# Building Sustainable Installations

## Advances in Waste-to-Energy Technologies



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*Environmental Scientist*

*September 27,2011*
*Washington, D.C.*

# Agenda Topics

*What We Will Talk About…*

- *Current Status*
- *Plasma Technology – Energy Security*
- *System Layout and Design*
- *Environmental Considerations*
- *Summary*

# Where Does Your Garbage Go?

# Where Does It Go?

## Business As Usual

# Where Does It Go?

*Seriously…?*

*Is this the best we can do???*

# Open Pit Burns in Theater

## Issues for Airmen downrange

Credit: *Air Force TImes*

# What is Plasma?

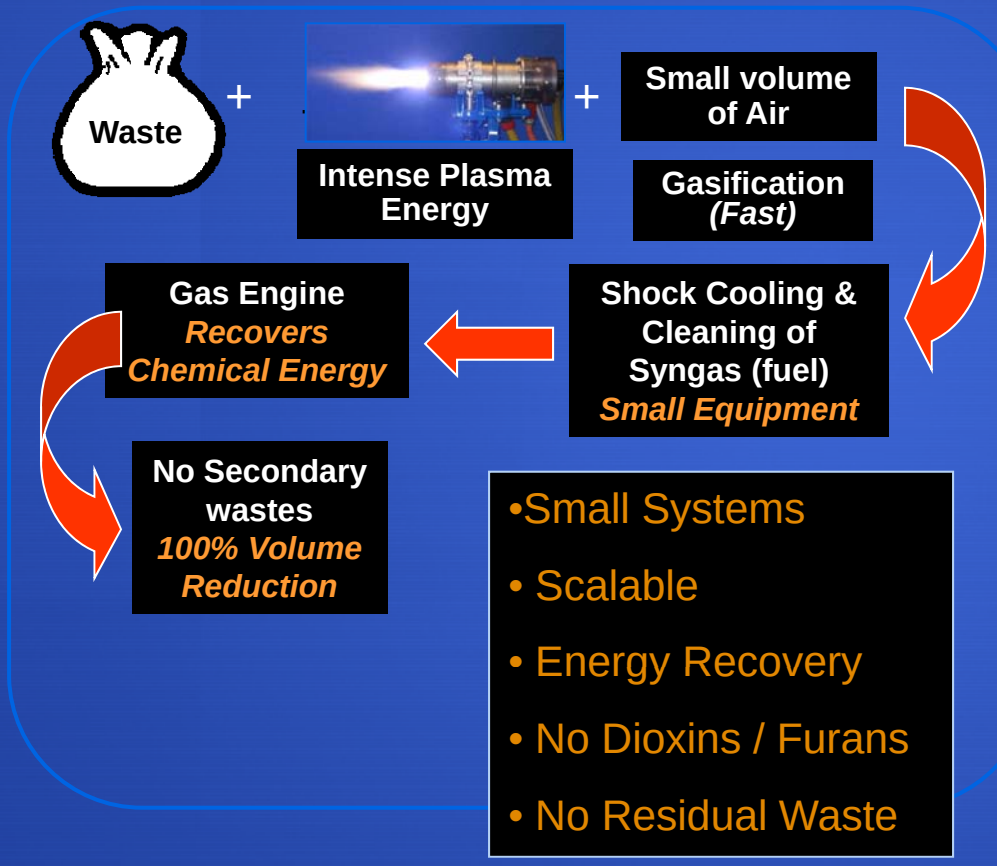
- *Plasma is an ionized gas that conducts electricity*
- *The electrical current releases large amounts of heat*
- *Several technologies have been developed to use this source of heat which can reach temperatures over 9,000°F*

