



# DIRECT MELTING SYSTEM

Waste Gasification Technology for Energy and Material Recovery

## NIPPON STEEL ENGINEERING CO., LTD.

### Headquarters

Osaki Center Building, 1-5-1 Osaki, Shinagawa-ku,  
Tokyo 141-8604 Japan  
TEL : +81-3-6665-2810  
<http://www.eng.nipponsteel.com/english/>

### Kitakyushu Technology Center

46-59, Nakabaru, Tobata-ku, Kitakyushu-shi,  
Fukuoka 804-8505 Japan  
TEL : +81-93-588-7181

### Nippon Steel Engineering India Private Limited

2nd Floor, Salcon Rasvilas, Saket District Centre, New Delhi, 110017 India  
TEL : +91-11-4947-8965/8900

### PNS CONSTRUCTION, INC.

10th floor, Salcedo Tower A, 169 H.V. Dela Costa Street, Salcedo Village Brgy.  
Bel Air, Makati City 1209 Philippines  
TEL : +63-2-8893-6756

### Bangkok Representative Office

909, Ample Tower 5th floor, Debaratna road, North-Bangna, Bangna,  
Bangkok, 10260 Thailand  
TEL : +66-2-744-1702

### Ho Chi Minh Representative Office

Room 712, 7th Floor, Sun Wah Tower, 115 Nguyen Hue Blvd, District 1 HCMC, Vietnam  
TEL : +84-28-3827-8064

### Jakarta Representative Office

Sentral Senayan II 201-2C Ground & Mezzanine Floor, Jl. Asia Afrika No. 8,  
Gelora Bung Karno - Senayan, Jakarta Pusat 10270 Indonesia  
TEL : +62-21-2903-6726

# Creating a Better Society for the Next Generation

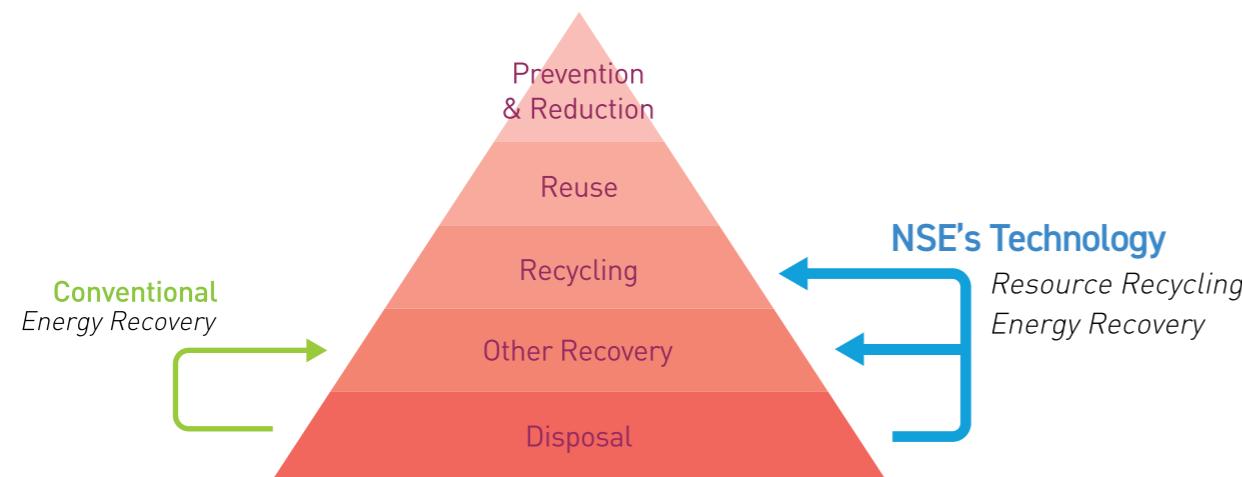
As the world progresses towards modernization, environmental issues such as the recycling of waste and the conservation of energy, have become a global theme.

We, the engineers and professionals at NIPPON STEEL ENGINEERING CO.,LTD.(NSE), are able to respond to such issues by using our latest technologies, supported by our unmatched knowledge acquired through years of experience.



