

Present Status of Zero-Waste Technology Development and Examples of Public-Private Partnership

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1. Introduction of Technology

2. Significance of Public-Private Partnership : Examples

3. Implications for Green Economy

- *GS Platech, the daughter company of GS Caltex - Korea oil refinery and energy company, has originally developed key technologies of Plasma Gasification & Vitrification*

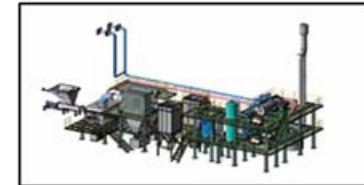
History

- 2001 : Founded
- 2008 : Completion of Cheongsong MSW⁽¹⁾ Plasma Plant and Verified from Korean Government
- 2011 : Building 100 ton/d Plasma Plant (it will be completed in Mar. 2012)



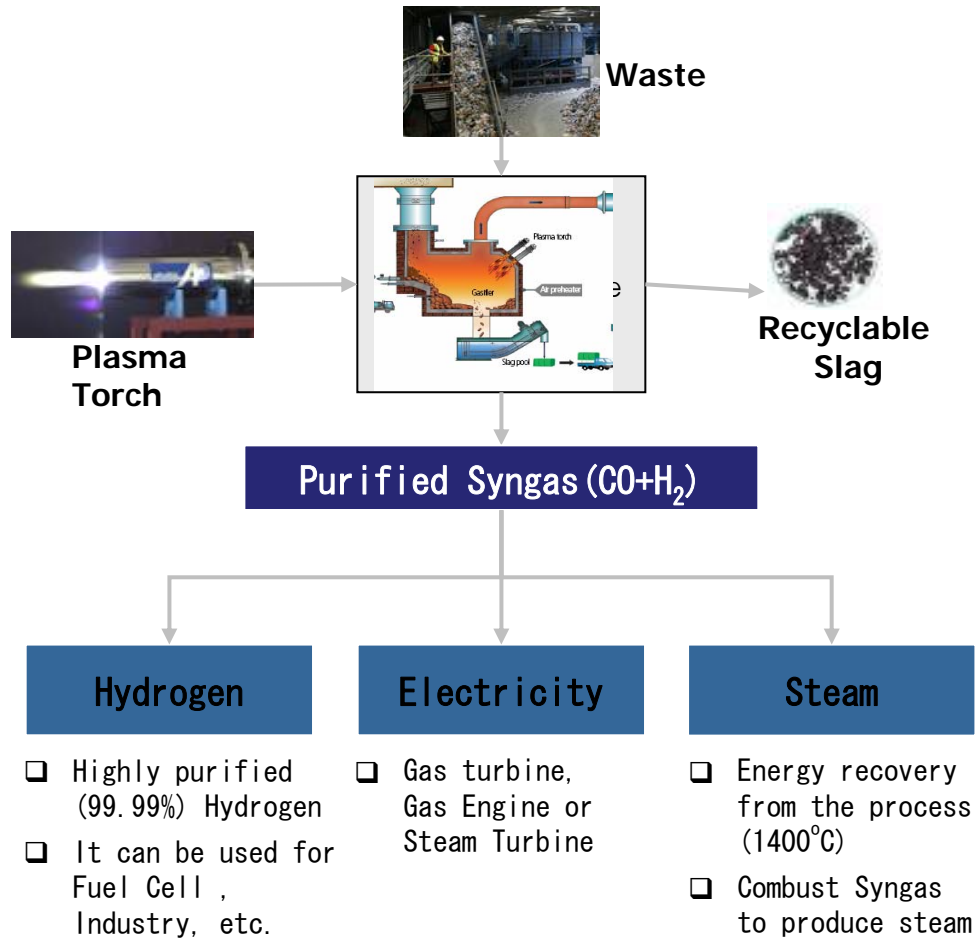
Key Technologies

- **Developing & Manufacturing Plasma Torch :**
 - Easy and stable operation
 - Long electrode lifetime
 - Flexible various medium
- **Design Plasma Gasification & Vitrification system**
 - Very high temperature (over 1,400°C)
 - Feed flexibility
 - Compact system
 - Much less pollutants than conventional incineration
- **Operation & Maintenance**
 - Total management service for Plasma plant



