NSENGI

◆Our Challenge for Environmental Problems

◆The Features of Our Waste Treatment Technology ～Direct Melting System～

NIPPON STEEL & SUMIKIN ENGINEERING CO., Ltd.

September/2013

Trajetória e desafio relacionados ao meio ambiente e a energia

Foto aérea da Usina de Yawata há 50 anos atrás

Foto aérea da Usina de Yawata há 30 anos atrás

Tecnologias relacionadas a Energia e Meio-Ambiente

Desenvolvimento de engenharia, operação, manutenção e controle de:

- Equipamentos de tratamento de águas e efluentes
- Despoeiradores
- Sistema de recuperação de calor
- Equipamentos de geração de energia
  (Direct Melting System)

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1. Company Overview

1.1 Group Structure

NIPPON STEEL & SUMITOMO METAL CORPORATION (NSSMC) GROUP

〈Steelmaking〉	〈Engineering〉	〈Chemicals〉	〈New Materials〉	〈System solutions〉
NIPPON STEEL & SUMITOMO METAL CORPORATION	NIPPON STEEL & SUMIKIN ENGINEERING Co., Ltd. (NSENGI)	NIPPON STEEL & SUMIKIN CHEMICAL Co., Ltd.	NIPPON STEEL & SUMIKIN MATERIALS Co., Ltd.	NS Solutions Corporation

NSSMC	
Total Revenue	43,899 m $ (13/3A)
Capital Stock	4,195 m $ (13/3A)
Number of Employees (consolidated)	71,946 (as of 31 Mar. 2013)
Business	■The 2nd largest steel making company in the world ■Nippon Steel Corporation and Sumitomo Metal Industries Ltd. were merged in 2012

Note: Exchange rate : JPY/USD = 100.0

1.2 NSENGI Company Profile (1/4)

Company name:	NIPPON STEEL & SUMIKIN ENGINEERING Co., Ltd.
Headquarters:	1-5-1 Osaki, Shinagawa-ku, Tokyo 141-8604 Japan
Technical Center:	46-59 Nakabaru, Tobata-ku, Kitakyushu-shi, Fukuoka 804-8505 Japan
Launched	2006 (Spun off from NIPPON STEEL CORPORATION) 100 % owned by NSSMC
Representative Director and President:	Makoto Takahashi
Total Revenue: (consolidated)	3,030 m $ (13/3A)
Capital Stock:	150 m $ (as of 1 Apr. 2013)
Number of Employees: (consolidated)	4,149 (As of 1 Oct. 2012)

Note: Exchange rate : JPY/USD = 100.0

Headquarters

Technical Center

1.3 Company Profile (2/4) Business Field

Steel plants

Environmental solutions

NSENGI

Energy facilities, Civil Engineering & Marine Construction

Building Construction & Steel Structures

1.4 Company Profile (3/4)

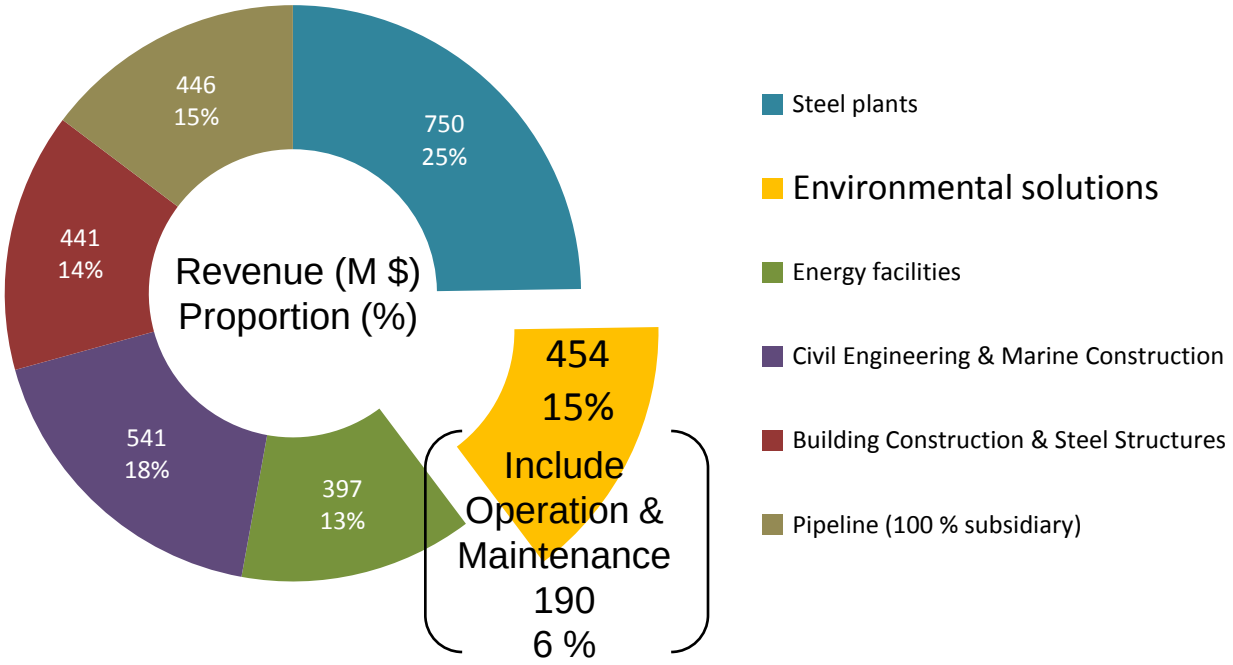
■ Total Revenue

(M $)

