Greeley Green Energy

*For a "Cleaner and Greener" Weld County*

NOVO CHEMIONYX SYSTEMS

# INTEGRATED WASTE-TO-VALUE FACILITY WELD COUNTY, COLORADO

## CLEAN ENERGY AND MATERIALS RECOVERY

A1 organics

LEVERAGED GREEN ENERGY

# The Facility

- **80 Acre Site in Keenesburg, CO**

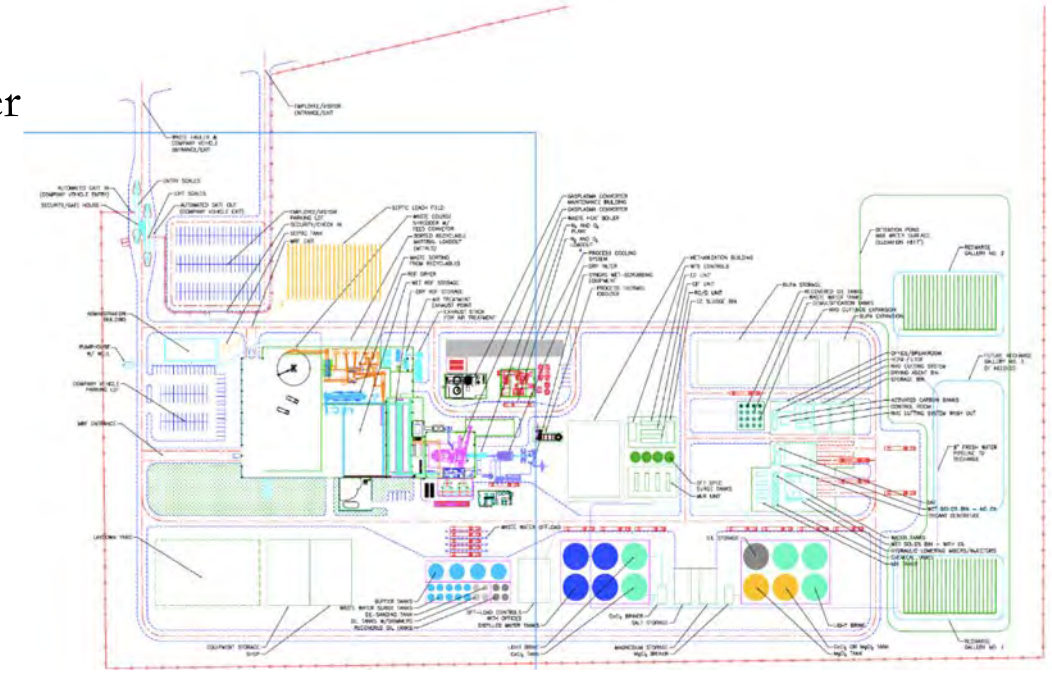
- **Construction start Target: Q1 2019**
- **Revenue start Target: Q1 2020**


## Will process:

- 150,000 tons of Biogenic Waste
- 300,000 tons of Oilfield Solid Waste
- 3,000,000 bbl of Oilfield Waste Water

## Will produce:

- 2,500,000 bbl of Salable Water
- 150,000 bbl of Salable Oil
- 25,000 tons of Renewable BioGas



PLASMA DEVELOPMENT

# THE FACILITY





PLASMA DEVELOPMENT

# Sponsor Group

The Sponsor Group consists of:

- **Plasma Development** – the project's originator, technology "combinator," and developer lead

- **NOVO** – A partner in Plasma Development who is providing water and wet solid waste technologies, and full-time engineering support to the waste recycling portions of the project.

- **A-1 Organics** – the current landowner who is investing 80 acres of land and cash for permitting

**Leveraged Green Energy** – a partner in Plasma Development who is contributing equipment, plasma gasification technology and development engineering support

FOR INFORMATION ONLY

# Project Overview -- Environmental

| Key Environmental Enhancements | |
|---|---|
| **Current Practice** | **Our Solution** |
| 3.5 Million bbl. dirty water to disposal well (includes water in Solid Waste below) | 240,000 bbl. Clean Road Spray<br>2.93 M bbl. Clean Water for Aquifer Recharge and Agriculture |
| 200,000 tons Wet and Dry Solid Waste 95% Landfilled | 270,000 bbl. Recovered Oil<br>80,000 Tons Clean Fill<br>20,000 Tons PlasmaRok™<br>60,000 Tons Road Base |
| 150,000 Tons Curbside Carbonaceous Waste currently Composted or Landfilled | 25,000 Tons Renewable BioGas<br>130,000 Tons pure CO2<br>15 Megawatts of Thermal Energy<br>10,000 Tons PlasmaRok™<br>Substantial Additional Diversion from Landfill |

Leveraged Green Energy

NOVO
CHEMIONYX SYSTEMS

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# PROJECT OVERVIEW

The Project will consist of:

- **NOVO's Water Recycling** facility that can recycle up to 3 million barrels of produced and "frack flowback" water annually;
- **NOVO's Solids Recycling** facility that can recycle up to 400,000 tons of drill cuttings, sludges, muds, and other oilfield solid waste annually;
- **LGE's Gasplasma® plasma gasification** plant that can transform 150,000 tons of organic waste annually into clean, usable synthetic gas (syngas);
- A **Biogas Methanation** unit to transform the syngas into 25,000 tons of engineered renewable fuel

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# CURRENT STATUS

| Permitting Progress | | |
|---|---|---|
| | Jan 2018 | County Package Assembled* |
| | Aug 2018 | State EDOP Package in Final** Draft |
| | Sep 2018 | Permit Applications for Air, Water, Waste, TENORM Final Draft |
| | Sep-Oct 2018 | EDOP complete, County Review in process |
| | Sep 2018 | Air, water, Waste, TENORM Permit Applications submitted |
| | Nov 2018-March 2019 | Permit to Construct, CD and USR issued |

*Notes:*

- *County Package – Results in "Use by Special Review" Permit (USR). Package*
- *EDOP – Basic State Permitting document "Engineering, Design, and Operati… Expect EDOP to be in final draft within 3+ weeks*

| Revenue Development | | |
|---|---|---|
| | Gasifier Feedstock | "Curbside-Plus" 140,000 tons per annum. Expect to have long-term supply commitment through A1 Organics. |
| | Oil & Gas Feedstock | Will be on MSA basis with several Operators PLUS local Landfill Operator. Focus on Production waste to minimize variance. |
| | BioGas | Expect long-term offtake contract |
| | RoadSpray | Expect long-term offtake contract |
| | Oil<br>Water<br>Clean Fill<br>PlasmaRok | Remainder of BUP are commodities easily sold locally |

*Notes:*

- *MSA – Master Service Agreement, market based*
- *BUP – "Beneficial Use Products"*

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# Waste Streams and Recycled Product Sales

## 1 Gasplasma® Unit – 1 Water & Solid Waste System – 23mW Power Generation

Produced Water

Tank Bottoms & Muds

Organic Waste

Pre-Composted Sludge

### WASTE STREAMS

- 3,250,000 Bbl. Produced and Flowback Water
- 190,000 TPA Wet and Dry Cuttings, Tank Bottoms
- 150,000 TPA Curbside + Waste From A-1
- Gasplasma® WTE Unit

### PRODUCT SALES

- 64,800 Bbl. cake
  16,200 Bbl. oil
  240,000 Bbl. Road Spray
  2,929,000 Bbl. Ag Water
- 50,000 tons Road Base
  25,000 tons Clean Fill
  25,000 tons Plasmarok
  285,000 TPA Ag Water
- 270,000 Bbl. oil
- 25,000 tons Renewable Biogas
  130,000 tons pure CO2
  40,000 mWhth Heat

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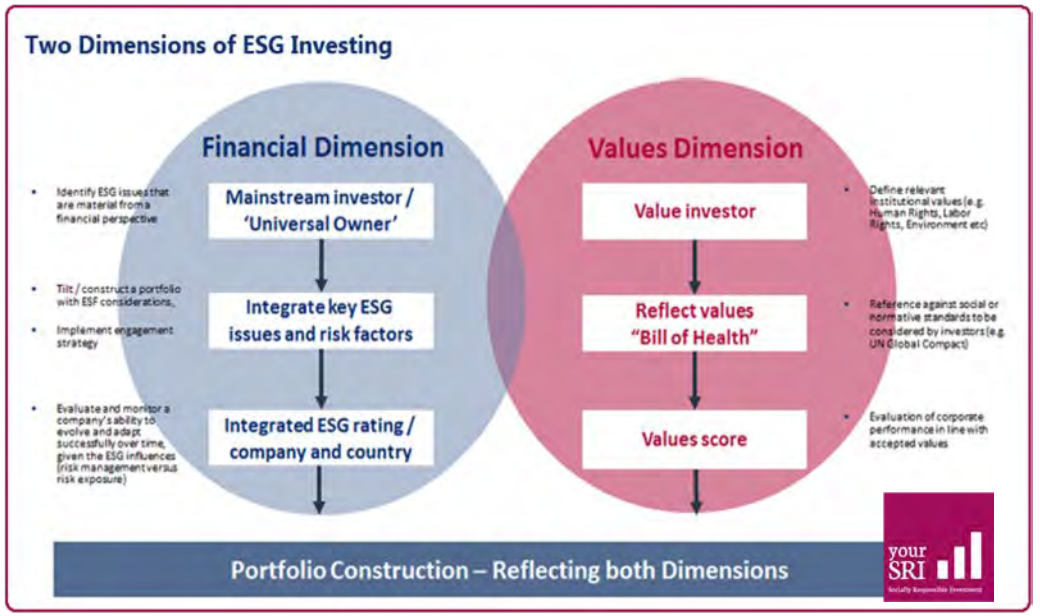
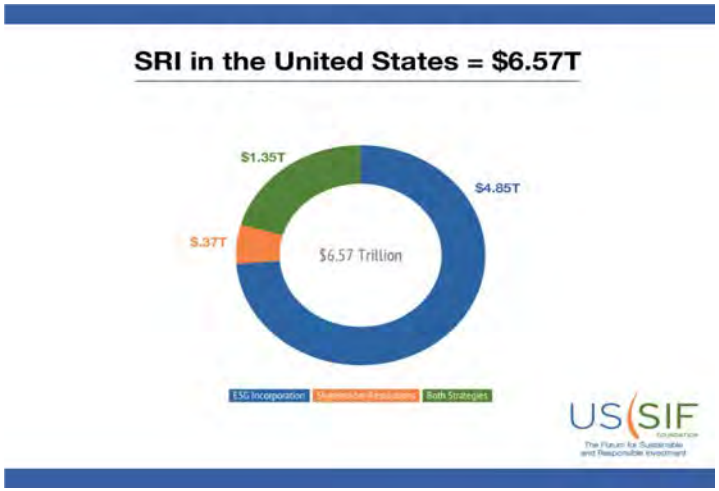
NOVO
CHEMIONYX SYSTEMS
ESG INVESTOR BIAS
Drives Project Selection of Feedstock and
Revenue Sources Toward Sustainability
Approach
A1
organics
LEVERAGED
GREEN ENERGY