## Gasification as an Alternative Waste to Energy

Waste gasification is recognized as an alternative thermal treatment technology. NSE's gasification and melting technology is a proven waste gasification technology based on more than 34 years of operating experience.



Waste hierarchy is a classification of waste management in order to minimize environmental impact; this hierarchy has been widely introduced across the globe. Waste to Energy technology is classified as "Other Recovery". NSE's technology can contribute to minimizing "Disposal" and maximizing "Recycling" in addition to "Other Recovery".

## Our Principle

NSE's gasification technology consists of four main concepts.

### Stability

A variety of waste is processed and converted to recyclables.

### Purity

Cleansed gas is discharged from the facility.

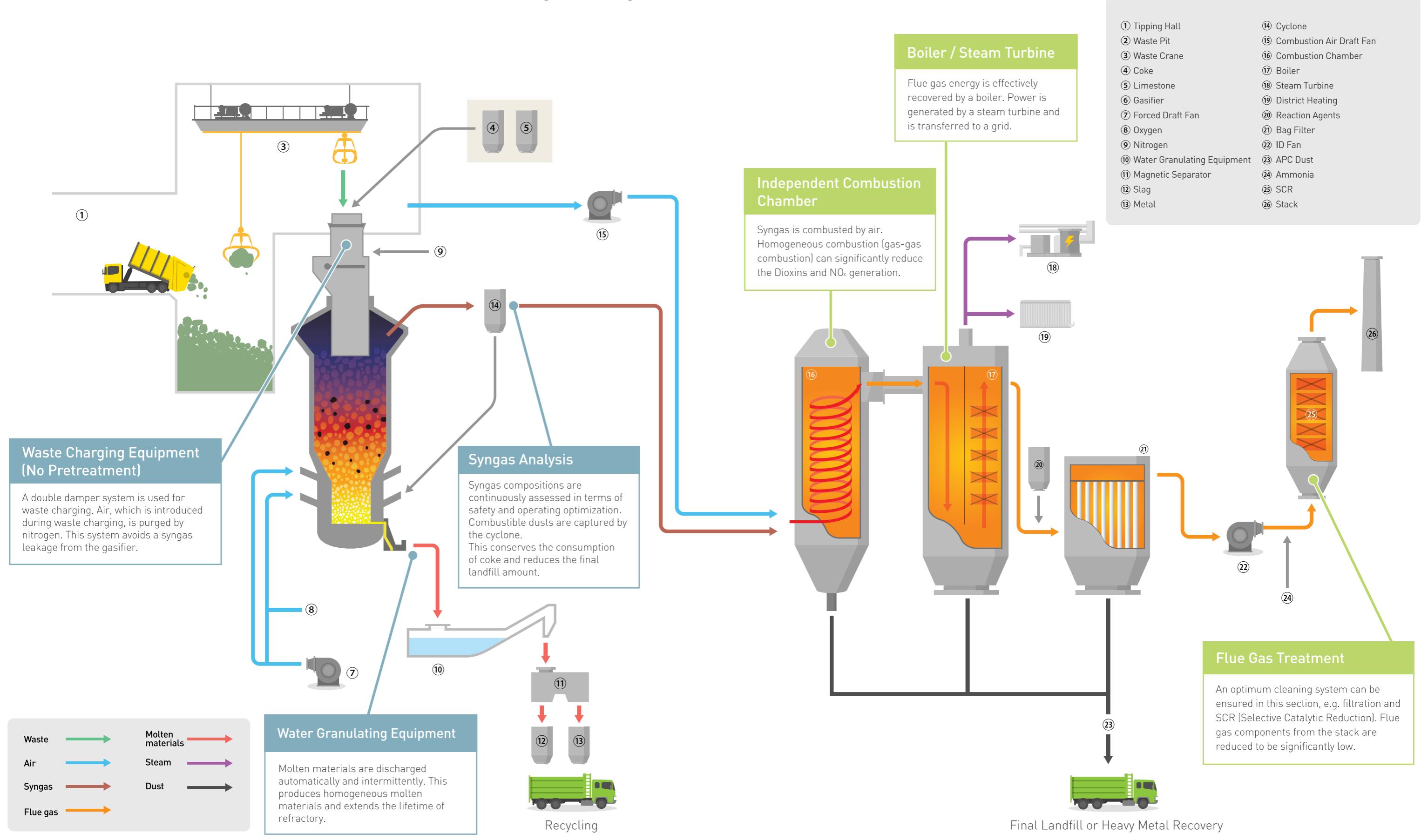
### Sustainability

Energy and recyclables from waste contribute to a recycle-based society.