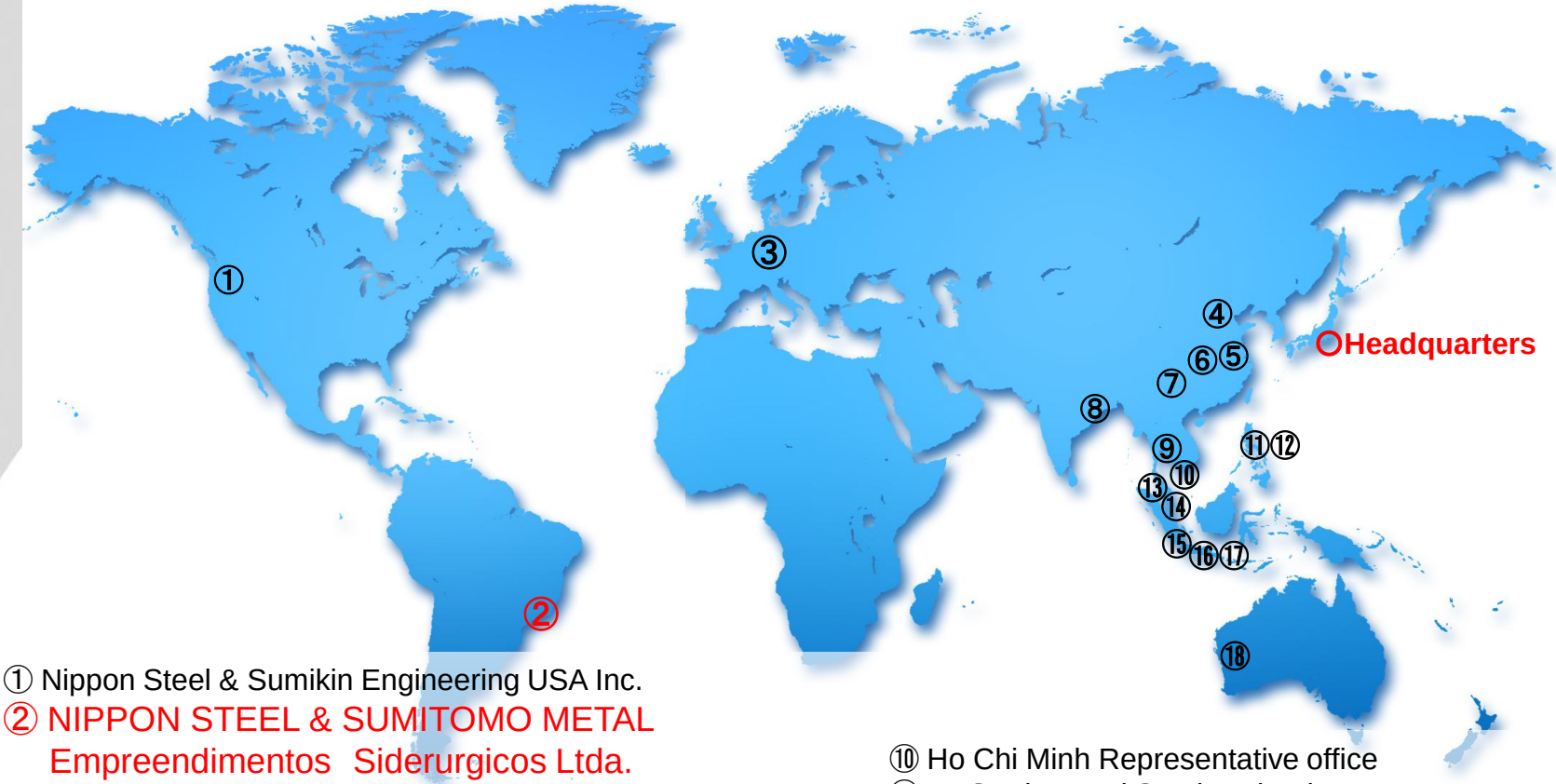
11/3A	12/3A	13/3A
2,549	2,498	3,030

Note: Exchange rate : JPY/USD = 100.0

■ Business Breakdown (13/3A)



1.5 Company Profile (4/4) NSENGI Oversea Bases



① Nippon Steel & Sumikin Engineering USA Inc.
② NIPPON STEEL & SUMITOMO METAL Empreendimentos Siderurgicos Ltda.
③ European office (Düsseldorf, Germany)
④ Beijing JC Energy & Environment Engineering Co., Ltd.
⑤ Nippon Steel & Sumikin Engineering (Shanghai) Co., Ltd.
⑥ Maanshan Sino-Japan Resource Recycling Engineering Technology Co., Ltd.
⑦ CN Steel Plant Engineering Co., Ltd.
⑧ Nippon Steel Engineering India Plant & Machinery Private Ltd.
⑨ Thai Nippon & Sumikin Engineering & Construction Corp., Ltd.
⑩ Ho Chi Minh Representative office
⑪ PNS Advanced Steel Technology, Inc.
⑫ Manila office
⑬ Nippon Steel & Sumikin Construction (M) Sdn. Bhd.
⑭ Singapore office
⑮ PT. Nippon Steel & Sumikin Batam Offshore Service
⑯ PT. Nippon Steel & Sumikin Construction Indonesia
⑰Jakarta Office
⑱Nippon Steel Engineering (Australia) Pty Ltd.