(1) Municipal Solid Waste

○ *GS Platech's Plasma Gasification & Vitrification can realize zero-waste technology by converting all types of wastes into clean syngas and recyclable slag*

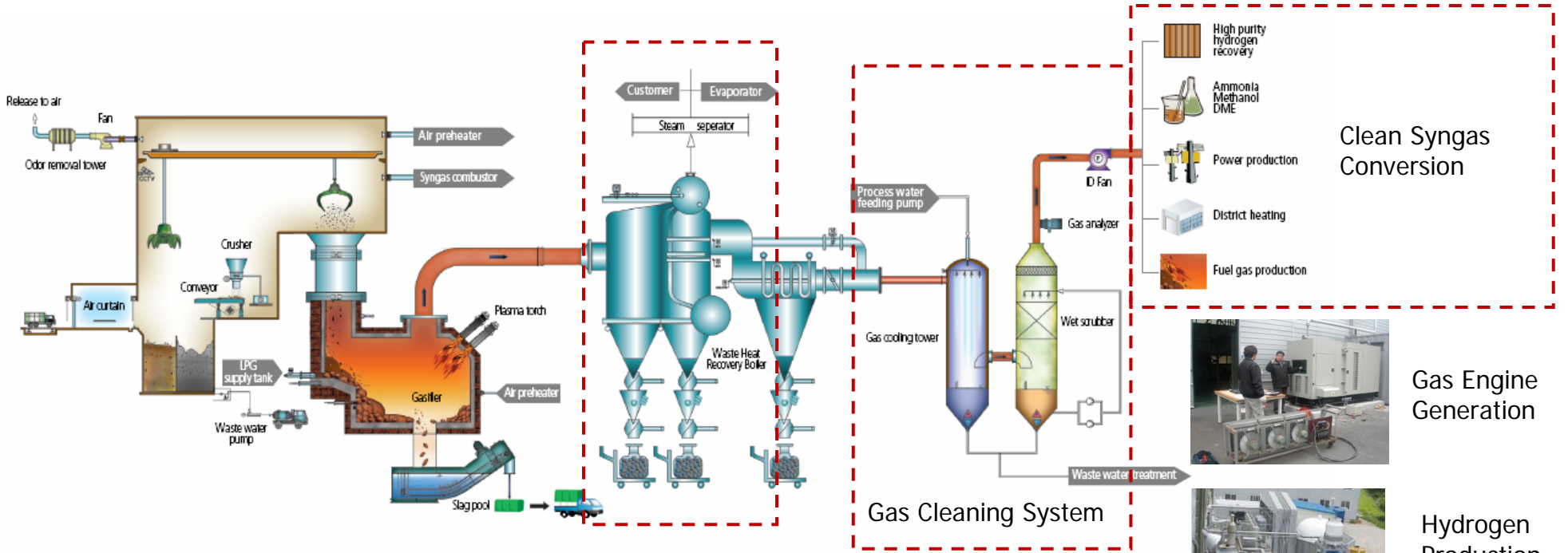


Features

- ❑ **High Economics throughout the process**
 - Overall energy recovery ratio excels other technologies (Over 80%)
- ❑ **Variety of Products**
 - The system can produce steam, electricity, hydrogen as customer's needs
- ❑ **Environmental Friendliness**
 - Emission level of NO_x, SO_x, Dioxin is much below the emission limit
 - Fly ash and heavy metal are vitrified and discharged into the solid slag
- ❑ **Variety of Feeds**
 - From normal MSW to low-quality Coal, Oil-well waste and even Radioactive waste

Energy Recovery from wastes

○ *Clean Syngas from waste can be easily converted into various forms of energy : heat, electricity by gas engine and fuel cell, Hydrogen and SynFuels*



Plasma Torch :
2 ~ 5% electricity usage
of Waste energy

Heat Recovery(Steam)

More than 75% of energy in waste can be recovered from this process



Gas Engine Generation



Hydrogen Production



Fuel Cell Generation

- Air pollutants such as SO_x, NO_x, Dioxin are suppressed at high temperature with reducing atmosphere, so they are easily controlled by simple equipments.

