The Westinghouse Plasma (WPC) Gasification solution is capable of turning environmentally destructive hazardous waste into a valuable source of energy: syngas. This syngas can be used to create power, generate steam, or produce methanol, ethanol or hydrogen. The plasma gasification process does several things:

- **Complete destroys hazardous waste**
- **Reduces harmful emissions and greenhouse gases when compared to other solutions like landfills**
- **Provides significant economic benefits through power, liquid fuel generation or syngas, which is an essential building block for many chemical processes**

The composition of syngas is rich in carbon monoxide and hydrogen making it an ideal product for chemical manufacturing processes or for conversion into hydrogen, ethanol, methanol or other hydrocarbon fuels. Syngas exiting the gasifier can be either fired directly in a boiler or conditioned and fed into a gas turbine to produce power.

**HIGH TEMPERATURES**

Plasma is a superheated column of electrically conductive gas. In nature, plasma is found in lightning and on the surface of the sun.

Operation at ambient pressure and high temperature (greater than 5,537 Deg C/10,000 Deg F) from plasma results in a complete destruction of hazardous materials while producing syngas and an inert, non-hazardous slag. The resulting slag can be used for construction aggregate. At these high temperatures the molecular bonds of materials are broken down, reducing the output of harmful toxins and organic poisons in the process.

**THE VALUE OF SYNGAS**

The Westinghouse Plasma (WPC) Gasification solution is capable of turning environmentally destructive hazardous waste into a valuable source of energy: syngas. This syngas can be used to create power, generate steam, or produce methanol, ethanol or hydrogen. The plasma gasification process does several things:

- **Complete destroys hazardous waste**
- **Reduces harmful emissions and greenhouse gases when compared to other solutions like landfills**
- **Provides significant economic benefits through power, liquid fuel generation or syngas, which is an essential building block for many chemical processes**

Plasma is a superheated column of electrically conductive gas. In nature, plasma is found in lightning and on the surface of the sun.

Operation at ambient pressure and high temperature (greater than 5,537 Deg C/10,000 Deg F) from plasma results in a complete destruction of hazardous materials while producing syngas and an inert, non-hazardous slag. The resulting slag can be used for construction aggregate. At these high temperatures the molecular bonds of materials are broken down, reducing the output of harmful toxins and organic poisons in the process.

**Hazardous Waste Management**

Hazardous waste is just that – hazardous. Medical, industrial and petrochemical wastes are all types of hazardous waste and pose threats to human health and the environment. Proper destruction of these materials is essential in keeping our environment clean. Using a safe, reliable and proven disposal method such as plasma gasification destroys waste while creating energy.
Proven Experience

The Westinghouse Plasma (WPC) Gasification technology is commercially proven. The technology is currently utilized at the energy recovery from hazardous waste facilities in India and China.

The facility in India processes hazardous waste and operating since 2009, and the facility in China processes municipal solid waste (MSW) and vitrifies incinerator Fly-ash and operating since 2014.

Additional testing of hazardous feedstocks has been successfully demonstrated at the WPC commercial demonstration facility in Madison, Pennsylvania, USA. Over the past 25 years more than 100 feedstocks have been successfully processed including the following hazardous wastes:

- Common hazardous wastes
- Medical Waste
- Bio-wastes and sewage sludge
- Remediated landfill waste
- Industrial wastes
- Heavy oil and waste oils
- Bitumen
- Chemicals (including the destruction of PCBs)
- Weapon (destruction)
- Tires

Vitrified Slag

Value is created in the plasma gasification process by being able to convert hazardous waste stream by-products into vitrified slag. By design, the plasma gasifier allows a molten liquid comprised of inorganic materials to flow out the bottom of the gasifier. This process allows for the separation of metals which can be sold. The remaining by-product can be used as a source for other materials – such as rock wool, floor tiles, insulation, landscaping blocks and road aggregate.