1.6 Environmental Solutions Division Business Line-up

Waste Gasification and Melting Technology (Direct Melting System (DMS))

- The world's highest number of facilities (42 orders)
- The world's largest facility capacity (230,000 t/annual)
- The world's longest-term operation (34 years)

- Gasification Recycling Facility for Waste Tyre
- Biomass Gasification / Biomass to Ethanol Technology
- Processing harmful and difficult-to-treat materials
- Soil remediation
- Sludge Drying System

(Direct Melting System / Gasifier)

2. Waste Gasification & Melting Technology

~ Direct Melting System (DMS) ~

2.1 Major Characteristics of DMS

■Promotion of a Recycling-based Society

1) Various kinds of waste can be processed via high-temperature gasification
2) High-quality slag and metal are stably produced
3) Energy and material recovery

■Low emission impact

4) Syngas combustion can minimize DXN's emission
5) Low HCl, SO_2 emission via our gasifier's process

■Proven and reliable gasification technology

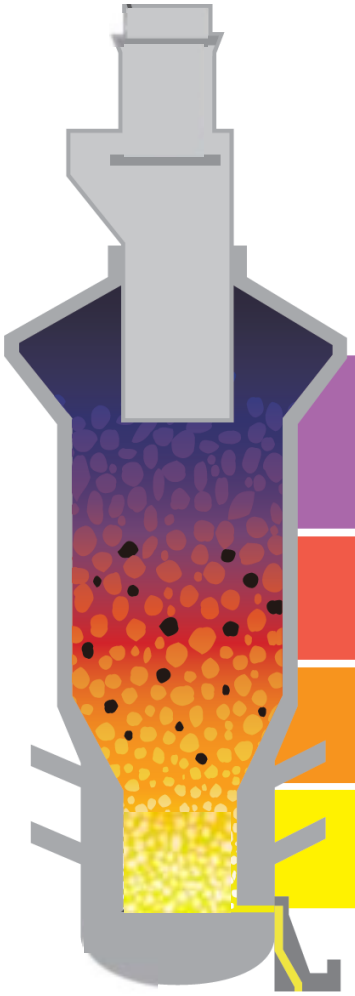
6) Reliability based on long-term operation and many references (42 plants / operated for 34 years)

2.2 Gasifier (1/2)

The Diversity of Processed Waste

- No Pre-treatment
- Simple Structure
- High Temperature & Reducing Atmosphere
- Slag and Metal Recycling

2.2 Gasifier (2/2)



Integrated gasification and melting furnace

Drying & Preheating Zone
300℃~400℃

Thermal Decomposition Zone
300℃~1000℃

Combustion Zone
1000℃~1700℃

Melting Zone
1700℃~1800℃

Slag and Metal Recycling

Slag

Metal

Asphalt paving

iron industry

Marine block

Counterweight

2.3 Comparison of DMS and Grate System

	Direct Melting System	Grate System
Process		 (Source: FBE HP)
Temperature	1,700 – 1,800 ℃	800 – 900 ℃
Residue Recycling	High Quality of Slag and Metal No Limitation for Recycling	Intermediate (Contains Toxic Heavy Metals) Limitation
Volume Reduction	< 1 %	25 – 30 %
Combustion	Syngas Combustion	Solid Combustion