Composition of Effluent Gases at the Stack

Items	GS Platech Cheongsong 10 TPD	Emission Limit	
		Below 48TPD	Over 48TPD
Dioxin/Furan (ngTEQ/m ³)	0.016	1	0.1
NO _x (ppm)	18	100(12)	70(12)
SO _x (ppm)	6	70(12)	30(12)
CO(ppm)	5	200(12)	50(12)
HCL(ppm)	0.38	20(12)	20(12)
Dust(mg/Sm ³)	0.43	40(12)	20(12)
Smoke	0	Below 2	Below 2
Phenol Compound (ppm)	0.9	10	10

- ❑ Results from plant operation in Choengsong
- ❑ Only wet Scrubber is operating in Choengsong plant.
- ❑ NO_x, SO_x, Dioxins elimination facilities are not equipped.

Suppression of Dioxin reformation

- Dioxins/Furans and their precursors are effectively destroyed at 1,400°C
- Reducing condition hinders the DECON reaction(HCl → Cl₂)
- After dust removal, even precursors and Cl₂ exist, dioxins can't be reformed

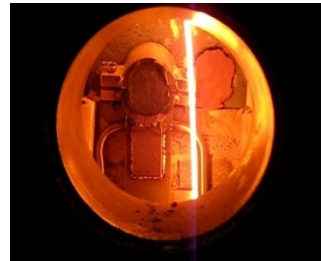
Suppression of NO_x/SO_x generation

- Plasma torch produces % level NO_x
- ~ 100 ppm fuel NO_x from waste
- NO_x, SO_x are eliminated quickly at 1,400°C~1,500°C reducing condition

○ *No need to landfill, and all inorganics in waste can be converted into recyclable slag*



Inorganics in Waste



Recycled aggregate

No need to landfill

Heavy metal leaching test result

Item	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Average
Pb (mg/L)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Cd (mg/L)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
As (mg/L)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Cu (mg/L)	N.D.	N.D.	N.D.	N.D.	0.05	N.D.
Hg (mg/L)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Cr⁶⁺ (mg/L)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.



