



Westinghouse Plasma Corporation

a division of Alter NRG Corp.

Transformation of Waste into Syngas using Plasma Gasification for the Production of Energy or Biofuels



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WESTINGHOUSE PLASMA CORP.

Our Vision

To provide the leading technology platform for converting the world's waste into clean energy for a healthier planet

Primary Market is Energy from Waste

- Our strength is being able to convert almost any waste stream (incl. municipal, commercial, industrial, petrochemical, and medical) into syngas
- Most of our customers are currently choosing to make power and heat
- We are probably not the best solution for a clean biomass plant

Strategic Partnerships



Technip

Uhde



ThyssenKrupp

coskata



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www.westinghouse-plasma.com



WHAT IS PLASMA?

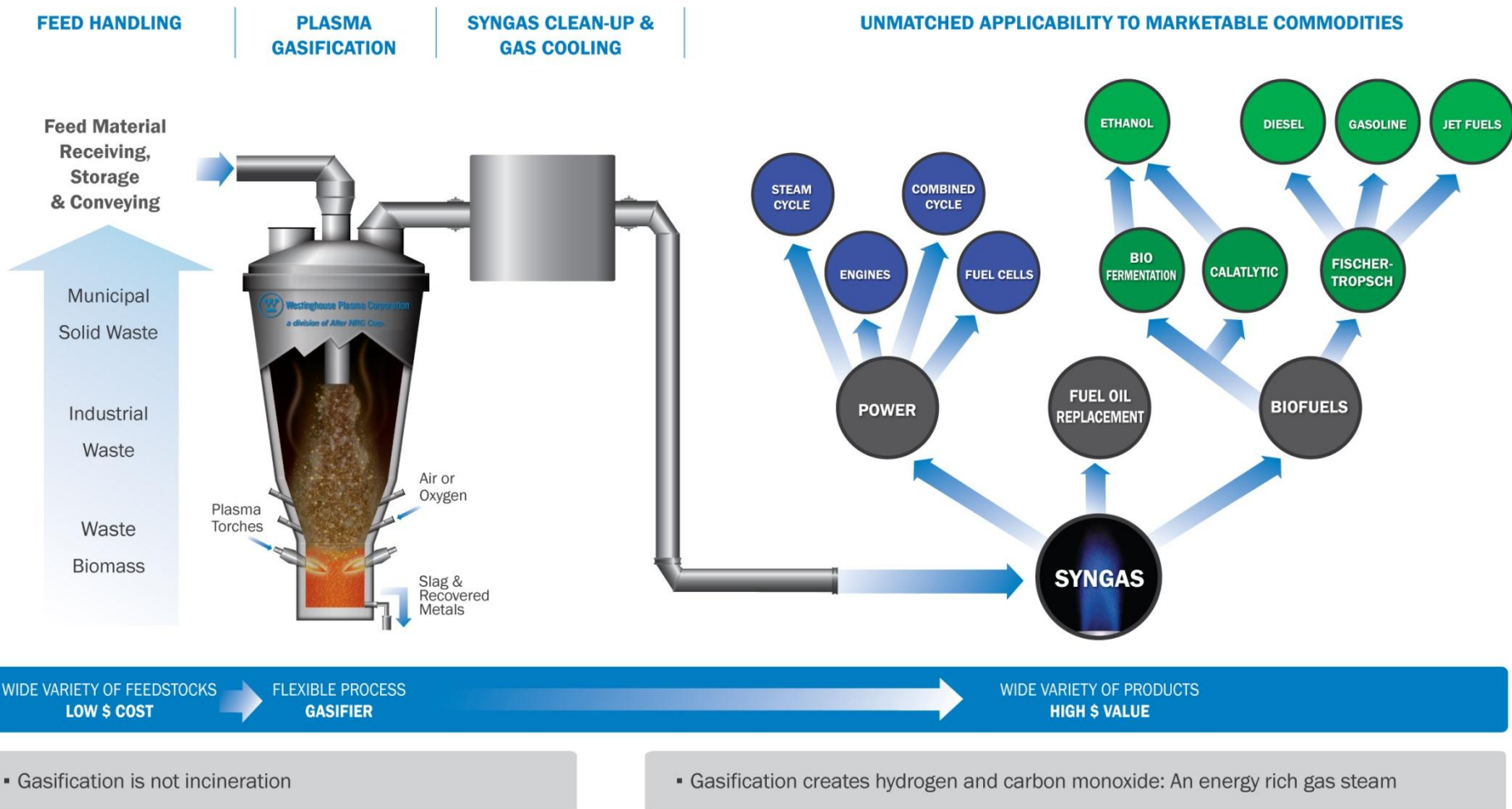
- Plasma is highly ionized or electrically charged gas
- An example in nature is lightning - capable of producing temperatures exceeding 7,000° C
- An ionized gas is one where the atoms of the gas have lost one or more electrons and has become electrically charged



