plant** **Hospital**
**School** **Train Station**

# WTE Plant Harmony with Town

## E-plant

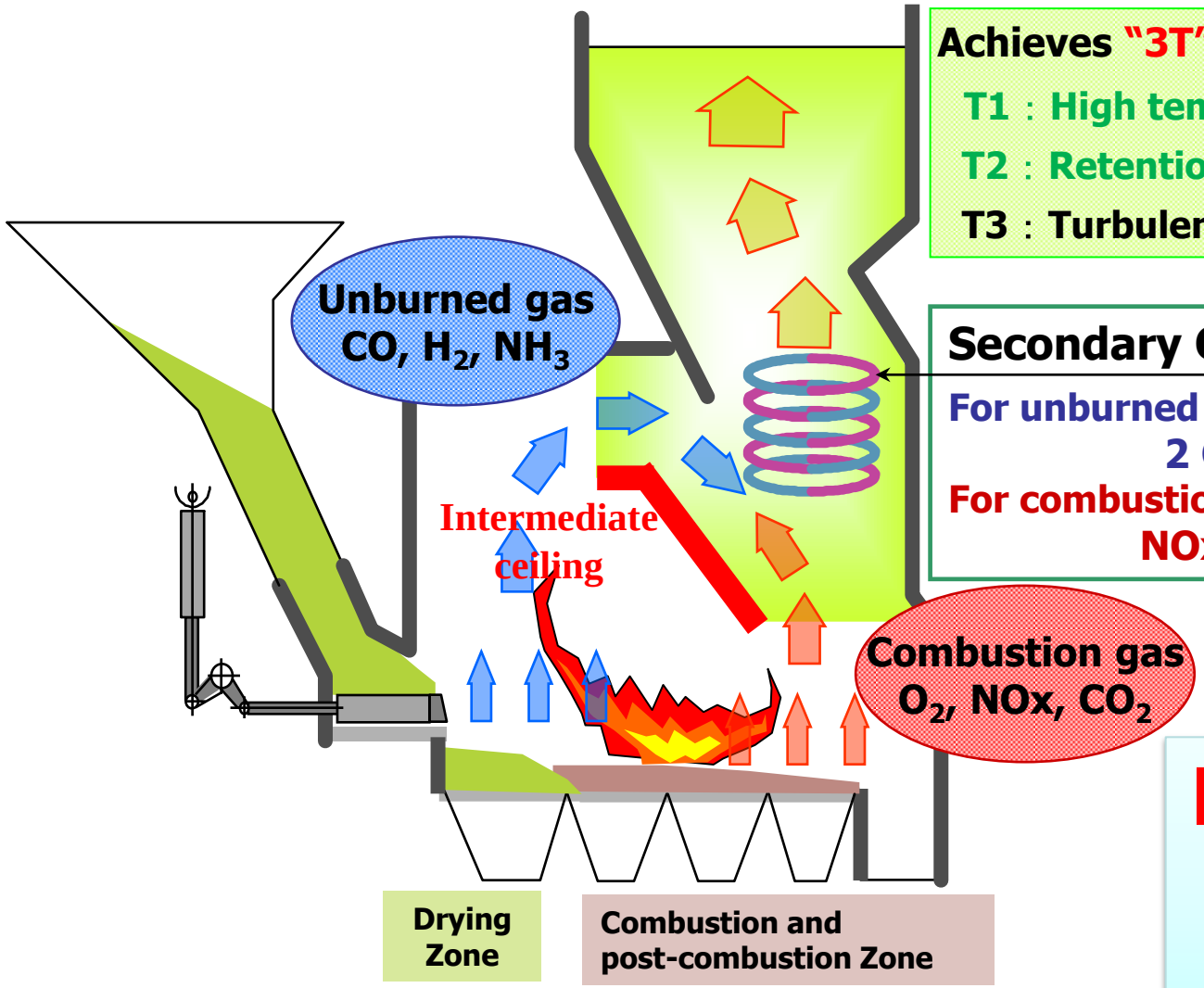





**Completion : January 1997**
**Capacity : 300ton/day x 2 lines**
**Power Output : 12,300 kW**

WtE Plant
Hospital
School
Train Station

# Realizing Low DXNs/CO and NOx




**Achieves "3T" for Dioxins Reduction**

- T1 : High temperature (850-950 deg C)
- T2 : Retention time(2sec)
- T3 : Turbulence