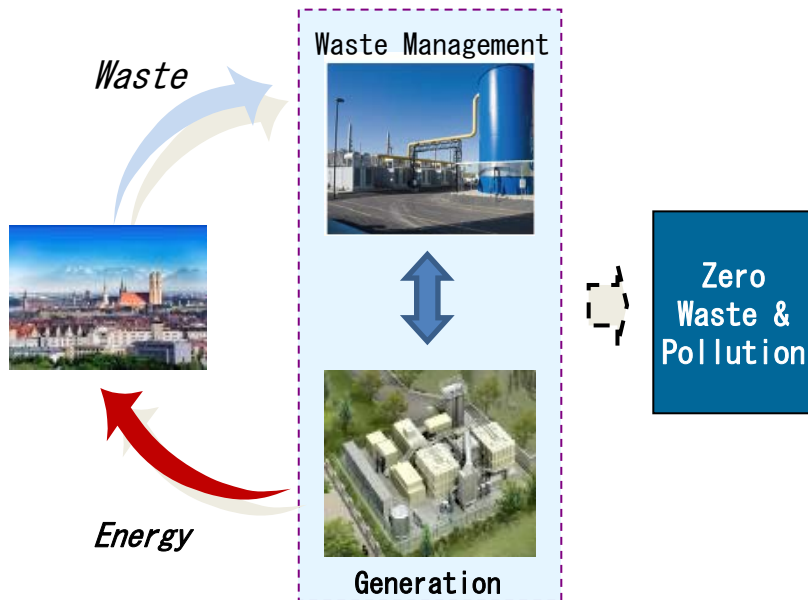
No need to landfill unlike incineration

→ It helps realizing Zero Waste Technology

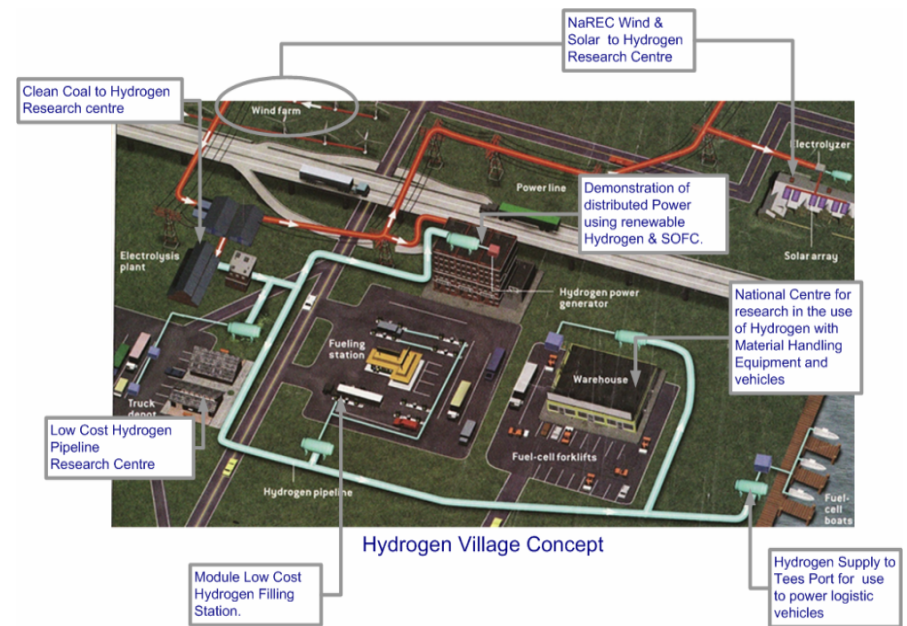
※ REMARKS : Officially measured and analyzed by Authorized Agency and certified from Ministry of Environment, Korea.

○ *GS Platech is continuously developing technologies for waste to energy and tries to build Green City which will realize Zero Waste & Pollution*

Zero- Waste Green City Solution



Hydrogen Vision



- ❑ Zero Waste : All waste will be converted to the clean product – syngas & slag
- ❑ Clean Energy Provider
 - Generation through gas engine or fuel cell

- ❑ Hydrogen village
 - Hydrogen produced from waste will be supplied to the fuel cell equipped within each house, facilities and fuel cell vehicles

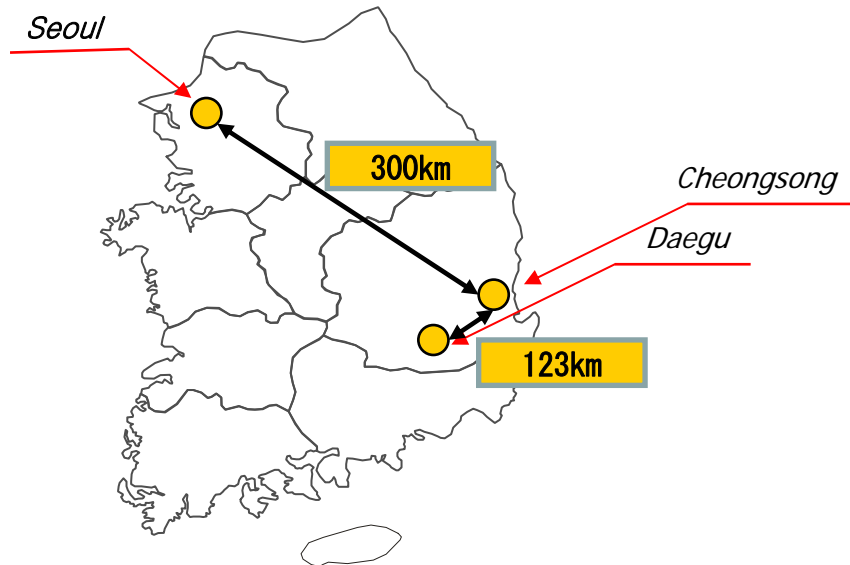
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- *Cheongsong Project is designed to resolve Cheongsong's waste management problems through GS Platech's new technology and satisfies public-private's demand*

Cheongsong Project Background



- ❑ **Dispose 15 ton per day waste by landfill in Cheongsong County**
 - Impossible to dispose waste by landfill after full capacity

➔ Cheongsong County gives technology development opportunity (Licensing, Waste, Tipping Fee)
GS Platech proves technology in own investment.