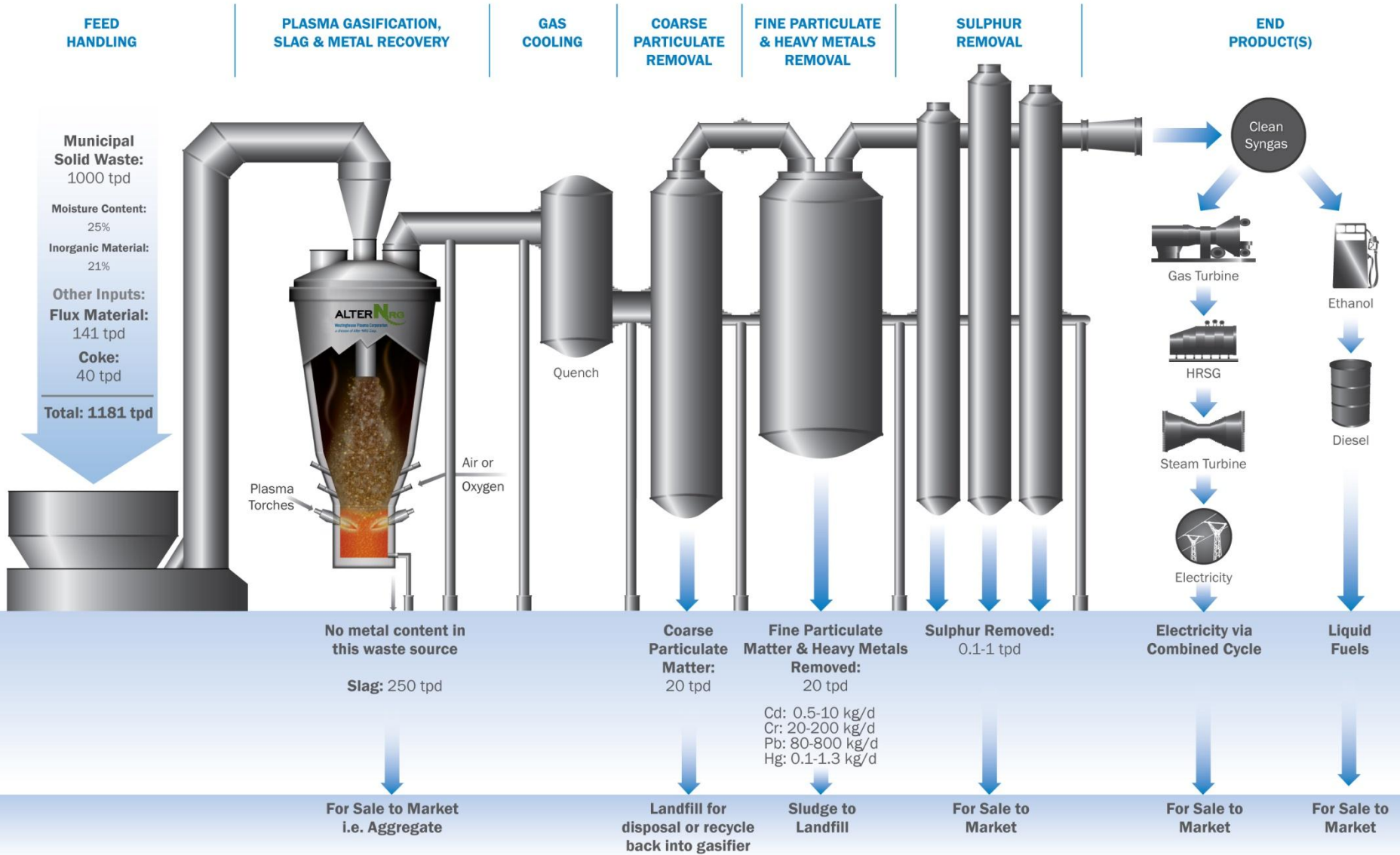
**Our plasma torch systems
create the intense heat inside
our plasma gasifier**