### Reliability

Long-term operation and maintenance lead the way for technical innovation.

# DIRECT MELTING SYSTEM - Deriving Energy and Materials from Waste -



Gasification / Material Recovery Process

Flue Gas Treatment / Energy Recovery Process

# Stability

A variety of waste is processed and converted to recyclables.

## Minimize “Disposal” and Maximize “Recycling” via Co-Gasification

### Stable Waste Processing

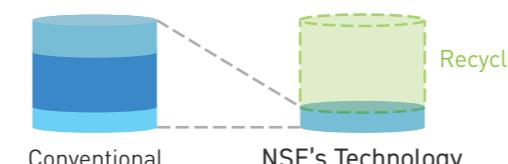
Processed waste is gradually gasified in a packed-bed which can homogenize flue gas quantities regardless of the processed waste compositions. No pretreatments such as drying, sorting or crashing are required.

### High-Temperature Gasification

Able to process a variety of waste and produce high-quality slag and metal.

### Minimizing Final Landfill

A high-temperature reducing atmosphere volatilizes toxic heavy metals such as lead and zinc, and produces high-quality slag and metal, which can be completely recycled. In addition to slag and metal recycling, recycling fly ash leads to “Zero Waste”.



Final Landfill Amount



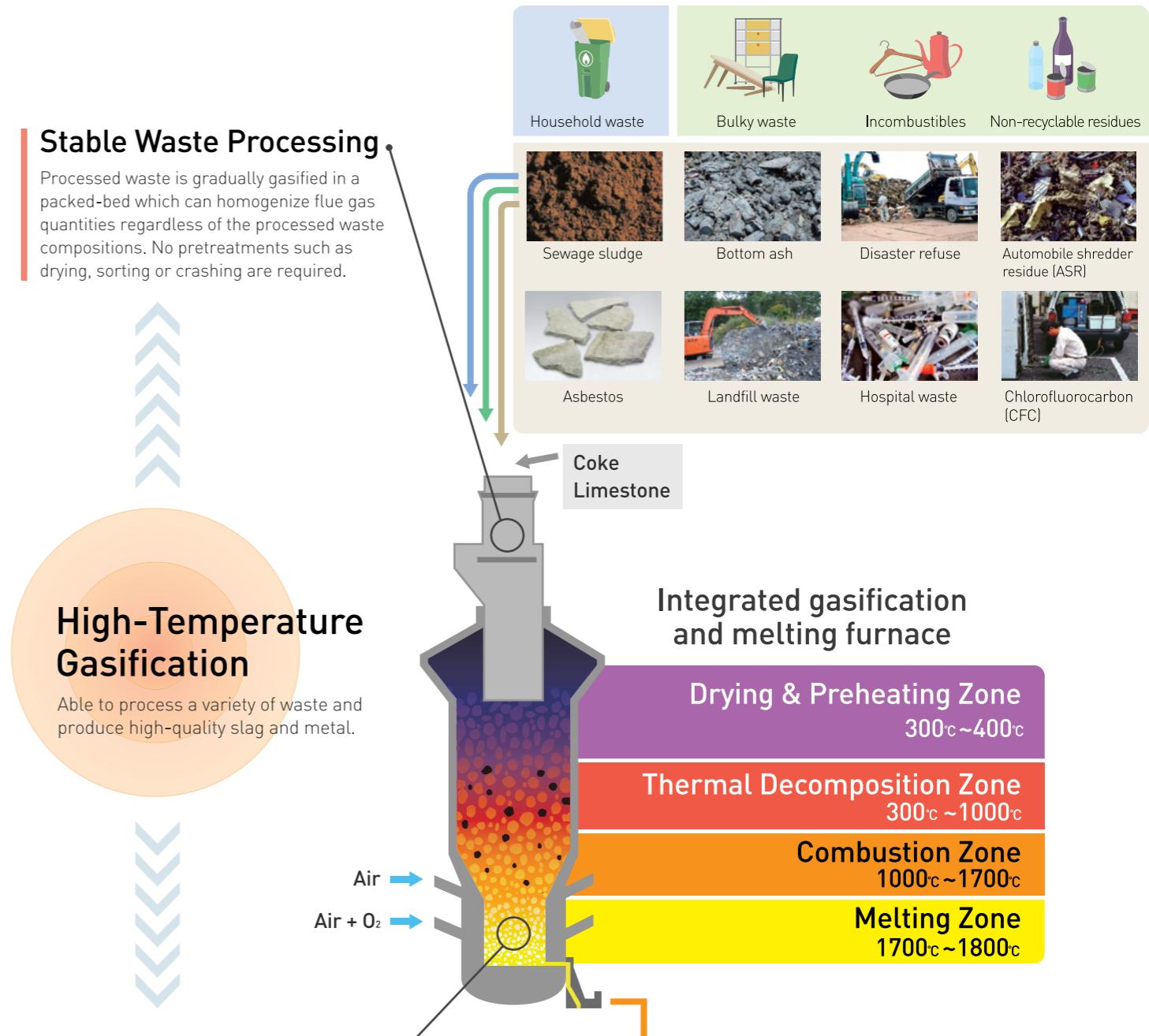
### Integrated gasification and melting furnace