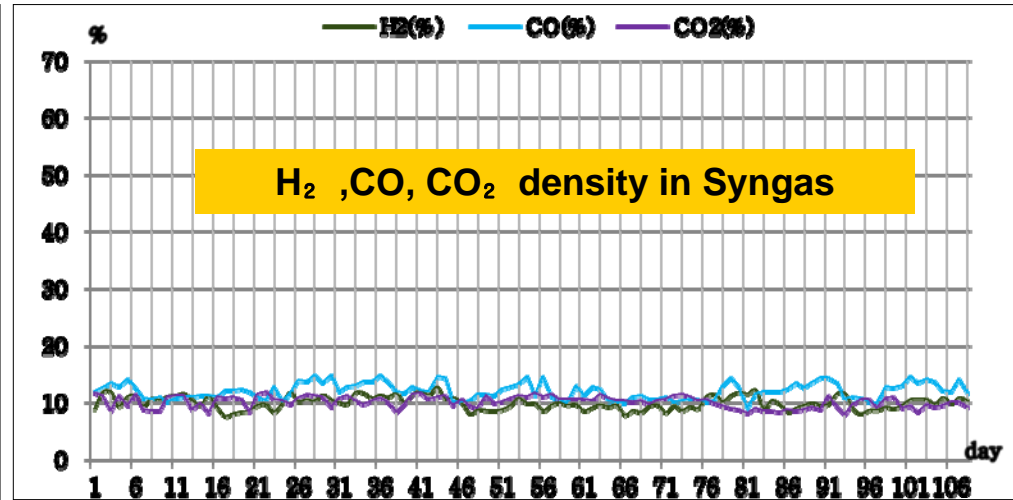
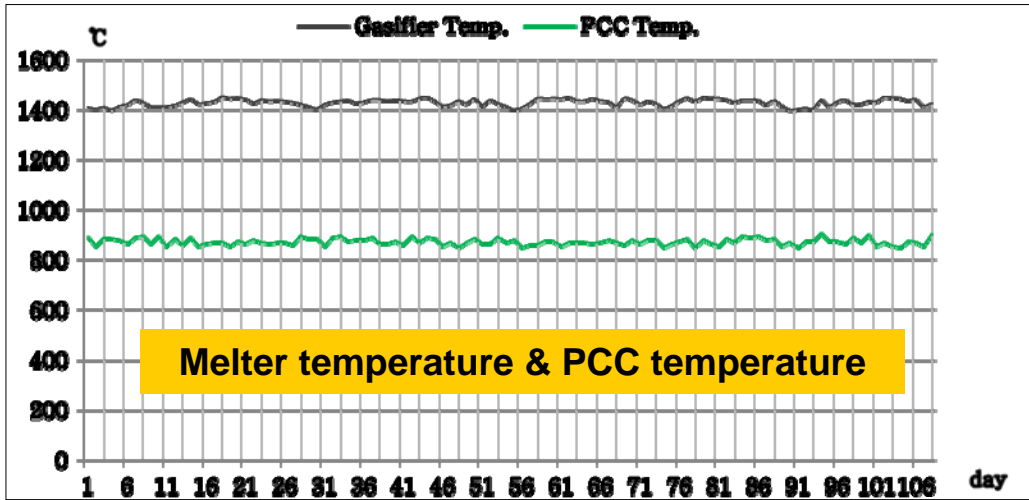
GS Platech Cheongsong Plant