# ESG Important theme for Investors

- ESG (Environmental, Social, and Governance) an important theme for institutional investors who finance projects such as this
  - Integrating "value" allocation with financial returns
  - Accepts "paying" for social externalities
  - Some expectation of future convergence
  - Both Regulator and Sponsor-driven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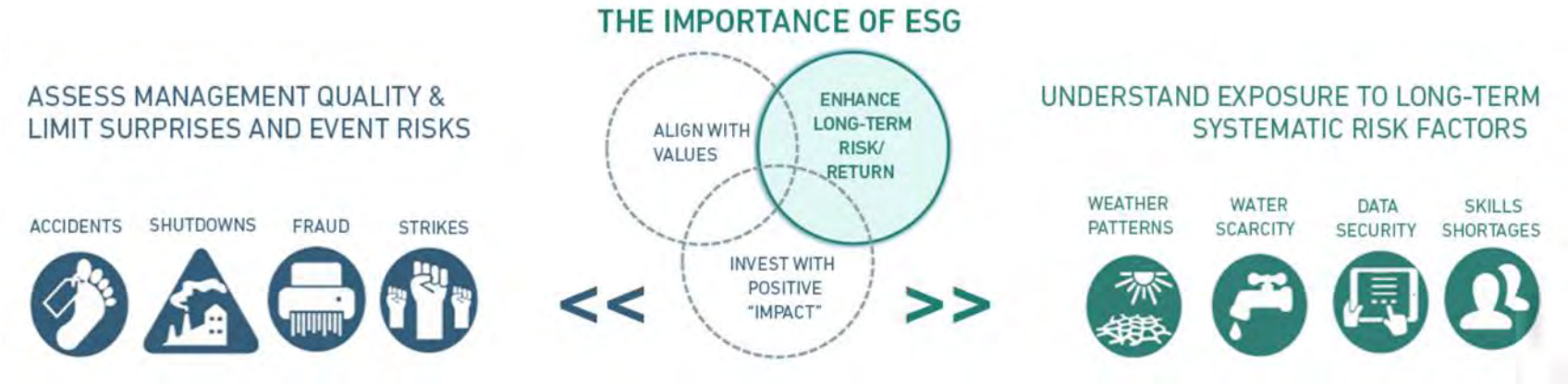
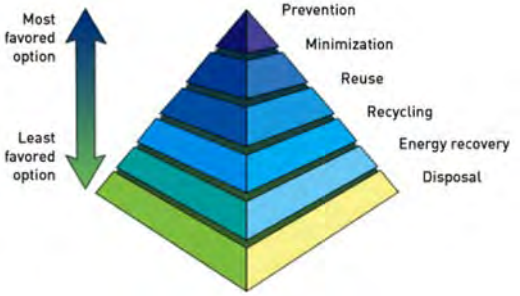
# ESG Finance-Values Convergence

## Risk-adjusted re-focus on potential long-term




*Source: MSCI*

- High-Value Target Areas
  - Waste Management
  - Power Generation
  - Water
  - Crop and Soil Management