2.4 Process Flow

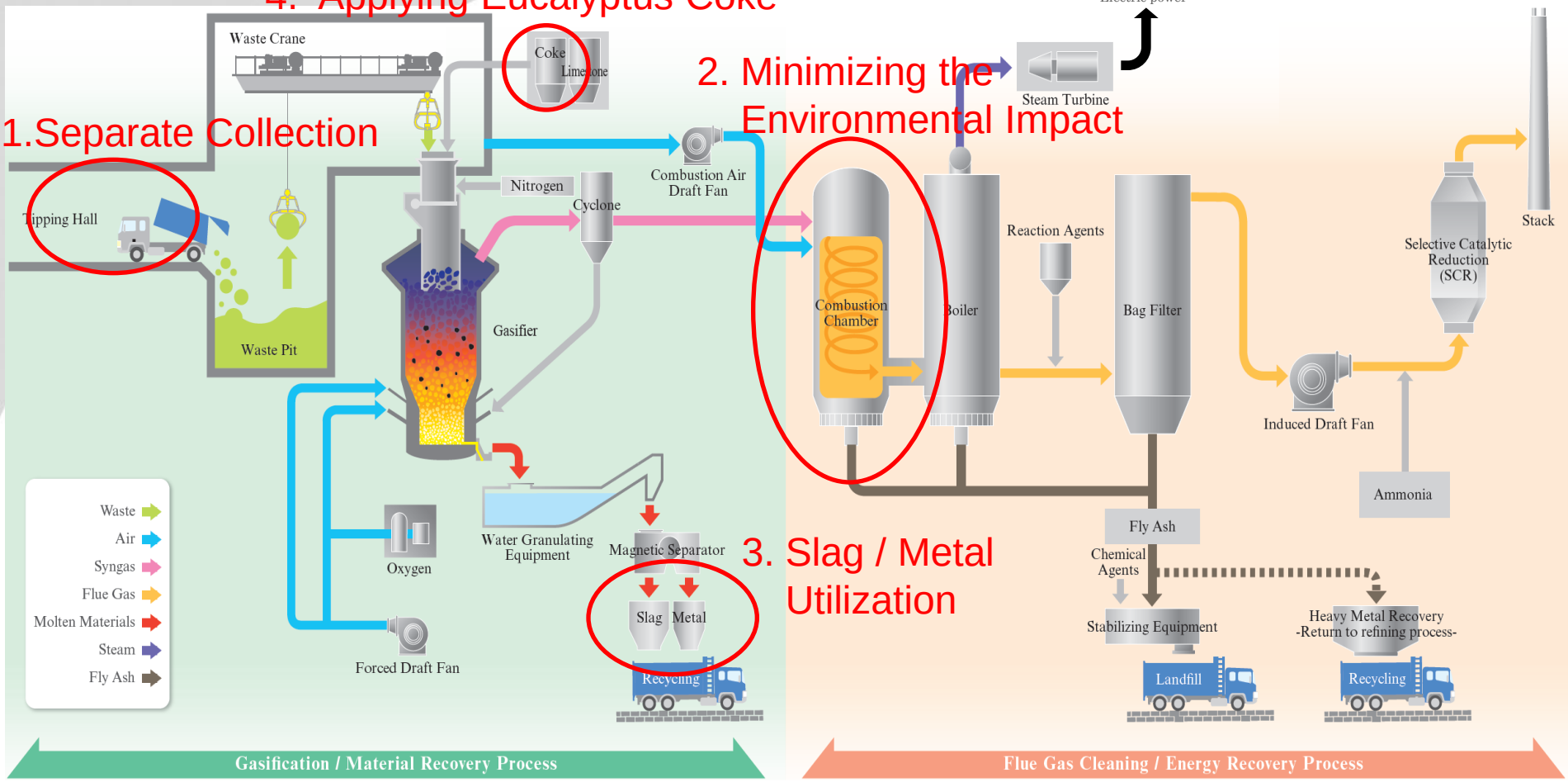
- Deriving Energy and Materials from Waste -