PLASMA TECHNOLOGY IS A KEY ENABLING TECHNOLOGY



MASS BALANCE: PROCESS FLOW INPUTS AND OUTPUTS



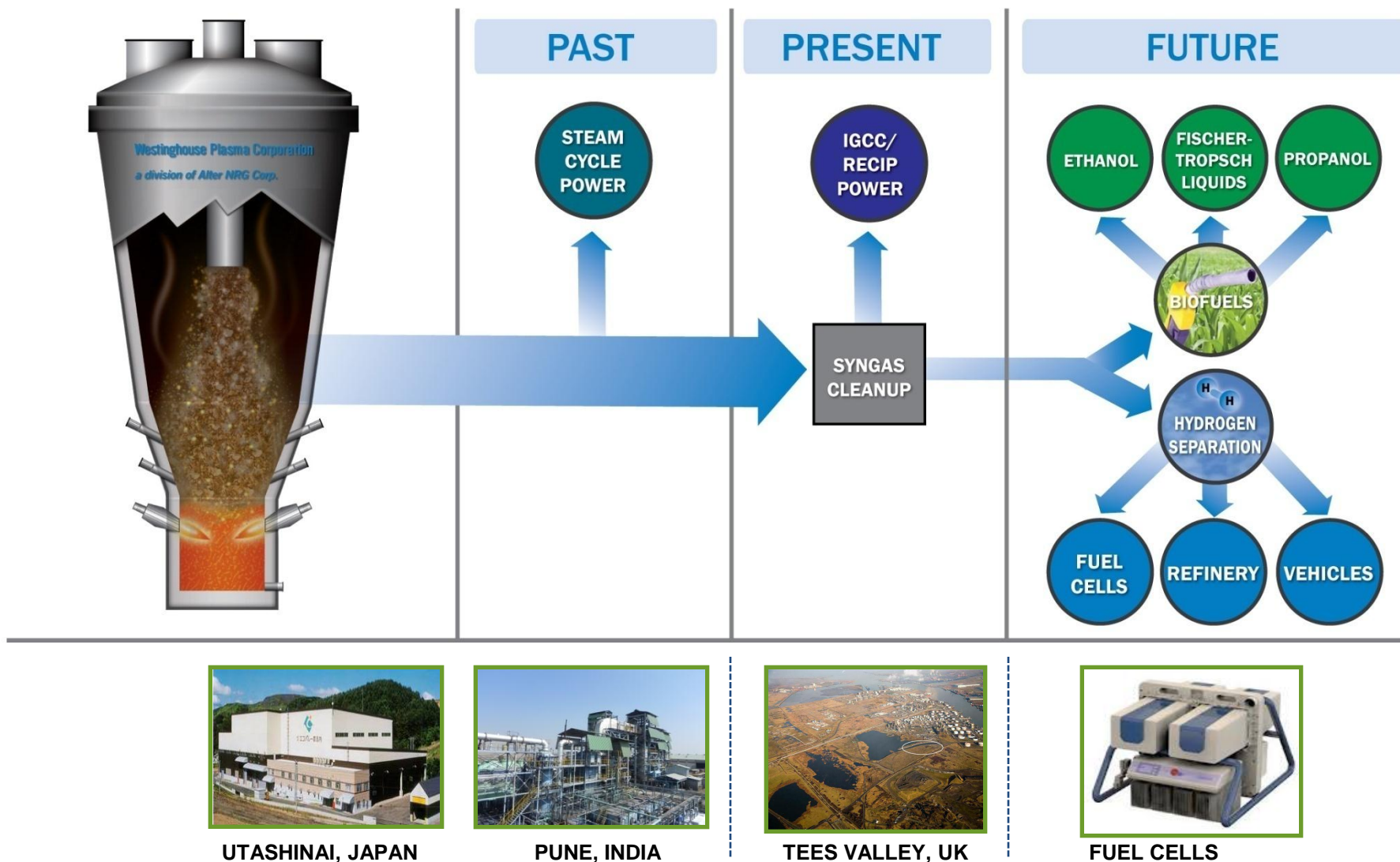
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PLASMA GASIFICATION – PAST AND FUTURE