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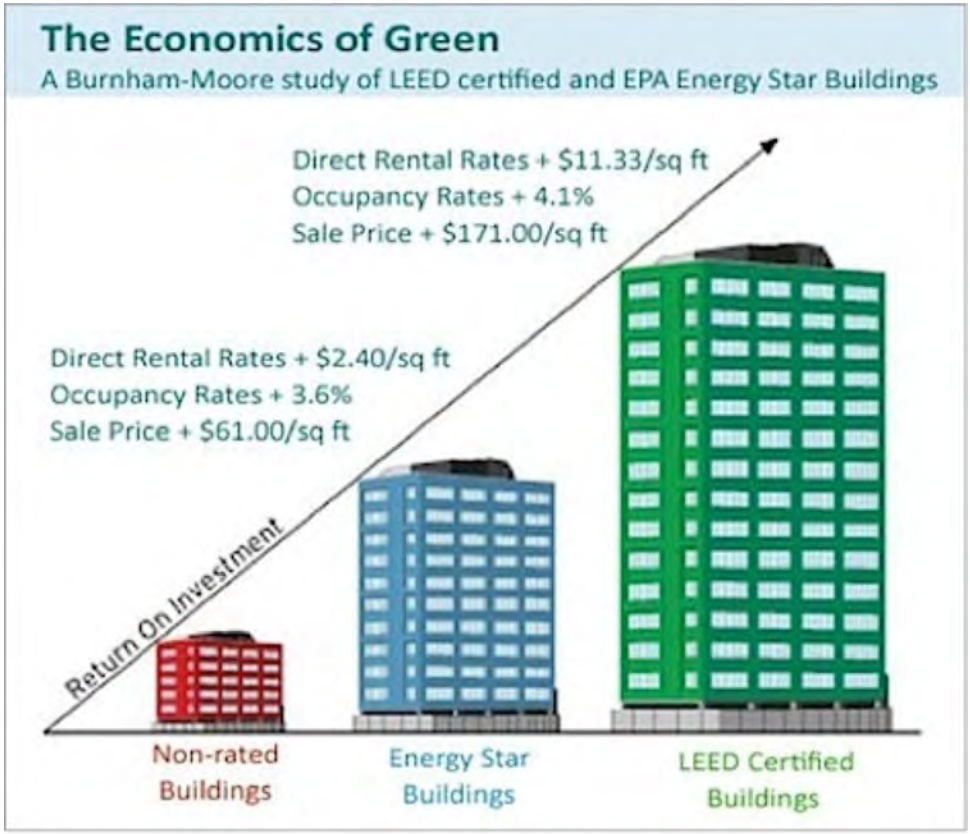
# Internalizing Environmental and Social Costs

## Regulatory Push

- Drive to force economic actors to pay for their environmental impact
  - Carbon tax
  - Tipping Fees on Waste
  - Emissions limits
- Provision of Incentives
  - FIT
  - Subsidies and Grants
  - Lowered cost of capital