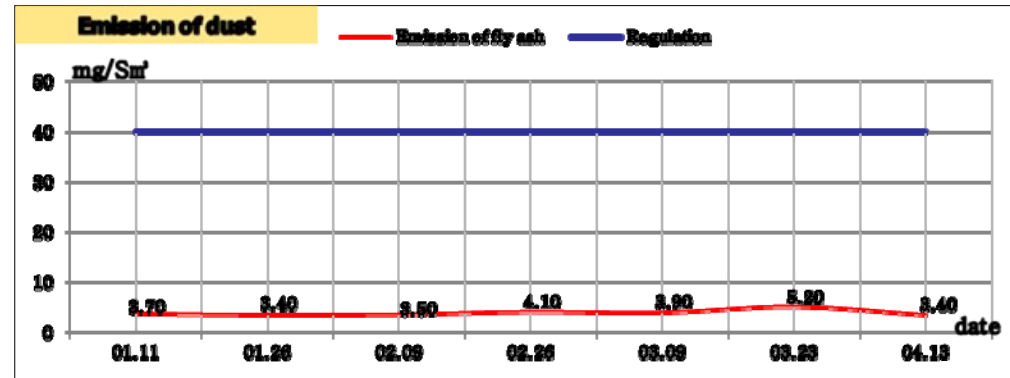
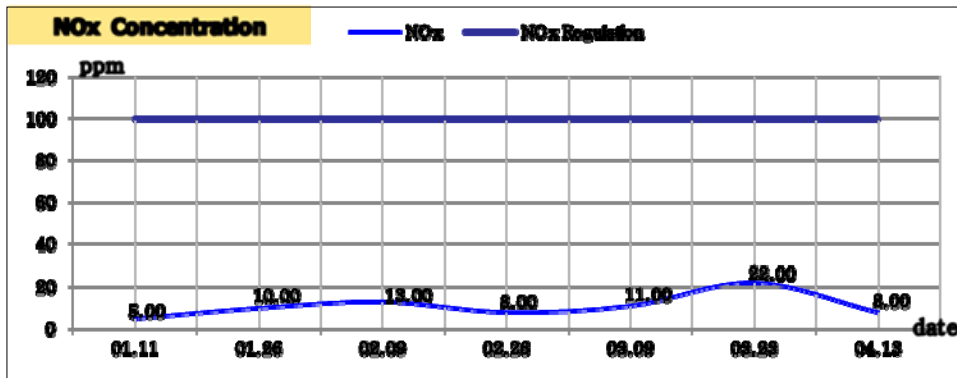
- ❑ **Operation started in Sep. 2008**
- ❑ **Feed : Municipal Solid Waste**
 - Waste disposal operation on consignment
 - Operate waste disposal system for 3 years
 - Chance for commercializing new technologies
 - First to build Waste to Fuel Cell plant in the world this year

Cheongsong Plant Operation Data - 1

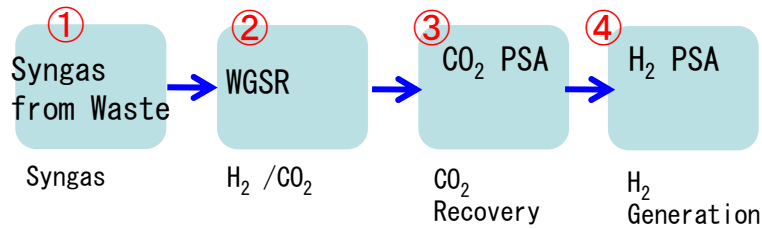
Over 300 days in a year, Cheongsong Plant runs at the constant condition



※ Operation period (January 1 ~ May 6, 2010. excepted overhaul period)



○ *First in the world to commercialize Waste-Hydrogen-Fuel Cell Generation with Korea and Canada government supports this year*



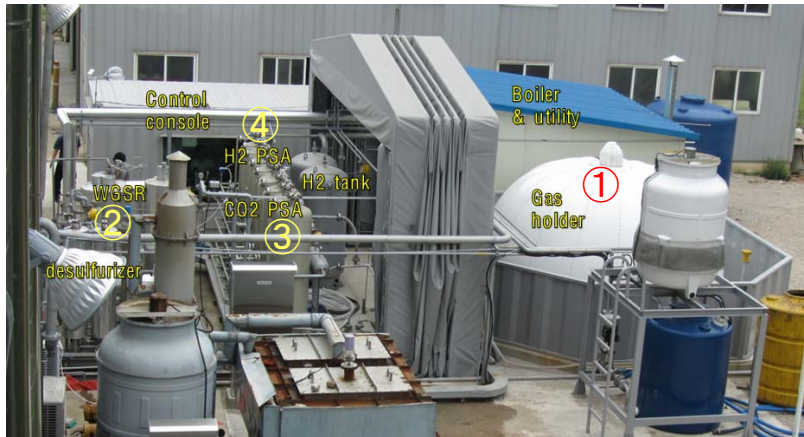
Fuel Cell Specification	
Capacity	50kW (5kW FC Unit X 10ea)
DC/AC Inverter	Max 6kW X 10ea

□ Features

- Waste To Hydrogen Fuel Cell for the first time in the world

-Fuel Cell directly linked with recovered **High Purity Hydrogen(99.99%)** from Syngas