**Secondary Combustion Zone**

For unburned gas : Oxidation reaction

$2\,CO + O_2 \rightarrow 2\,CO_2$

For combustion gas : Reduction reaction

$NOx + NH_3 \rightarrow N_2 + H_2O$

**Low CO(DXN)**

**Low NOx**

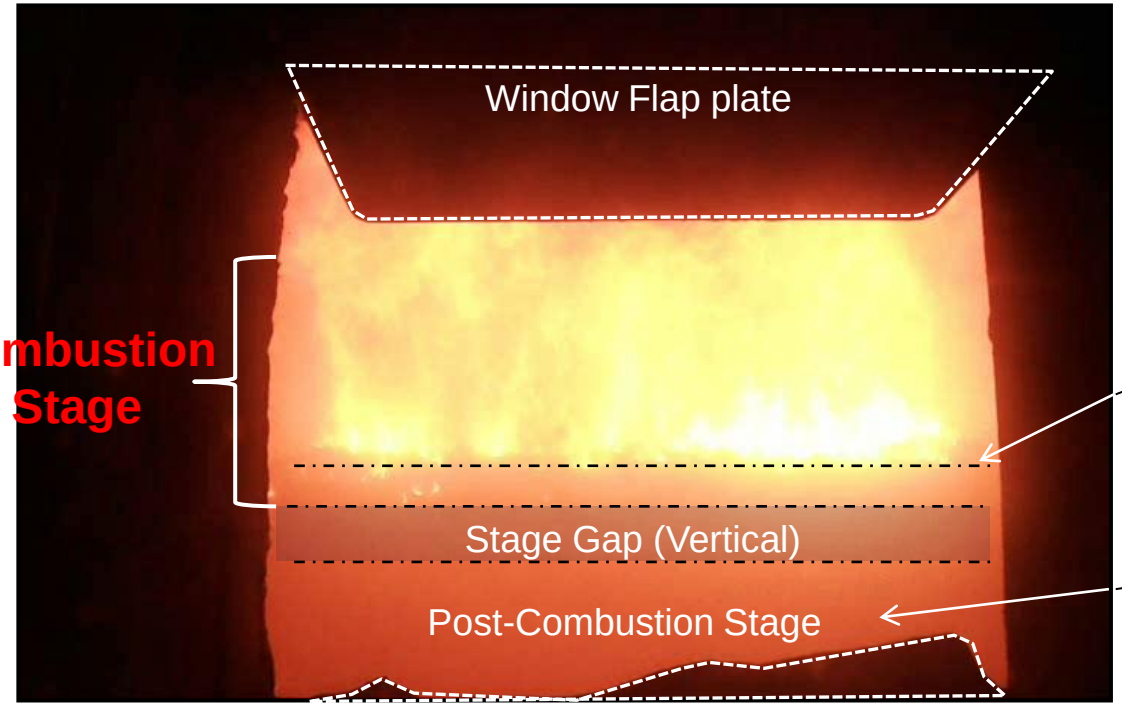
# Part 4.