## Market and Technology Pull

- Efficiency programs
- "Quality" branding
- SRI Investment mandates

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# GASPLASMA OVERVIEW

A1 organics

LEVERAGED GREEN ENERGY

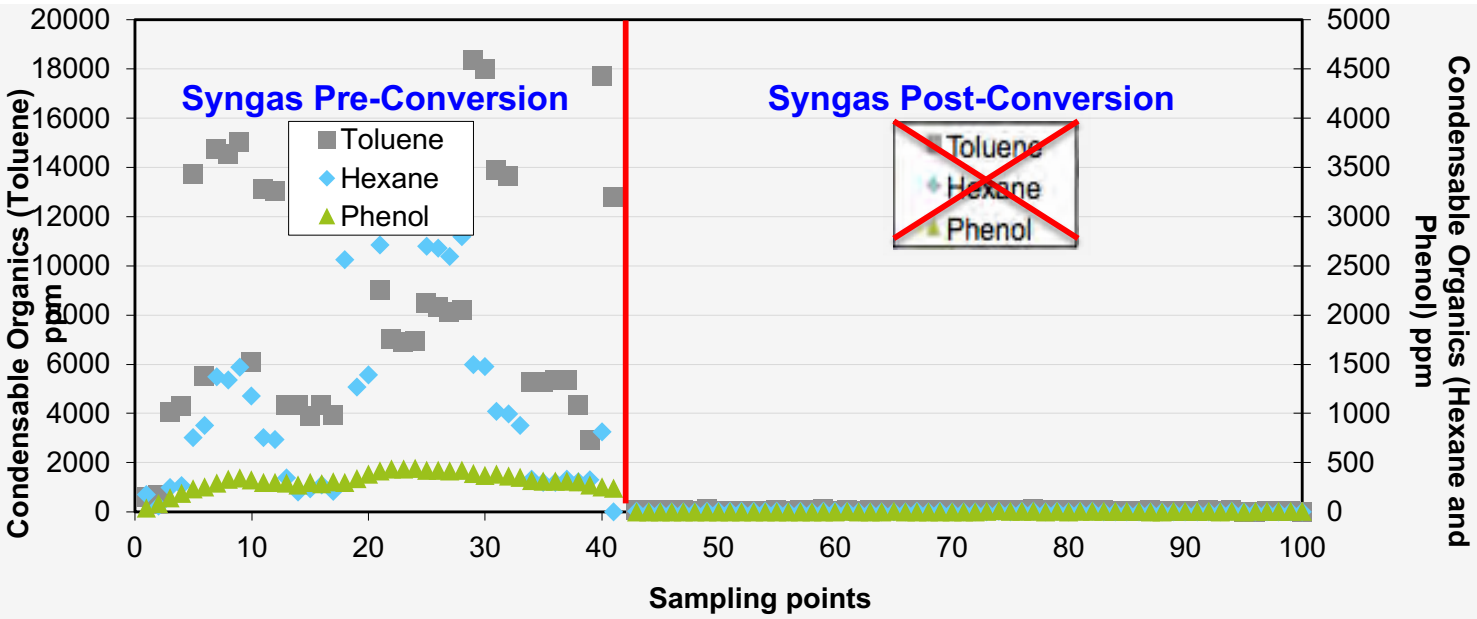
# GASPLASMA® WASTE TO VALUE

- Converts any organic waste to syngas
- Very high energy conversion rate
- Gas clean enough to use in GG or Fuel Cells
- Tested and Validated by U.S. Army


DEVELOPMENT

# GASPLASMA® SYNGAS QUALITY

## Syngas Purity




Syngas Composition
H2 36%
CO 37%
CO2 17%
N2 3.7%
H2O 4.2%
CH4 1.4%

- High temperatures of operation (1,100˚C+)
- Plasma 'cracks' the crude syngas and breaks up the complex molecular structure, into $H_2$, CO & $CO_2$ primarily
- Result is clean hydrogen-rich fuel gas of consistent calorific value
- Multiple applications: Hydrogen; Bio-SNG; Fuel Cells; Gas-to-Liquids

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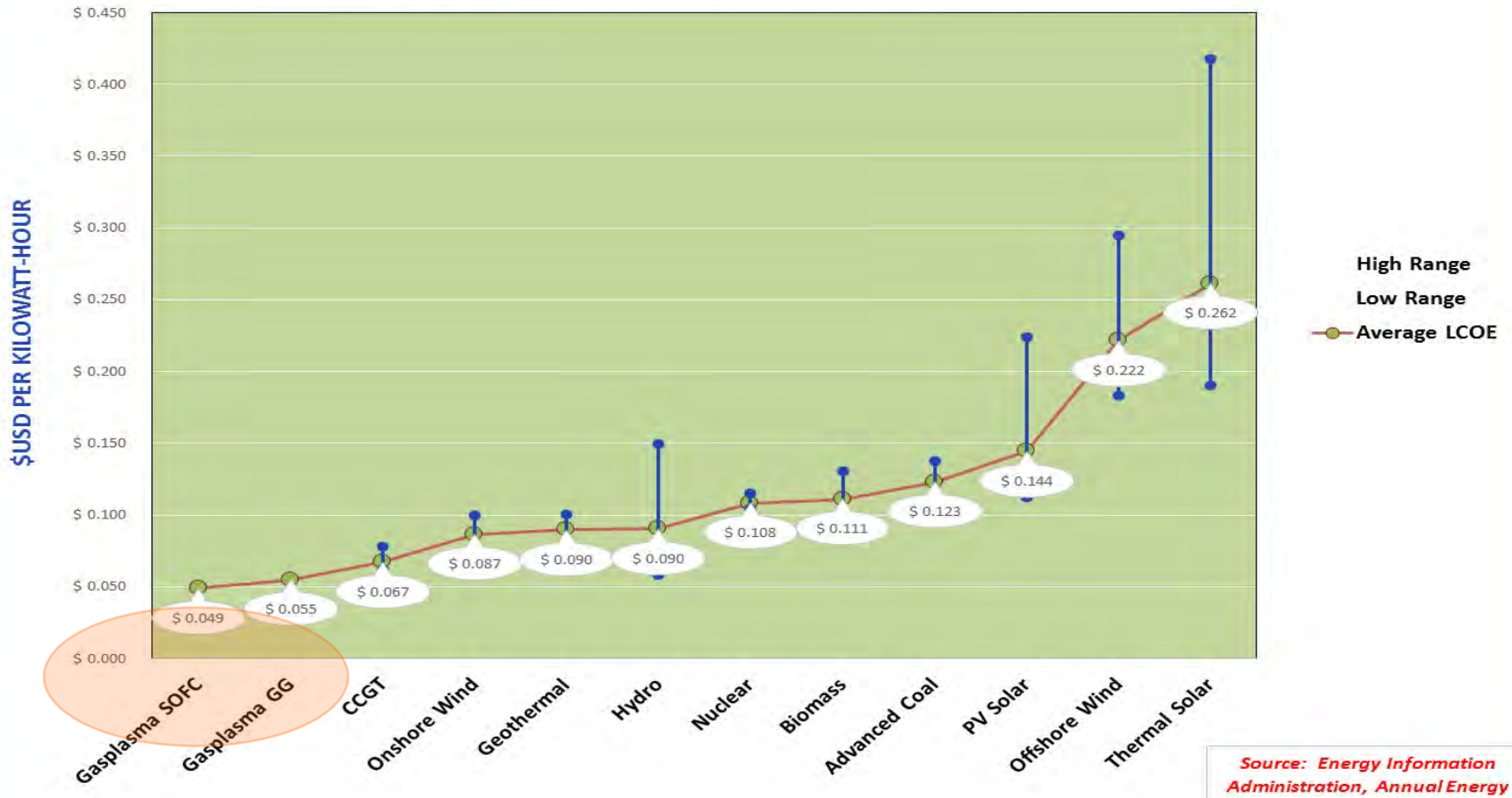
# GASPLASMA® PERFORMANCE