4. Applying Eucalyptus Coke

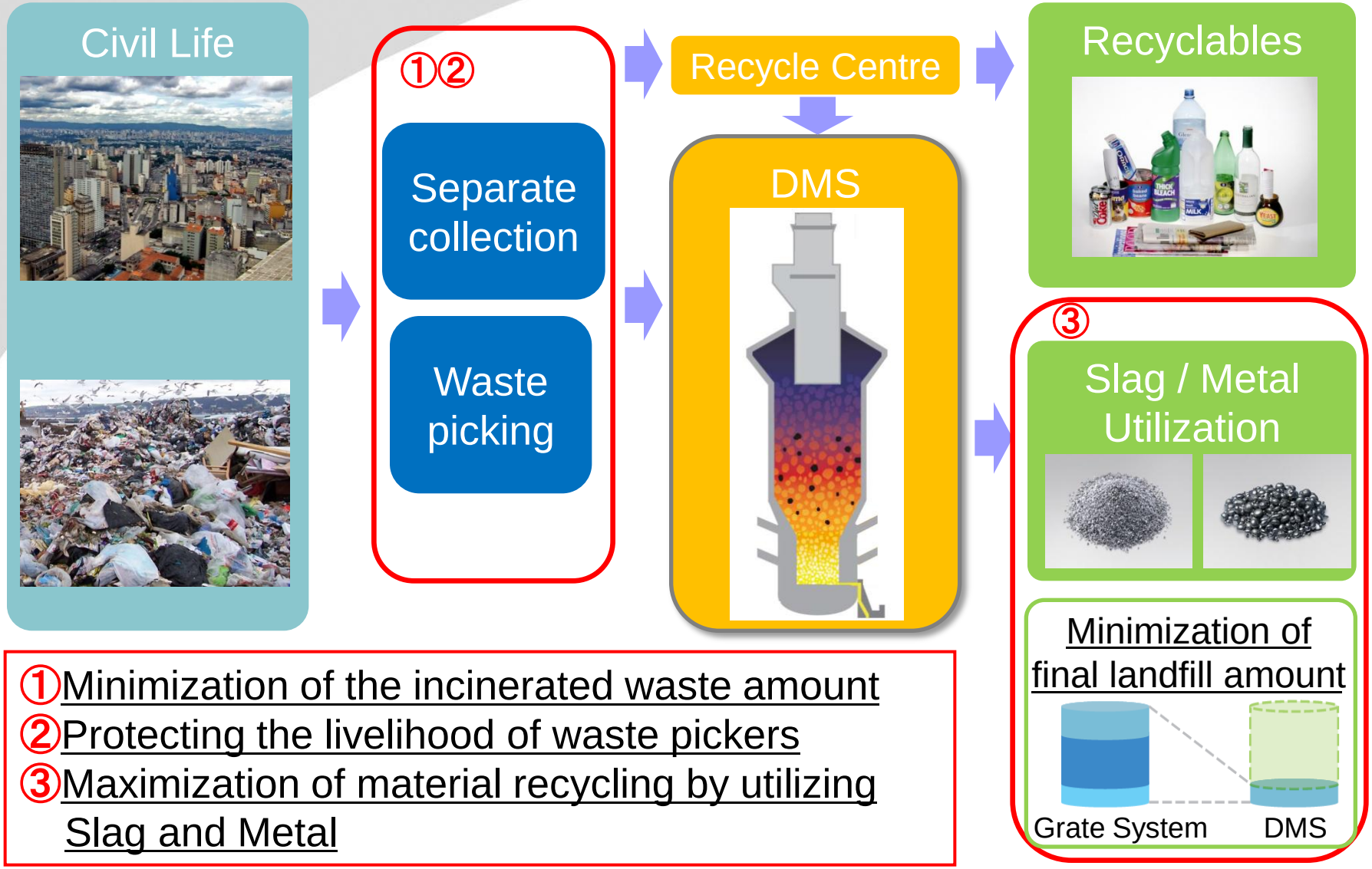
1.Separate Collection

2. Minimizing the Environmental Impact

3. Slag / Metal Utilization



2.5 An Image of Social System of The Waste Treatment

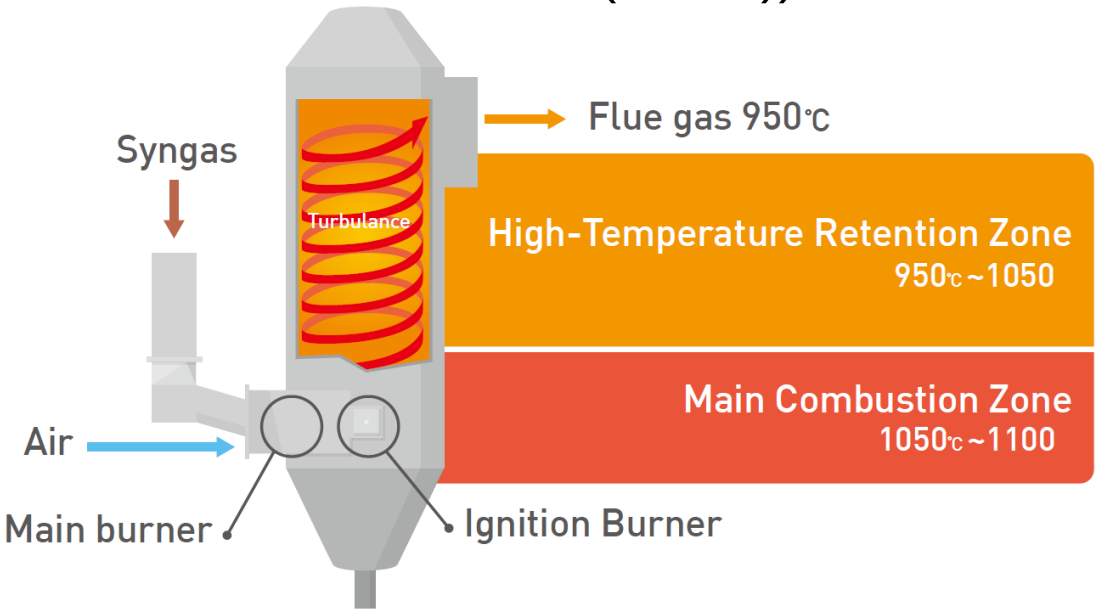


①Minimization of the incinerated waste amount
②Protecting the livelihood of waste pickers
③Maximization of material recycling by utilizing Slag and Metal

2.6 Dioxins & NO_x Reduction

■Dioxins & NO_x Reduction (Simple Combustion Control)

- Combustible dust discharged from the gasifier is captured by a cyclone.
  → Sygnas contains few dusts.
- The DMS employs an Independent Combustion Chamber, which can achieve Gas-Gas Combustion (homogeneous combustion) and reduce Dioxins emissions.
- 3T (Temperature, Turbulence, Time (>2sec))



2.7 Flue Gas Compositions (1/2)

■ Flue Gas Compositions

Limestone injection, which helps the adjustment of slag fluidity and viscosity, can lead to lower hydrogen chloride level in the flue gas.

Limesotone consists of $CaCO_3$ and reacts with hydrogen chloride as shown below:

$$CaCO_3 \rightarrow CaO + CO_2$$
$$CaO + 2HCl \rightarrow CaCl_2 + H_2O$$

2.7 Flue Gas Compositions (2/2)

Due to this chemical reaction, the concentration of hydrogen chloride at the inlet of the boiler is much lower than that of incinerators.

		DMS	MSW incinerators
Dust	g/m^3N	3	5
NO_x	mg/m^3N	200	250~300
HCl	mg/m^3N	300~400	600~1000
SO_2	mg/m^3N	30~100	100~300

■Removal of Dioxins

- Activated carbon is injected into the gas flow. The activated carbon shows a high adsorption efficiency for mercury as well as for Dioxins. SCR destroys gaseous Dioxins through catalytic oxidation.

2.8 Slag / Metal Utilization

■Slag Utilization

Slag is 100 % recycled into components for interlocking blocks, concrete blocks, and asphalt pavements.