-Can produce maximum 400 kW from 10 tons/day of disposed waste



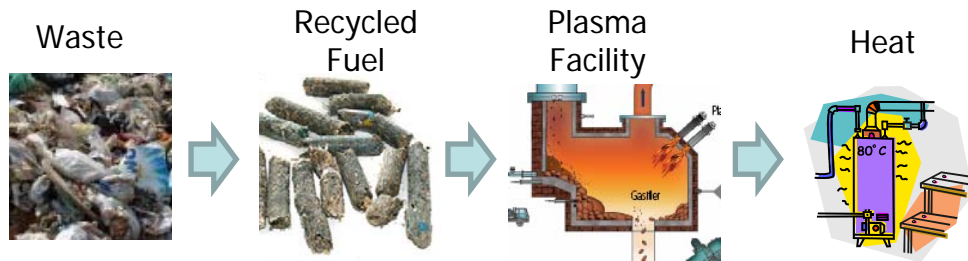
<High Purity Hydrogen Recovery>



<Fuel Cell Generation >

- Public-Private Partnership creates new chance to supply clean energy from waste to the industrial park at the lower price than conventional fossil fuel

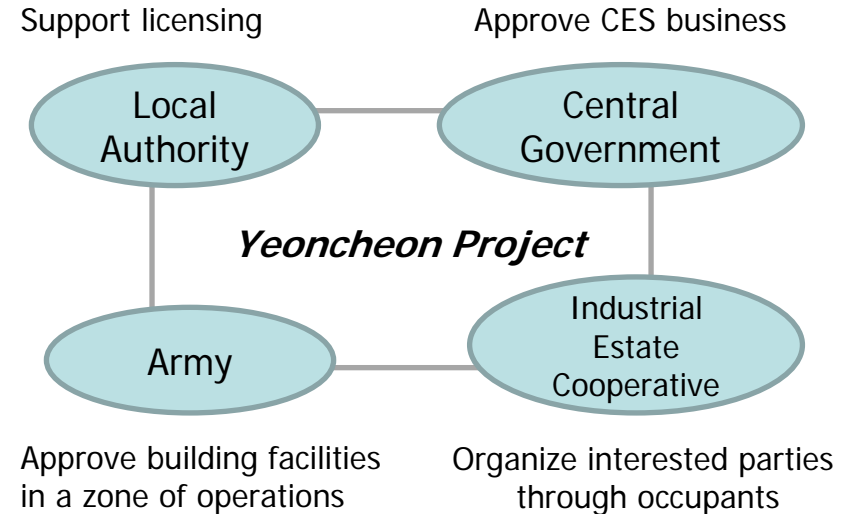
Yeoncheon Project



- Supply thermal energy(Steam) to small fabric manufactures in Yeoncheon industrial park utilizing recycled plastic waste
 - Lower price of steam with 80% of fossil fuel
- Features of facilities
 - Steam 35ton/h (RPF 110 ton/day)
 - Operate eco-friendly by minimizing air pollutants compared with existing RPF boilers



Public-Private Partnership



- Project goes through Private's Investment and Public's active cooperation.
- Improving cost competitiveness through supplying eco-friendly low cost energy from waste

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- *To make Zero Waste possible, require efforts to change the existing policies and overcome technology constraints.*

Constraints that block Zero Waste

1. Difficulties changing the existing landfill oriented policies

- Securing Zero Waste Technology's economic feasibility at an early stage is harder than landfill's because of cheap cost and easy operation
- Introducing new policy assumes landfill's way so that Zero Waste Technology would not be adopted.

2. Organize interested parties in existing Waste Industry

- Stakeholder's network in existing waste disposal system such as landfill and incineration inhibit new policies on zero waste

3. Negative public sector in introducing new technology

- Public sector stands negative as Waste Disposal System is the basic infrastructure so that public risk increases if problems occur.
- It is essential to get general understanding to accept new technologies to realize Zero Waste .

- *To make Zero Waste possible, public role grows in clarifying policy goal and organizing interested parties with innovation of Waste-to-Energy technologies*



- Develop New Innovative Technology
 - Minimize environmental effects
 - Maximize energy recovery
- Improve Efficiency of Waste Management
- Design new biz model for zero waste

- Clarify Gov. Policy Goal
 - Develop and support policies for zero waste
- Organize Interested Parties
 - Give new roles to existing parties after changing policies
- Support to the private efforts



Zero Waste cannot be realized if public sector doesn't support adequate policies and give opportunities as public sector is the core customer in Waste Industry.