## Levelized Cost of Energy Generation Compared to Gasplasma - North America

*(U.S. DOE Forecast 2018-vintage Plants)*




*Source: Energy Information Administration, Annual Energy Outlook 2014, December 2013*

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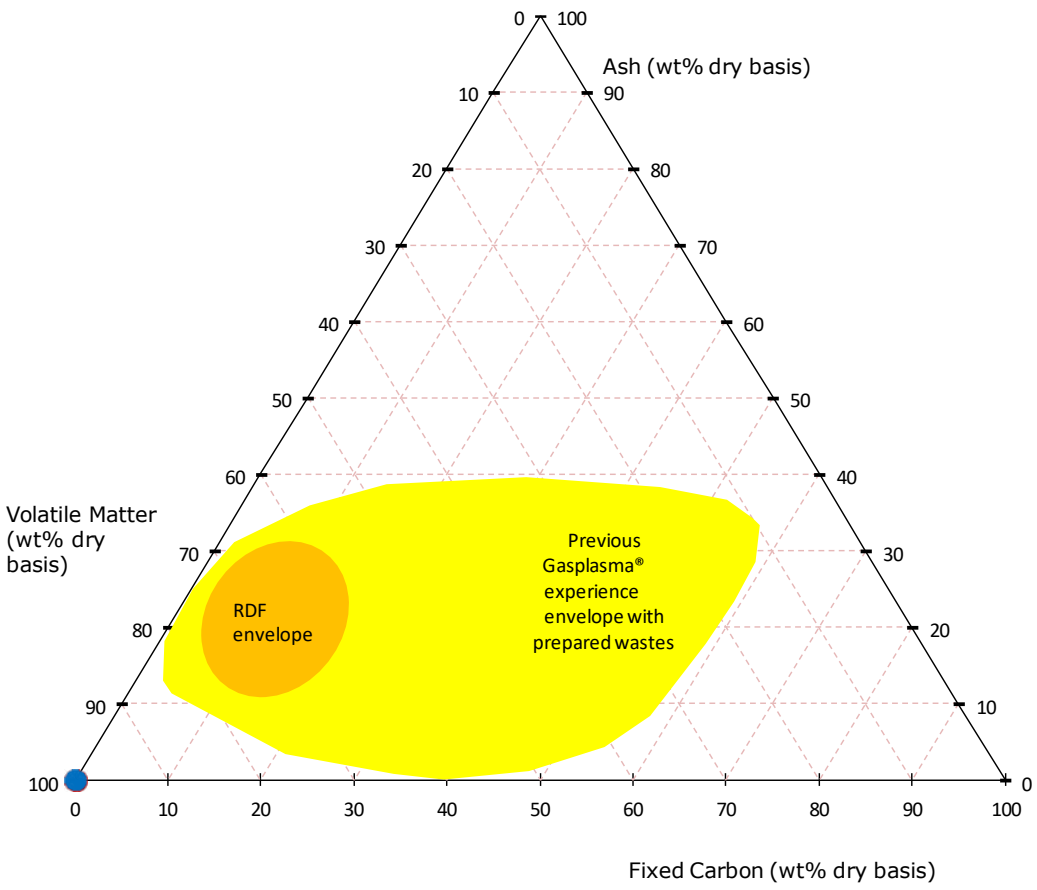
# GASPLASMA® FEEDSTOCK FLEXIBILITY




- Flexible, wide feedstock range
- Scalable, high efficiency, very low residues
- Only coarse shredding of waste needed
- Utilisation of steam for drying
- Recovery of Recyclates, i.e. metals, dense plastics (complies with waste hierarchy)

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# Gasplasma® Industrial Applications

Gasplasma® Combined with New Technologies

Gasification of Organic Materials (industrial process for engineered fuels)

Direct Treatment of Inorganic Materials (recovery of materials)