Drying & Preheating Zone  
300°C ~ 400°C

Thermal Decomposition Zone  
300°C ~ 1000°C

Combustion Zone  
1000°C ~ 1700°C

Melting Zone  
1700°C ~ 1800°C



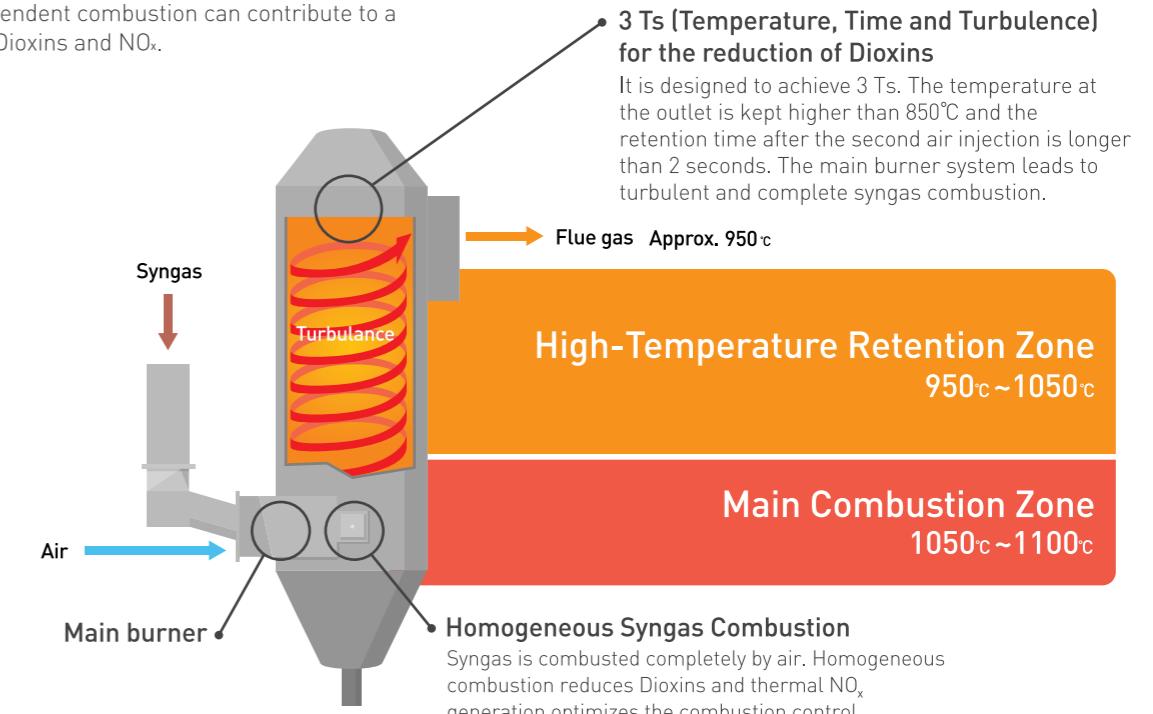
# Purity

Cleaned gas is discharged from the facility.

## Complete Syngas Combustion and Significant Reduction of Dioxins

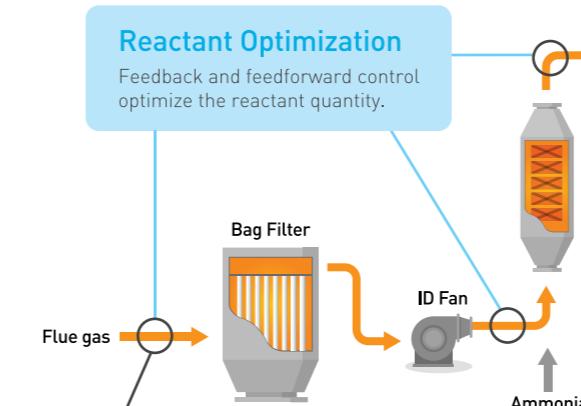
### Independent Combustion Chamber

Syngas independent combustion can contribute to a reduction of Dioxins and NO<sub>x</sub>.



### Flue Gas Treatment

Optimization of flue gas treatment can minimize the environmental impact.



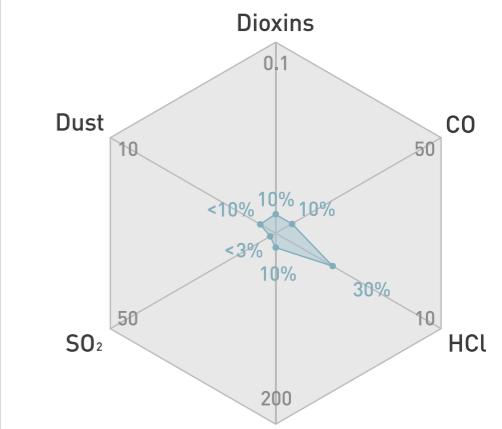
#### Lower Environmental Impact

Lower flue gas components are discharged from the thermal unit. Limestone injection in the gasifier can lead to lower HCl and SO<sub>2</sub> emissions in the flue gas. Limestone reacts with HCl and SO<sub>2</sub> to reduce emissions.

#### Lower Emissions

Emissions are significantly lower than the EU regulation limit.

European Regulation  
Our Reference Result



#### Examples

Inlet of BF	NSE's Technology
Dust	g/m <sup>3</sup> N
NO <sub>x</sub>	mg/m <sup>3</sup> N
HCl	mg/m <sup>3</sup> N
SO <sub>2</sub>	mg/m <sup>3</sup> N
Dioxins	ng-TEQ/m <sup>3</sup> N

(Depending on the waste compositions)