Tests on the slag generated at the Mihama-Mikata Facility in Japan have been conducted by independent laboratories - Shimadzu Techno Research and ALS Laboratory Group. The results of these tests indicate that the Mihama-Mikata slag components are far below the test detection limits for certification and that the slag is considered non-leaching. The testing has also scientifically proven that the leachate of Mihama-Mikata’s slag is inert and consequently does not contaminate ground water or drinking water sources. The Mihama-Mikata facility sells the slag for use in local cement production.
## Hazardous Waste Facilities

The following facilities are using the WPC Gasification solution to destroy hazardous wastes:

<table>
<thead>
<tr>
<th>Location:</th>
<th>Maharashtra Enviro Power Limited (MEPL) in Ranjangaon, Pune, India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner:</td>
<td>SMS Infrastructures Limited subsidiary, SMS Envocare Ltd. is a provider of environmental infrastructure projects and consultancy services</td>
</tr>
<tr>
<td>Technology:</td>
<td>Plasma-assisted gasification utilizing the WPC reactor design and torches</td>
</tr>
<tr>
<td>Configuration:</td>
<td>Gasification followed by combustion of syngas in boiler and flue gas clean-up</td>
</tr>
<tr>
<td>Date Commissioned:</td>
<td>MEPL in Ranjangaon, Pune: Q1 2009</td>
</tr>
<tr>
<td>Feedstock:</td>
<td>Over 30 types of hazardous and industrial waste</td>
</tr>
<tr>
<td>Products:</td>
<td>Net 1.6MWe to the grid.</td>
</tr>
<tr>
<td>Capacity:</td>
<td>72 tonnes per day</td>
</tr>
</tbody>
</table>
| Advantages: | • Facility can gasify a multitude and variety of feedstocks. The feedstocks can change day to day and season to season  
• Facility processes difficult waste streams and exports 1.6MW of electricity to the grid  
• The primary by-product is an inert vitrified slag  
• Environmentally sound process creating a resultant synthesis gas (“syngas”) that contains very low quantities of NOx, SOx, dioxins and furans |
| Partnership: | • WPC and SMS Envocare Ltd. have partnered to replicate the Pune plant configuration around the world |

<table>
<thead>
<tr>
<th>Location:</th>
<th>Co-located with Shanghai Environmental (a subsidiary of large, state-owned enterprise Shanghai Chengtou Holding Co. Ltd.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner:</td>
<td>GTS Energy</td>
</tr>
<tr>
<td>Technology:</td>
<td>Plasma-assisted gasification utilizing the WPC reactor design and torches</td>
</tr>
<tr>
<td>Configuration:</td>
<td>Gasification followed by combustion of syngas in boiler and includes the particulate recycling system, after burner, steam turbine generator, gas cleanup system and thermal oxidizer</td>
</tr>
<tr>
<td>Date Commissioned:</td>
<td>GTS in Shanghai, China: Q1, 2014</td>
</tr>
<tr>
<td>Feedstock:</td>
<td>Municipal solid waste (MSW) and Incinerator Fly Ash Vitrification</td>
</tr>
<tr>
<td>Products:</td>
<td>Slag and Syngas</td>
</tr>
<tr>
<td>Capacity:</td>
<td>30 tonnes per day</td>
</tr>
</tbody>
</table>
| Advantages: | • Convert MSW and incinerator ash  
• The plasma gasification process does not create any bottom ash. All inorganic materials are transformed to an inert non leaching vitrified slag product that can be sold for beneficial use  
• Processes additional high value hazardous waste to create syngas and improve plant economics |
| Partnership: | • WPC and GTS Energy have partnered to jointly market and sell this hazardous waste solution globally |
SMS Envocare, India: Process Flow Diagram

1. Waste Generator
2. Transport to Facility
3. Weigh Bridge
4. Hazardous Waste Storage
5. Lab Analysis
6. Waste Feeding System
7. PGVR
8. Thermal Oxidizer
9. Waste Heat Recovery System
10. Steam Turbo Generator
11. Condensate Recycle
12. Air Pollution Control
13. ID Fans
14. Secured Landfill
15. Raw Water
16. Water Treatment Units
17. Stack

Captive Use
Flux
Vitrified Mass
Used for Road Bed
Steam

Power
Power & Process Air
Oil Air

Atmosphere
Treated Water

Source: SMS EnvoCare
7. Plasma Gasification Reactor
8. Thermal Oxidizer
10. Steam Turbo Generator
11. Condensate Recycle
12. Wet Electrostatic Precipitator (WESP) - Air Pollution Control
12. Polishing Scrubber - Air Pollution Control
12. Venturi and Direct Contact Spray Scrubber - Air Pollution Control
13. ID Fans
The Plasma gasification system includes eight sub-systems as follows:

- Feed System
- Plasma gasification system
- Plasma torch system
- Heat Recovery System
- After burner syngas combustion system and water quench
- Exhaust treatment system
- Electronic control system
- Auxiliary systems