New Processes

## Clean Syngas and Usable Recovered Materials

| Mining and Minerals | Oil , Gas, & Coal Extraction | Chemical & Petrochemical Manufacturing | Wood, Pulp, and Paper Processing | Transportation Waste Elimination |
|---|---|---|---|---|
| Cement | Enhanced Oil Recovery (CO2) | Pharmaceutical Waste Disposal | Chemically Treated Wood | Harbors and Ports<br>•bilge & oil spills<br>•fertilizer & pesticide residue<br>•chemicals |
| Industrial Lime | Power Generation (Gas, Syngas, H2) | Legacy Pond Elimination | Gasification of Substandard Biomass | Airports and Aircraft<br>•consumer waste<br>•oils & lubricants<br>•de-icing fluid |
| Non-Ferrous Metals | Gasification of Coal Waste | Pollution Control (particulates, chemicals, and CO2) | Waste Biomass for Energy Recovery | Railways<br>•discarded industrial materials<br>• chemically treated wood<br>•organic and inorganic industrial and hazardous materials |
| Ferrous Metals | | Slop Oil, Bottom Oil, and Refinery Waste | Treatment of Off-gasses and Black Liquor | |

Downstream Processing

Energy Recovery and Processing

Cleanup and Energy Recovery

Cleanup and Energy Recovery

Cleanup and Energy Recovery

## New Products

| Engineered Fuel Products | Combined Processes |
|---|---|
| -Pure Hydrogen<br>-Clean Co2<br>-Engineered Biofuels<br>-Gas-to-Liquids | Syngas & Fuel Cells<br>-Solid-Oxide<br>-Hydrogen |
| -Synthetic Methane | |

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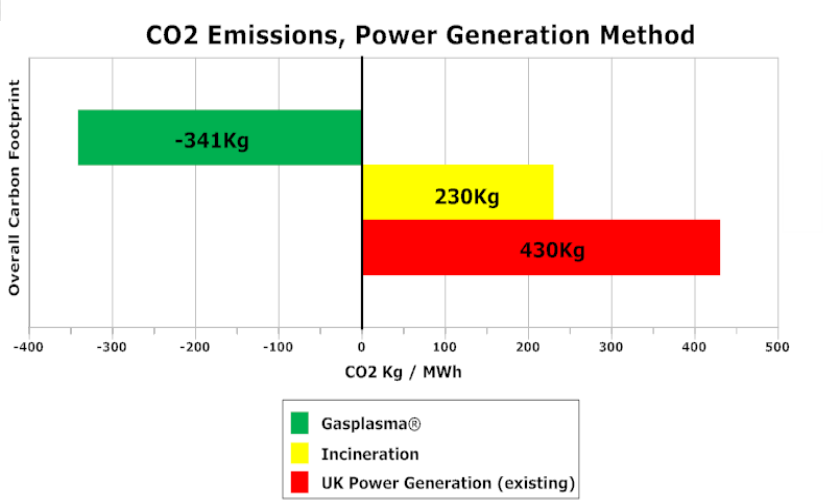
# GASPLASMA® PERFORMANCE

- **Gasplasma® is:**
  - A patented two-step process that gasifies carbon-rich municipal, commercial, industrial and hazardous waste and then cleans the resultant syngas by cracking it with a plasma torch.
  - An application of proven technologies in a novel way to produce a substantial jump in efficiency, and near-elimination of unusable wastes.
- **Third-Party Testing has Demonstrated that the Gasplasma® Process:**
  - Is economically competitive with fossil fuels;
  - Mitigates of a wide spectrum of persistent environmental liabilities, with production of high value engineered fuel at reduced cost;
  - Has a documented negative carbon footprint;
  - Can be used for the generation of second level engineered fuels such as syngas to bio-diesel; and,
  - Has a significant first-mover advantage protected by patents in 56 countries.




*Source: Wardell Armstrong (UK) study, 2010*


PLASMA DEVELOPMENT

# Gasplasma® Competitive Advantage

**Gasplasma® Presents a Technology Breakthrough:**

- Gasplasma® has been evaluated as demonstrably superior to existing competing technologies by a number of independent third-party organizations. Gasplasma®'s patented process takes a fundamentally different approach to the production of syngas as follows:
- **Use of Starved Oxy-Steam in the Gasifier** -- competing technologies us air or starved-oxy-air in the gasifier. Gasplasma®'s gasification process requires much less energy, produces a higher-quality syngas, and is overall substantially more efficient.
- **Separation of Gasification from Cleaning of the Syngas** – competing technologies use plasma torches to add heat to the gasification process and increase mass conversion.
- **Gasplasma Process Delivers Superior Performance Against Competitive set, with:**
  - 80% or greater mass conversion, no pyrolysis, chars or tars created.
  - Very consistent syngas quality, 10MJ/kg v. 4-6MJ/kg using other technologies.
  - Syngas production is virtually emission-free.
  - High-uptime, High-efficiency, Economically viable, Transformative technology.