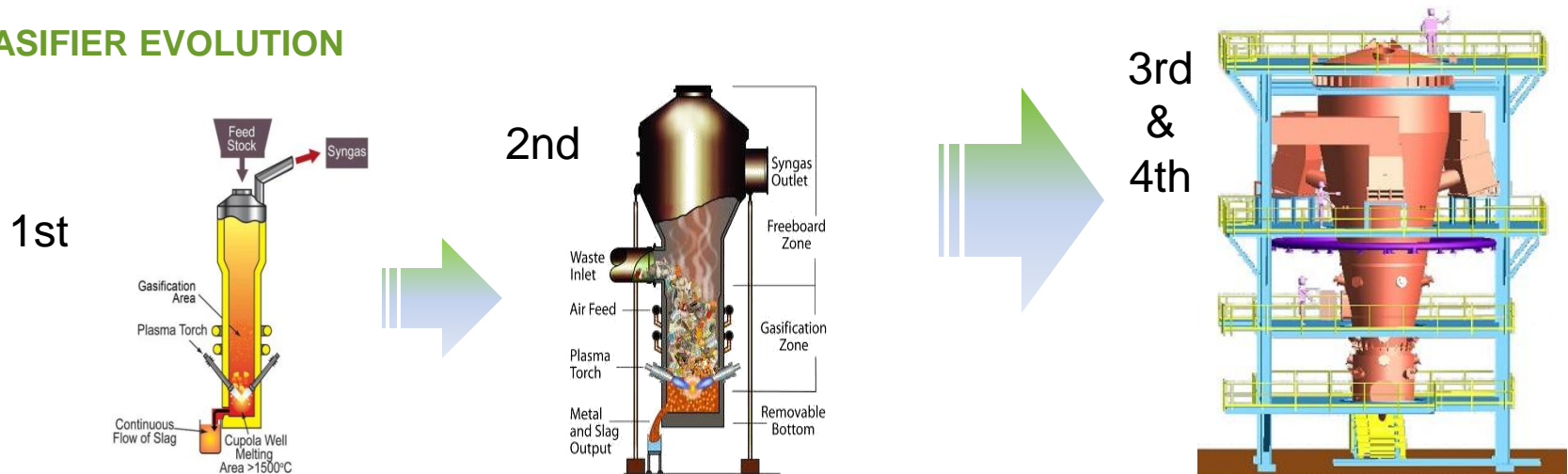


EVOLUTION: FROM DEMO...TO COMMERCIAL...TO INDUSTRIAL...