# Excellent Combustion Control

## Maintain Performance even for LOW calorie MSW

# LOW Calorie Waste Combustion

## Stable Combustion




**GOOD STABLE COMBUSTION**

Combustion completes before end of combustion stage

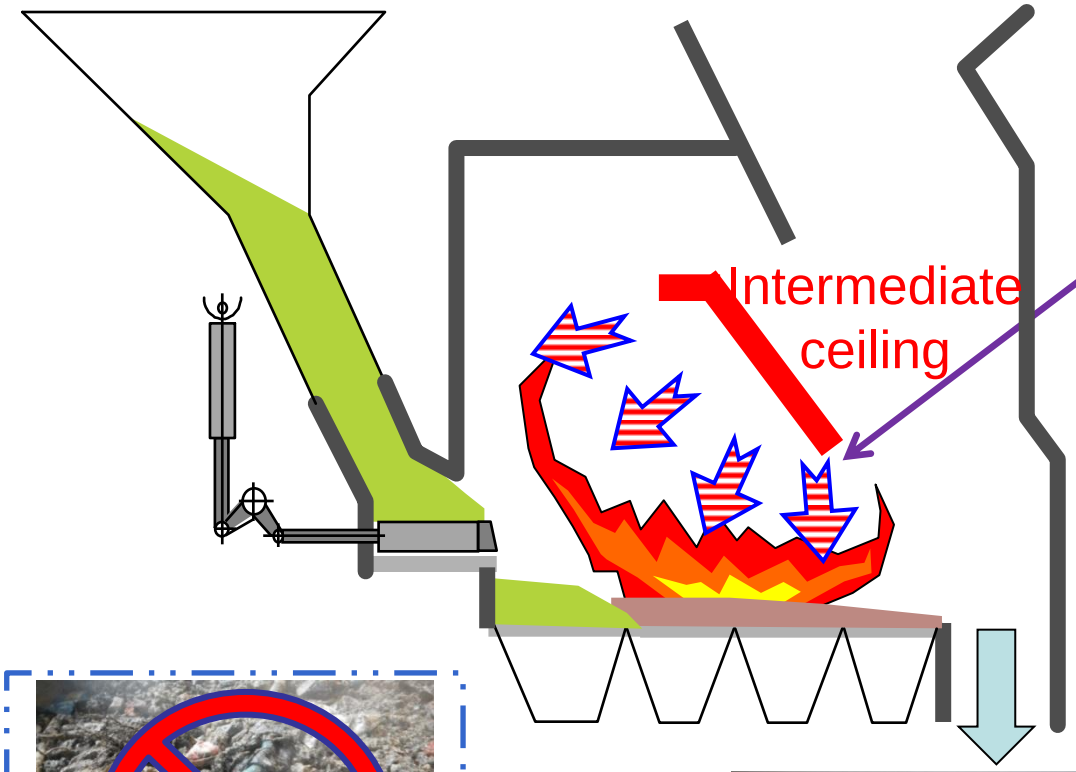
No outstanding flare In this stage

| Waste Characteristics | Value |
|---|---|
| Moisture (%) | 50～60 |
| Ash (%) | 18～23 |
| Burnable (%) | 22～27 |
| Lower Heat Value (MJ/kg) | 4.7～5.8 |