From This:

To This:

PLASMA DEVELOPMENT

# Advanced Plasma Power

Advanced Plasma Power (APP) is a UK-based global pioneer in advanced waste-to-energy and fuels technology that has developed and patented Gasplasma® technology in 56 countries

Founding company of APP is Tetronics International, established in Oxfordshire, UK in 1964 to supply world leading DC Plasma technology.

Tetronics Plasma thermal treatment technology is core to the APP Gasplasma® process.

APP formed in 2005 to commercialise the globally patented technology

Gasplasma Pilot plant operated from 2005, full demonstration plant from 2008

LGE recapitalized the company in 2009 and has led the development and deployment effort for the technology since that time

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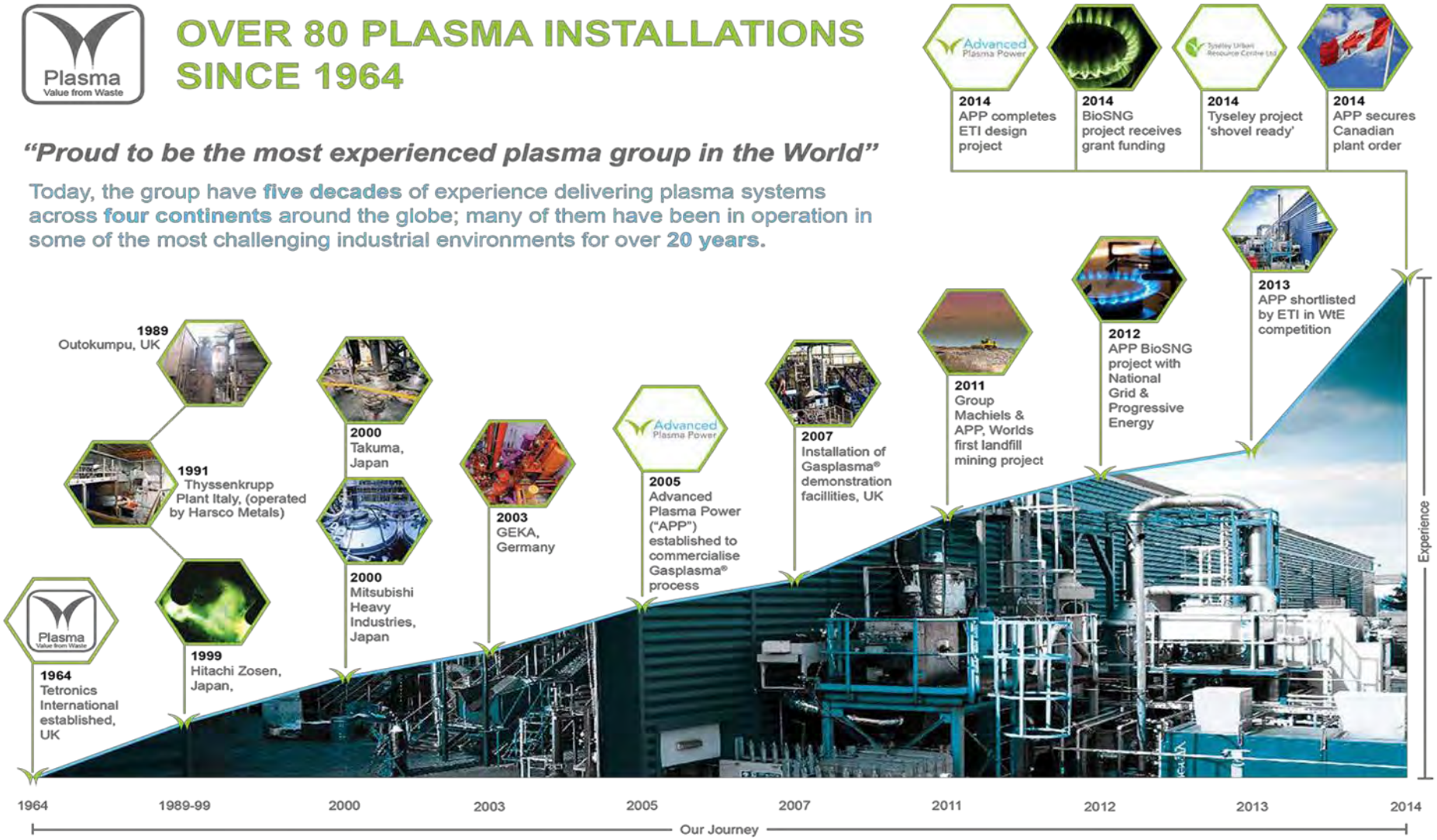
# TETRONICS 50-YEAR TRACK RECORD

## OVER 80 PLASMA INSTALLATIONS SINCE 1964

***"Proud to be the most experienced plasma group in the World"***

Today, the group have **five decades** of experience delivering plasma systems across **four continents** around the globe; many of them have been in operation in some of the most challenging industrial environments for over **20 years.**



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