WESTINGHOUSE PLASMA PROJECTS



GASIFIER EVOLUTION



ALTER NRG PLASMA GASIFICATION HAS MATERIAL COMMERCIAL ADVANTAGES

- Minimal feedstock preparation
 - Typically a basic pre-sorting of recyclables and a one stage shredding of the material
- Handles a wide range of feed compositions
 - Blend any number of solid or liquid feedstock's
 - Ability to blend feedstocks reduces project feedstock risk and significantly increases project economics
- High reliability
 - Operates in rugged industrial applications
 - Over 500,000 hours and 20 years of industrial use on the plasma torches
- Superior Environmental Footprint
 - Vitrified Slag is inert/non-leaching and is being used as a construction aggregate
 - Air emissions significantly below legislated limits



WESTINGHOUSE PLASMA vs INCINERATION

	Westinghouse Plasma Gasification	Incineration
Feedstock Flexibility	<ul style="list-style-type: none"> • Ability to mix feedstocks such as <ul style="list-style-type: none"> – MSW – Industrial Waste – Commercial & Industrial Waste – Hazardous Waste – Tires Waste – Biomass Fuels (such as wood waste) 	<ul style="list-style-type: none"> • MSW and other common waste streams
Fuel Created	<ul style="list-style-type: none"> • Syngas (Carbon Monoxide and Hydrogen) 	<ul style="list-style-type: none"> • not applicable
End Product Opportunities	<ul style="list-style-type: none"> • Replacement Fuel for Natural Gas and Fuel Oil • Power via Steam cycle • Power via Combined cycle or Reciprocating Engines • Power via Fuel Cells (future) • Process Steam • Liquid Fuels (ethanol, bio-diesel) • Hydrogen • Fertilizer Compounds 	<ul style="list-style-type: none"> • Power via Steam cycle • Process Steam
Overall Plant Efficiency	<ul style="list-style-type: none"> • Combined Cycle Process: 1 tonne of municipal solid waste is capable of creating 1000 kWh of power via combined cycle configuration 	<ul style="list-style-type: none"> • Steam Cycle Process: 1 tonne of municipal solid waste generates between 500-650 kWh of power
Emissions	<ul style="list-style-type: none"> • Combined Cycle Process: <ul style="list-style-type: none"> – Nitrogen Oxide (NOx): <36 ppmvd – Sulfur Dioxide (SO₂): <1.05 ppmvd – Mercury (Hg): <1.4 µg/dscm² 	<ul style="list-style-type: none"> • Nitrogen Oxide (NOx): 110-205 ppmvd • Sulfur Dioxide (SO₂): 26-29 ppmvd • Mercury (Hg): 28-80 µg/dscm²
By-product	<ul style="list-style-type: none"> • Inert, non-hazardous and non-leaching glassy slag salable as an aggregate building product or rock wool • Most particulate recovered during cleaning of the syngas is recyclable 	<ul style="list-style-type: none"> • Hazardous Fly Ash and Scrubber Residues • Incinerator Bottom Ash



APPENDIX



PLASMA GASIFICATION - FEEDSTOCK FLEXIBILITY

Westinghouse Plasma Corp gasification technology can:

- Process heterogeneous feedstock with minimal feed preparation
- Process high moisture and high inert content waste
- Blend solids, liquids and slurries
- Reduce dependence on one feedstock, optimize revenue based on available feedstocks
- Produce a tar free syngas – something most non-plasma gasification technologies cannot do

Westinghouse Plasma customers are currently processing or in the planning stages of processing the following feedstocks:

- MSW
- RDF/SRF
- Medical Waste
- Garbage dredged from river
- Paints/solvents
- Petrochemical waste - oil sludge
- Sewage waste
- Auto Shredder Residue
- Tires
- E-waste
- Biomass including wood chips, rice husks, bagasse, etc
- Construction and Demolition waste
- Petcoke flyash
- Spent ammunition
- Animal waste
- Meat processing plant waste
- Hazardous waste
- Cuttings from drilling activity
- Waste mined from landfill
- Waste coal or coal dust
- Pharmaceutical waste
- Forestry Industry waste (black liquor, paper sludge)
- PCB contaminated soil



PROVEN FEEDSTOCK FLEXIBILITY

Mihama-Mikata, Japan

- 24 tpd of waste to power
- MSW and waste water sludge
- Commissioned in 2002



Utashinai, Hokkaido, Japan

- 220 tpd of waste to power
- MSW and auto shredder residue
- Constructed in 2002, operational since 2003



Pune, India

- 72 tpd of hazardous waste to power
- Over 40 different hazardous waste streams blended
- Commissioned in 2009



Westinghouse Plasma Center

- 48 tpd Pilot Facility
- Completed over 125 tests, including a 2 year waste to cellulosic ethanol demonstration
- Over 40 different feedstocks tested, including MSW, hazardous, biomass, tires, medical, petrochemical, ash, liquids etc.