Concrete blocks


Asphalt paving


Marine block

■Metal Utilization

Metal is 100 % recycled and used in various industries, such as metallurgical and heavy machinery industry.

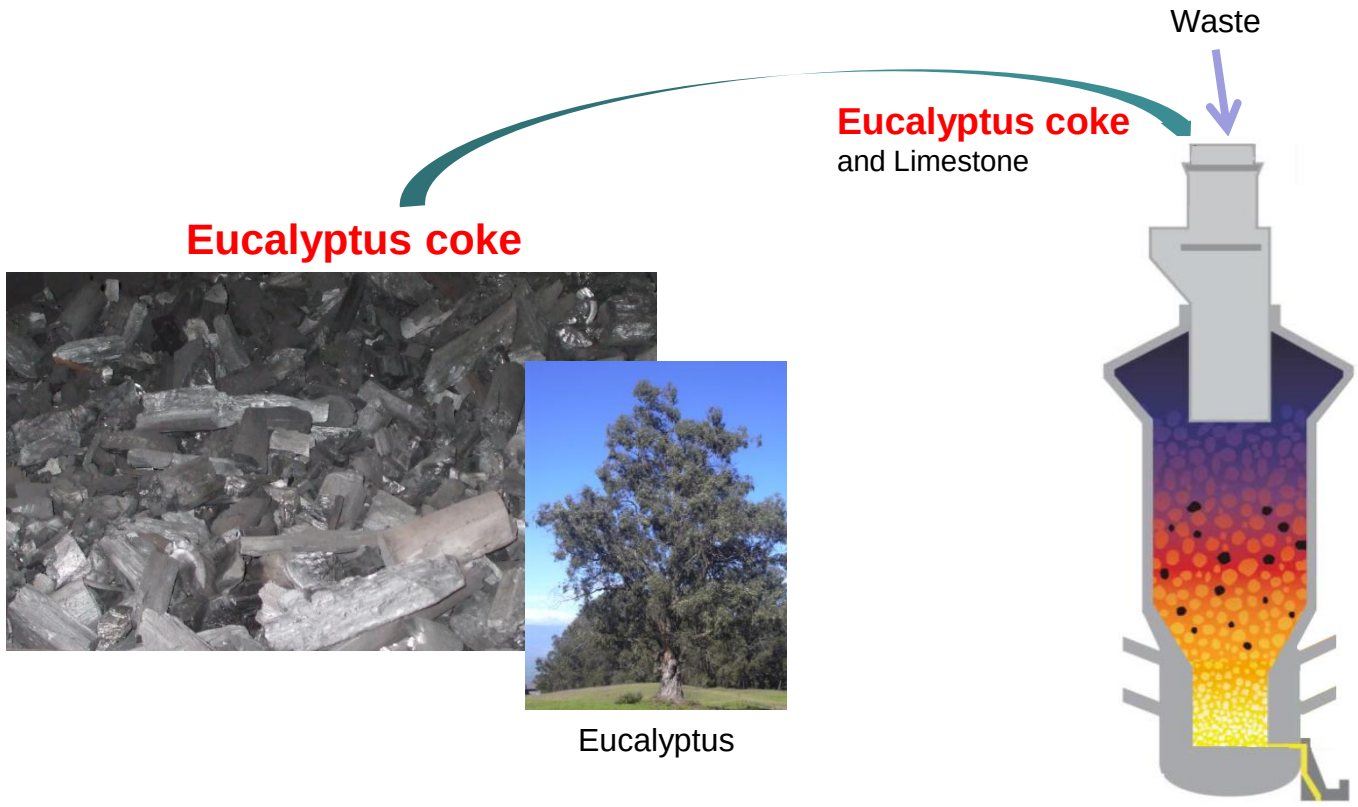

Iron industry


Materials for non-ferrous metals industry


Counterweight

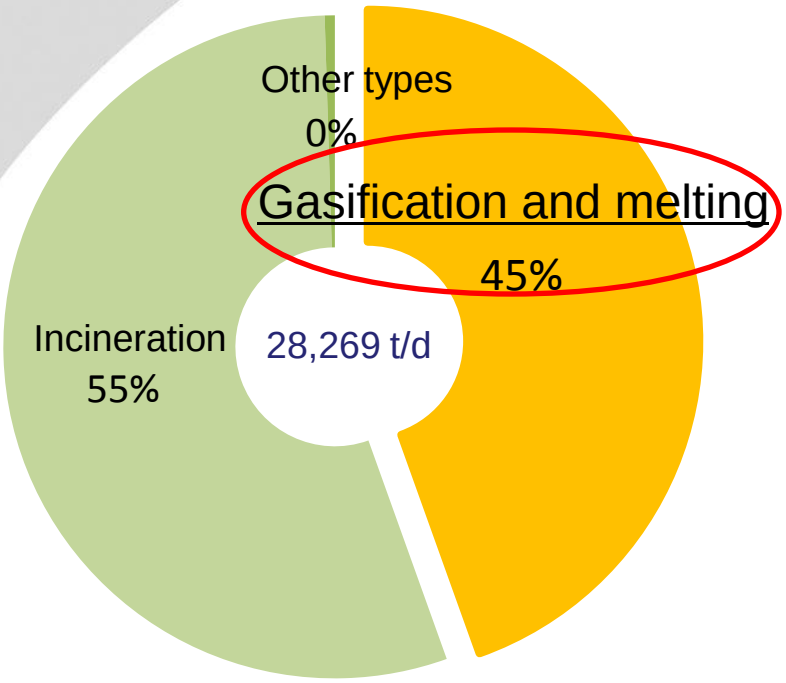
2.9 Applying Eucalyptus Coke ~ environmentally friendly ~

- Eucalyptus coke is expected to substitute coke.
- Unlike regular coke, eucalyptus coke is carbon neutral.
- The usage of eucalyptus coke will allow the DMS to operate without emitting Greenhouse Gas (e.g. CO_2) from fossil fuel.