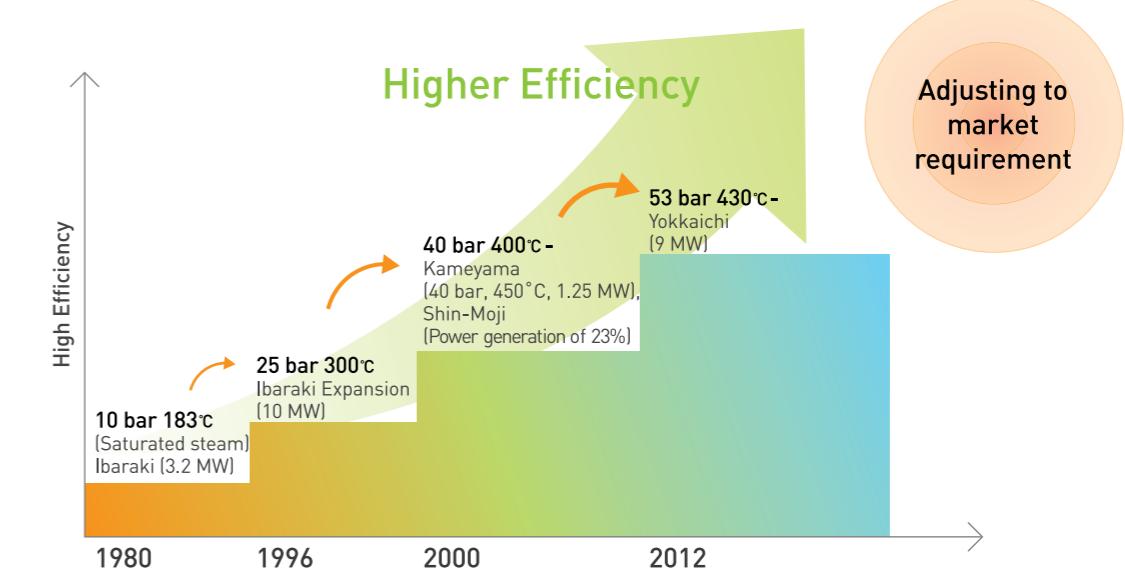
# Sustainability >>

Energy and recyclables from waste contribute to a recycle-based society

## Contribution to a "Recycle-Based Society"

### Energy from Waste

Power generation is the most important issue in Energy from Waste plants. NSE has developed state-of-the-art and highly efficient plants in Japan where the main priority of waste processing is volume reduction. NSE has been improving its boiler and power generation system in line with market demand.



### Materials from Waste

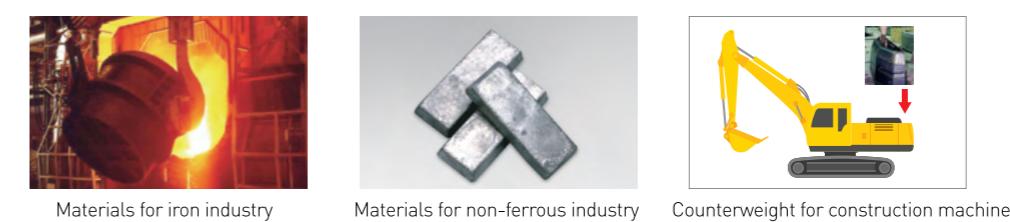
High-temperature gasification produces high-quality slag and metal. The produced slag is almost the same quality as natural sand. Slag can not only be recycled for secondary construction materials, but also for agricultural use.

#### Slag Recycling



(JIS-K0058-2)