CONTINUOUS TECHNOLOGY OPTIMIZATION

WPC COMMERCIAL DEMONSTRATION FACILITY, PA, USA

- Up to 48 tpd pilot facility in Madison, Pennsylvania, USA
- Completed over 125 pilot tests to provide baseline information on various feedstock's
- Recently completed a 2 year commercial demonstration of the Coskata cellulosic ethanol technology
- WPC testing was a critical piece of the Air Products commercial facility design process
- State of the art, real-time gas composition monitoring
- Predictive modeling capability through VMG simulation software, including balance of plant
- Actively working on refining the core plasma torch and gasification technology
- Capability to test almost any feedstock
- Wide range of feedstocks tested, including:
 - Waste (municipal solid, refuse derived fuel, hazardous waste, construction and demolition waste)
 - Waste Water Sludge
 - Wood and Bagasse
 - Coal



- Excavated Landfill Material (PCB disposal)
- Tires
- Auto Shredder Residue
- Heavy Oil
- Ash

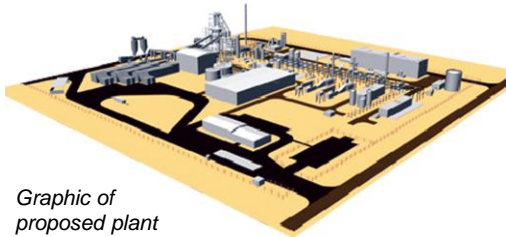


AIR PRODUCTS – TEES VALLEY RENEWABLE ENERGY FACILITY

- 300,000 tpa of processed MSW
- Approximately 50 MW
- Combined Cycle Configuration
- Two ROCs per MWh



Location of the 49MW Tees Valley Project in Billingham, UK



Graphic of proposed plant

- Previous WtE experience in Incineration
- Licensed technology in January 2009
- Intention to build 5 facilities



"I welcome the progress that Air Products has made with its project to bring advanced gasification to the UK. Energy from Waste leads to considerable reductions in waste going into landfill, and makes an important contribution to the UK's low carbon energy supply. This new technology will be an exciting addition to the energy from waste sector and I look forward to seeing the announcement of more of these projects."

- Greg Barker, UK Energy and Climate Change Minister

"Air Products hopes to build up to five advanced gasification plants in the UK in the coming years, amounting to an investment of more than £1bn and with the potential to generate around 250 MW of electricity."

- Ian Williamson, Air Products European Hydrogen and Bioenergy Director (Aug 11, 2011)

"Today's announcement makes clear the Government's commitment to supporting long-term investment in the UK's renewables industries."

- Nick Clegg, The UK Deputy Prime Minister



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SUPERIOR ENVIRONMENTAL FOOTPRINT

Air Emissions and Slag leachate tests were independently undertaken and were significantly below legislative laws

NON LEACHING VITRIFIED SLAG: Mihama-Mikata Slag JLT-46 Results				
Heavy Metal	Unit	Method Detection Limit	Average Measured Value of Slag	JLT-46 Limit
Arsenic	mg/L	0.001	<0.001	0.01
Cadmium	mg/L	0.001	<0.001	0.01
Chromium VI	mg/L	0.005	<0.005	0.05
Lead	mg/L	0.001	<0.001	0.01
Mercury	mg/L	0.0001	<0.0001	0.005
Selenium	mg/L	0.001	<0.001	0.01
Notes: mg/L = parts per million (PPM) JLT-46 performed by Shimadzu Techno Research, Inc., Kyoto Japan on Mihama-Mikata slag samples received from Kamokon				