Data / Photo from Qingdao(China) plant

# LOW Calorie Waste Combustion

## Better Bottom Ash Quality



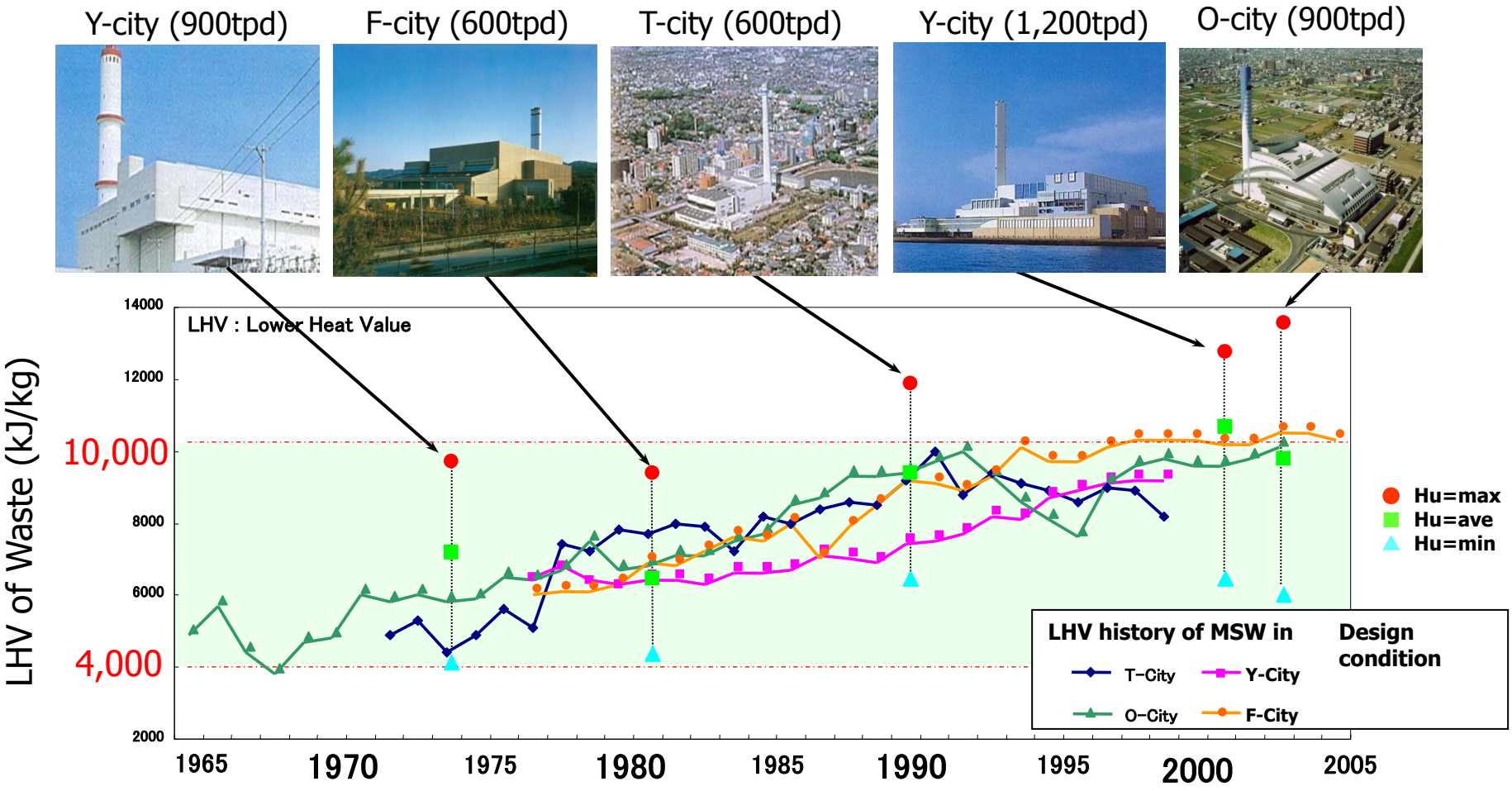

**Effective Radiation**

**Better**
**Bottom Ash Quality !**

**Ash with Unburnt**

**Less Unburnt**
**Less Organics**
**to**
**Final Landfill**

# Enough Experience of Wide Range Waste Heat Value



# Part 5.

# Latest Updates

# BIOMASS Utilization

## Biomass briquette can replace Coke

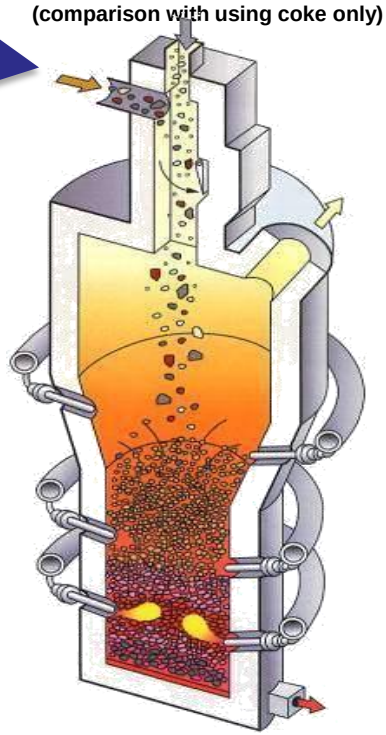
**Biomass resources**




**Biomass Briquette**

## $CO_2$ Reduction : 50%

(comparison with using coke only)



# WtE : Integrated Approach

JFE

Wastes

E-Wastes

Plastics

Industrial Wastes

C & D


Organics (Kitchen Wastes)

Sewage Sludge

Pre-Treatment

Conversion

Utilization

MRF

Recycling

Stoker

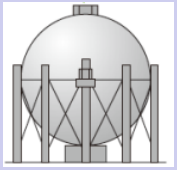
Power

Gasification

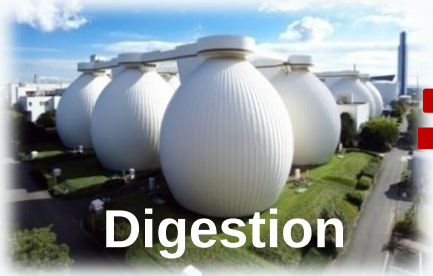
Recycling

RDF Plant

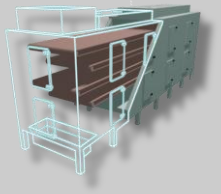
Gas Fuel



Digestion



Solidification Plant



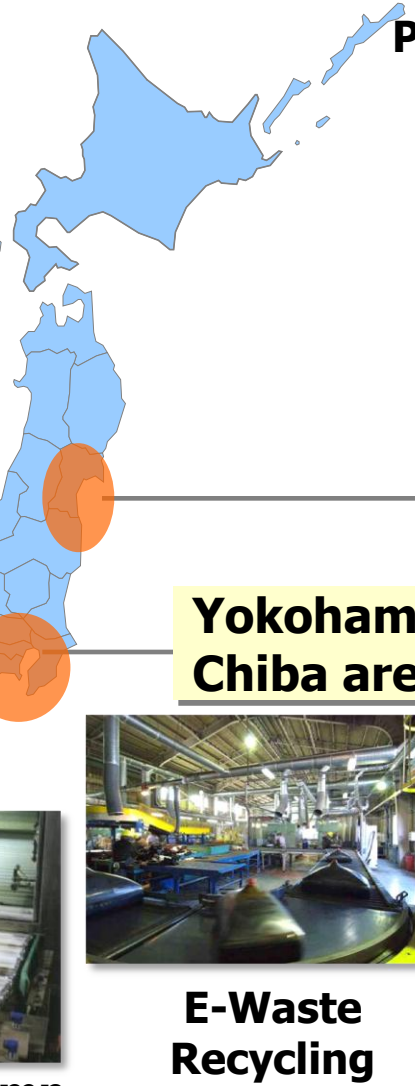
Solid Fuel

# Recycling Business

JFE Engineering Corporation

# Recycling Business Sector

- Refuse Treatment & Recycling
- Waste Collection/Transportation
- Refuse-Derived Fuel (RDF) Power-generation



Plastic/Fluorescent Lamp/Wood wasteRecycling

Sendai area

Yokohama-Kawasaki - Chiba area

Fukuyama - Kurashiki area

RDF Power-generation

Biomass Carbonization

Fluorescent Lamp Recycling

E-Waste Recycling

Food Recycling

# Recycling Business Sector




# Contact

# Thank you

Further info. Available in

http://www.jfe-eng.co.jp/en/