#### Metal Recycling



# Reliability

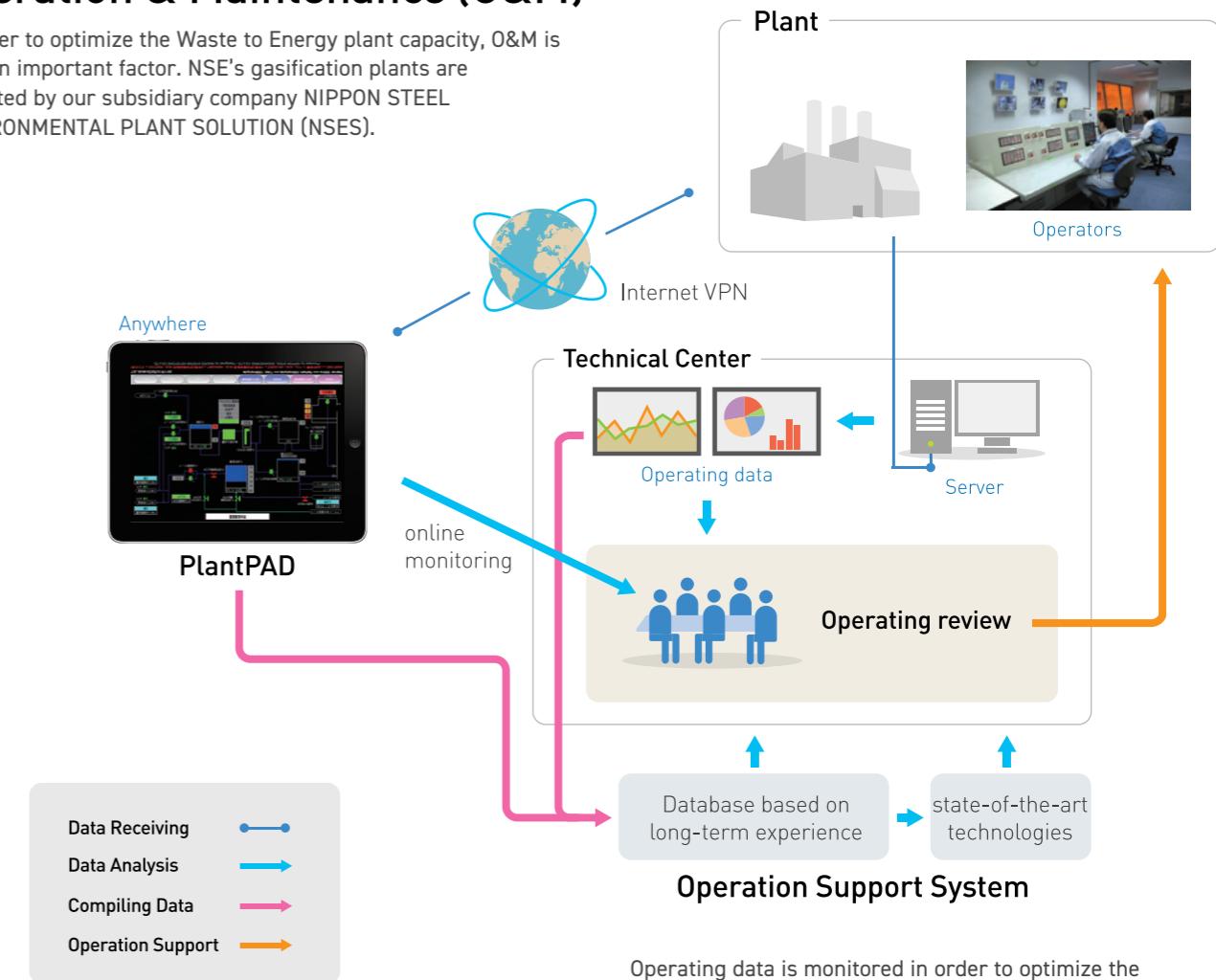
Long-term operation and maintenance lead the way for technical innovation



## Confidence Confirmed by Long-Term Operation and Development

### Operation & Maintenance (O&M)

In order to optimize the Waste to Energy plant capacity, O&M is also an important factor. NSE's gasification plants are operated by our subsidiary company NIPPON STEEL ENVIRONMENTAL PLANT SOLUTION (NSES).



Operating data is monitored in order to optimize the operating conditions. Unexpected trouble can be solved through optimum operation support. Long-term operating experiences can help develop new technologies. in addition, online monitoring can be conducted using the smart tablet developed by NSE (PlantPAD)

### Research & Development (R&D)

Gasification pilot plants are located in NSE's technical center in Japan. Fundamental areas of research, new technical applications, and operating optimization methods have been explored. Biomass-coke, for example, has been developed to reduce greenhouse gas emissions.



# Reference Plants

The Direct Melting System has been operating for more than a generation.  
Over 40 plants have been employed and operated continuously.

## Shin-Moji Plant



Largest gasification plant with high power generation efficiency.

Capacity :  
10.0 t/h, 3 lines(720 t/d)

Gross Power Generation :  
23,500 kW

Start of operation :  
Apr. 2007

Waste to be treated :  
1) Municipal Solid Waste  
2) Incombustibles  
3) Sewage Sludge

## Kamaishi Plant



Capacity :  
2.3 t/h, 2 lines(109 t/d)

Start of operation :  
Sep. 1979

Gross Power Generation :  
District Heating

Waste to be treated :  
1) Municipal Solid Waste  
2) Incombustibles  
3) CFC Gas

After 32 years of operation, NSE's first plant was replaced with the "Iwate Plant" nearby. Although it was shut down, it started operating again to process waste from the aftermath of the Tohoku earthquake and tsunami.