SYNGAS SPECIFICATIONS AFTER CLEANUP

After gas clean-up, Syngas production using Westinghouse Plasma Gasification technology can meet the following quality

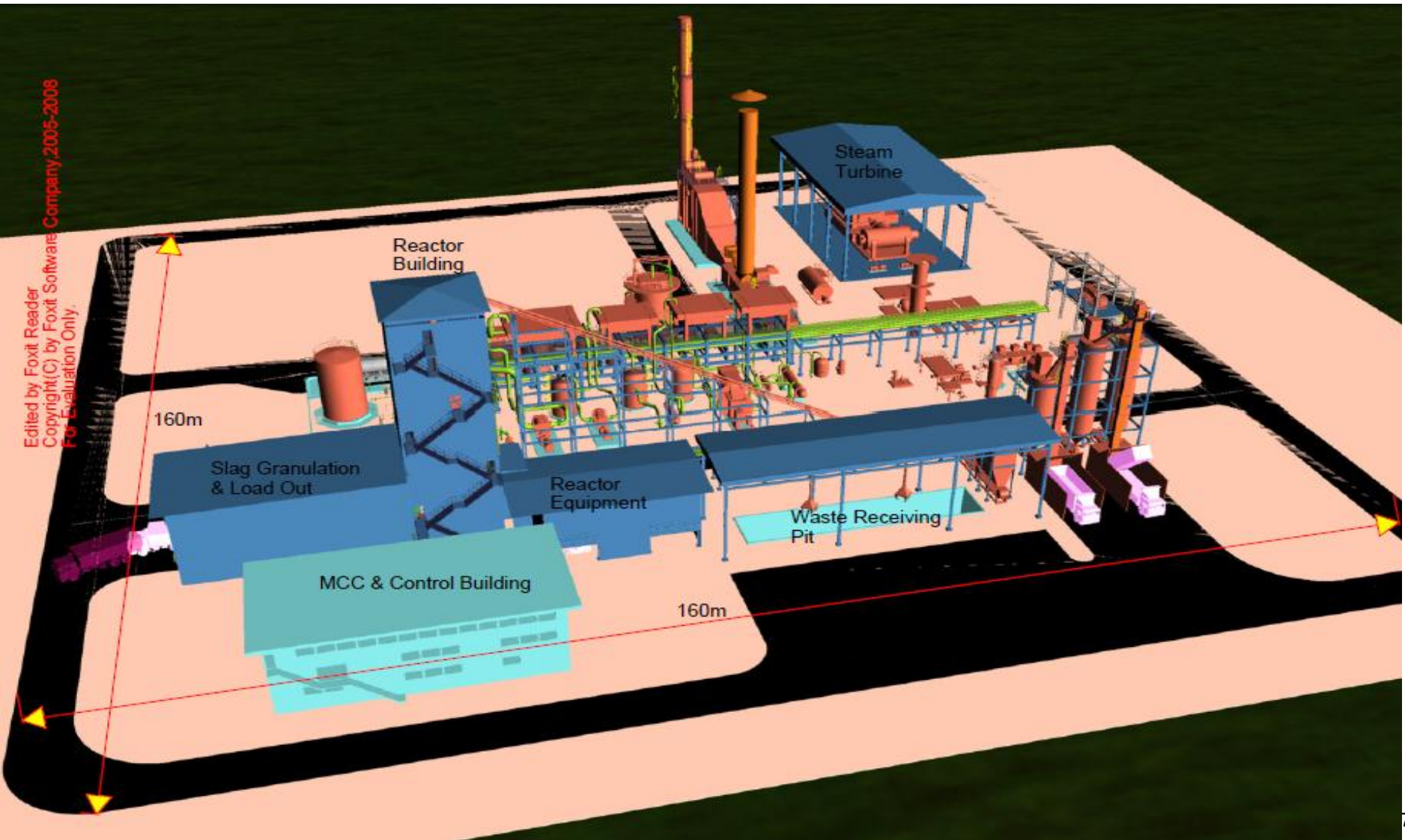
	Specifications
Sulphur	< 200 ppmw
Alkali metals	< 1 ppmw
Volatile metals	< 1 ppmw
Halogens	< 1ppmw
Particulate	< 20 ppmw
Syngas Calorific Value	7-12 MJ/Nm3