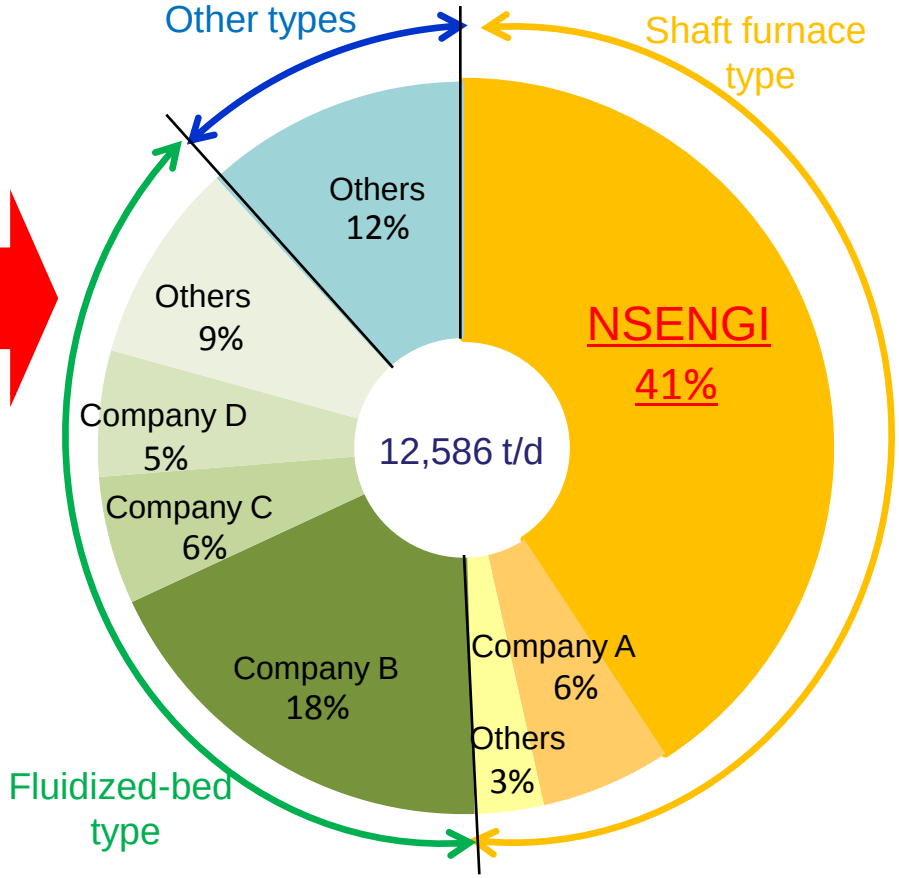


2.10 Market share of Energy from Waste (EfW) in Japan from 2003～2012

EfW market share



NSENGI's position in the G&M market



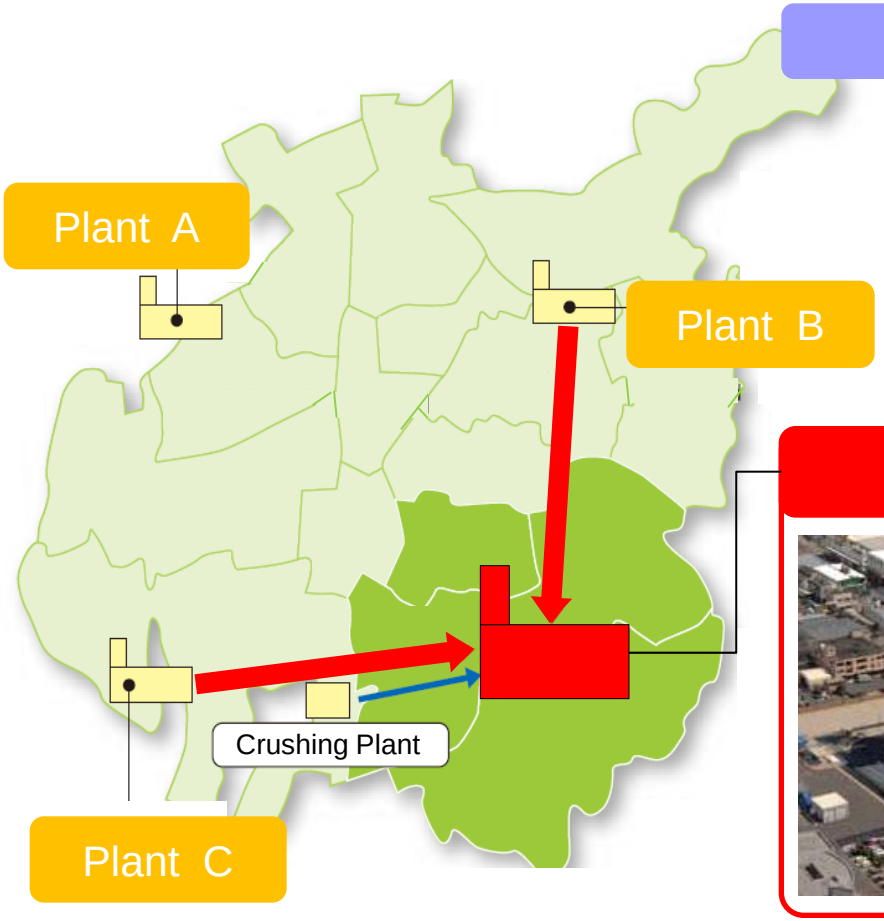
Source : NSENGI's Company Research

2.11 Shin-moji plant – the world's largest gasification plant

Completion	April 2007
Capacity	10 t/h X 3 lines (230,000 t/annual≒720 t/day)
Processing Waste	Municipal Solid Waste, Incombustibles, Sewage sludge
Power Generation	23.5 MW_{Gross}

2.12 Waste treatment flow of Nagoya City

Nagoya city (Population : 2.3 million)



Waste treatment flow

Municipal Solid Waste

Other Waste Treatment Plants
(Grate system / Crushing)