## Ibaraki Plant



Capacity :  
6.3 t/h, 3 lines(450 t/d)  
6.3 t/h, 2 lines(300 t/d)  
Renewed(150 t/d)

Start of operation :  
Aug. 1980 Apr. 1999

Gross Power Generation :  
10,000 kW

Waste to be treated :  
1) Municipal Solid Waste  
2) Incombustibles

The first 3 lines were shut down after expansion (1996) and replacement (1999)

## Kazusa Plant



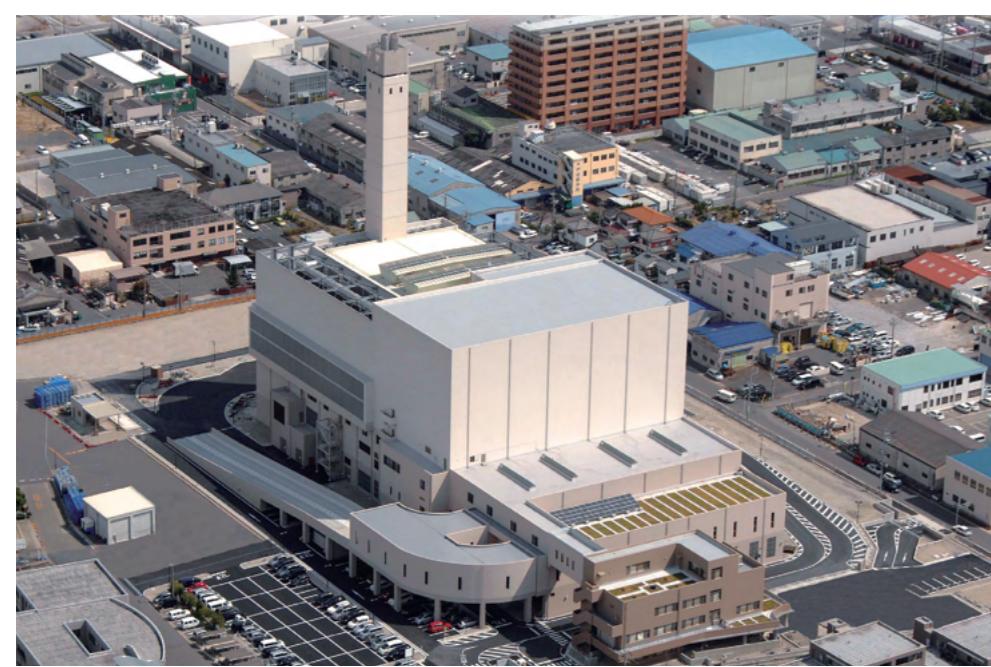
Capacity :  
4.2 t/h, 2 lines(200 t/d)  
5.2 t/h, 2 lines(250 t/d)

Start of operation :  
Apr. 2002 Mar. 2006

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

Waste to be treated :  
1) Municipal Solid Waste  
2) Incombustibles  
3) Sewage Sludge  
4) Incineration Residues

## Narumi Plant



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

Gross Power Generation :  
9,000 kW

Start of operation :  
Jul. 2009

Waste to be treated :  
1) Municipal Solid Waste  
2) Incombustibles  
3) Incineration Residues

## Akita Plant



Capacity :  
9.6 t/h, 2 lines(460 t/d)  
\*Increased from 200 t/d  
1 line to 230 t/d

Start of operation :  
Apr. 2002 Apr. 2012

Gross Power Generation :  
8,500 kW

Waste to be treated :  
1) Municipal Solid Waste  
2) Incombustibles  
3) Incineration Residues  
4) Sewage Sludge

## Himeji Plant



Capacity :  
5.6 t/h, 3 lines(402 t/d)

Start of operation :  
Apr. 2010

Gross Power Generation :  
10,500 kW

Waste to be treated :  
1) Municipal Solid Waste