Most stringent specifications can usually be met

Note: ppmw: Parts per Million by weight



3D MODEL OF PLASMA GASIFICATION FACILITY



CONCLUSIONS

Less Risk – The WPC solution is commercially proven and operating at scale

- Westinghouse Plasma has commercialized the world leading platform for converting difficult waste streams into energy rich syngas
- Westinghouse Plasma is commercially proven at scale with multiple reference facilities throughout the world
- Plasma gasification has been identified in many countries as the waste conversion technology of choice.

Transformation of waste into various “Back-end” products

- The Westinghouse Plasma Technology is able to process multiple waste streams, and create an energy rich syngas that is a key building block for many other products: Energy / Hydrogen / Ethanol / Fertilizers / Bio-Diesel

Environmentally Sustainable

- Proven non-leaching aggregate appropriate as a construction material
- Air emissions and slag leachate tests were independently undertaken and were significantly below legislative laws
- Valuable energy products can be created from the syngas

Economically Attractive

- Projects are economic in today's markets with returns in excess of 20%
- Westinghouse Plasma technology attracts preferential tipping fees and off take contracts in certain markets



•WESTINGHOUSE PLASMA GASIFICATION TECHNOLOGY HAS BEEN REVIEWED AND ENDORSED BY INDEPENDENT INDUSTRY EXPERTS AS A TECHNICALLY ROBUST AND ENVIRONMENTALLY SUPERIOR WASTE CONVERSION TECHNOLOGY



R.W. Beck is a group of technically based business consultants serving public and private infrastructure organizations worldwide

RW Beck reviewed Alter NRG's plasma gasification technology for power plant retrofit and MSW applications and identified no major technical challenges and opined that "the plasma technology appears to be a sound method of gasifying organic feedstock's and producing fuel gas compatible with boiler combustion" and "the review did not identify major design issues."



•(Environmental)

ENSR, a division of AECOM, is a global provider of environmental and energy development services

ENSR – AECOM completed an engineer's review that verifies Alter NRG's assumptions of emissions from a 750 tpd MSW Plasma Gasification Combined Cycle WTE facility will be below emission limits for North America. The report confirms that processing waste through plasma gasification results in "emission levels substantially below mass burn processes."



•(Environmental)

AMEC provides scientific, environmental, engineering and project management support in more than 30 countries

AMEC/BDR completed Design Basis Memorandums that included complete process flow diagrams and CAPEX estimates for three different facility configurations: combined cycle, steam cycle and syngas.



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Golder Associates provides civil/geotechnical and environmental consulting services worldwide

Golder reviewed emissions data from Utashinai and Mihama-Mikata and confirmed that the existing plants operate below their regulated emissions limits in Japan, as well as below North American Standards



Shimadzu Techno Research is an analytical research service provider in the health, environment and product and material testing markets

Shimadzu Techno Research tested slag from the Mihama Mikata plasma gasification facility in Japan. The results of this study showed that this vitrified slag composition is considered inert and does not contaminate soil or drinking water.



Juniper Consultancy is recognized as one of the leading independent analysts of emerging technologies in the waste management field

Juniper conducted a thorough review of the Westinghouse Plasma Gasification technology and the technology in application at the Mihama-Mikata and Utashinai WTE facilities. Juniper recognizes these facilities as “the only commercial plasma gasification facilities in the world processing MSW.” Juniper acknowledges the Alter NRG/Westinghouse Plasma Gasification technology as more proven than direct competitors and views Alter NRG as becoming a world leader in the design and supply of plasma-based systems.





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