Incineration Residues
Incombustibles

Narumi Plant (DMS)

Capacity :
- 11.0 t/h, 2 lines (530 t/d)

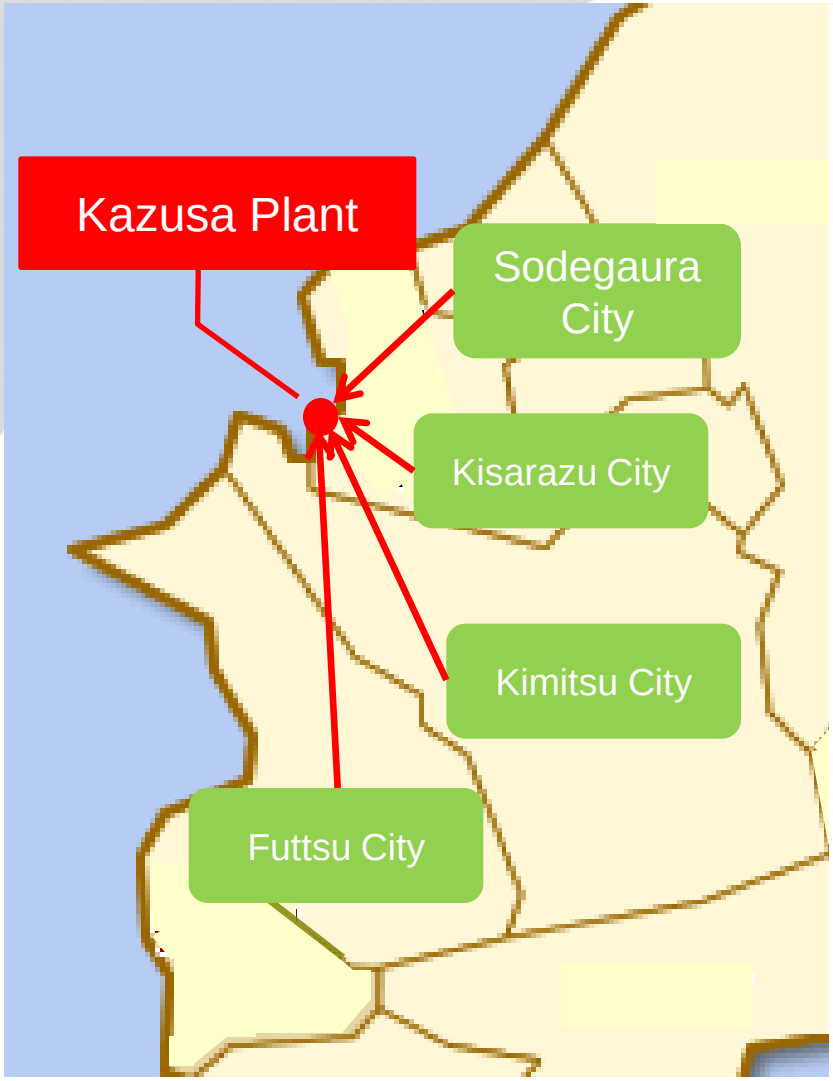
Gross Power Generation :
- 9,000 kW

Start of operation :
- Jul. 2009

Minimization of final landfill amount

2.13 Waste treatment flow of western part of Chiba Prefecture

Western part of Chiba Prefecture



4 municipalities
(Population : 0.3 million)

Incombustible residues
Sewage sludge
Incineration residues

Kazusa Plant (DMS)

Capacity :
- 4.2 t/h, 2 lines (200 t/d)
- 5.2 t/h, 2 lines (250 t/d)

Gross Power Generation :
- 3,000 kW
- 5,000 kW

Start of operation :
- Apr. 2002
- Mar. 2006

Minimization of final landfill amount

Obrigado