**There are four states of matter**

SOLID → LIQUID → GAS → **PLASMA**
<32°F >32°F >212°F >9000°F
ICE → WATER → STEAM → **IONIZED GAS**

Hot as the surface of the sun

# Plasma Gasification Process



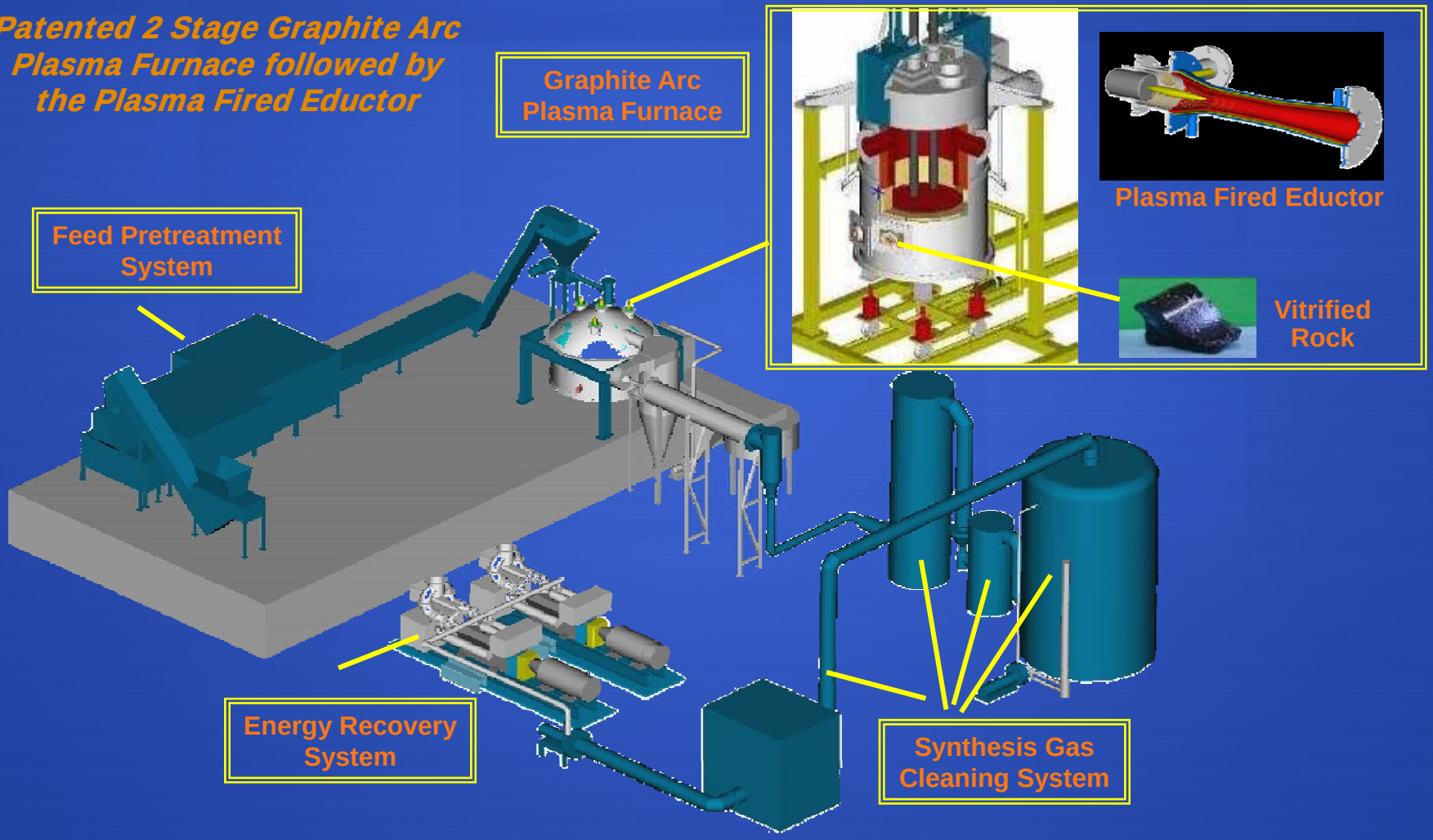

## Plasma Byproducts




**Reduces GHG → Carbon Credits**

# Typical Design Layout

***Patented 2 Stage Graphite Arc Plasma Furnace followed by the Plasma Fired Eductor***




Credit: *PyroGenesis Canada*

# Pilot Project in Florida

***System can handle hazardous and/or non-hazardous wastes:***

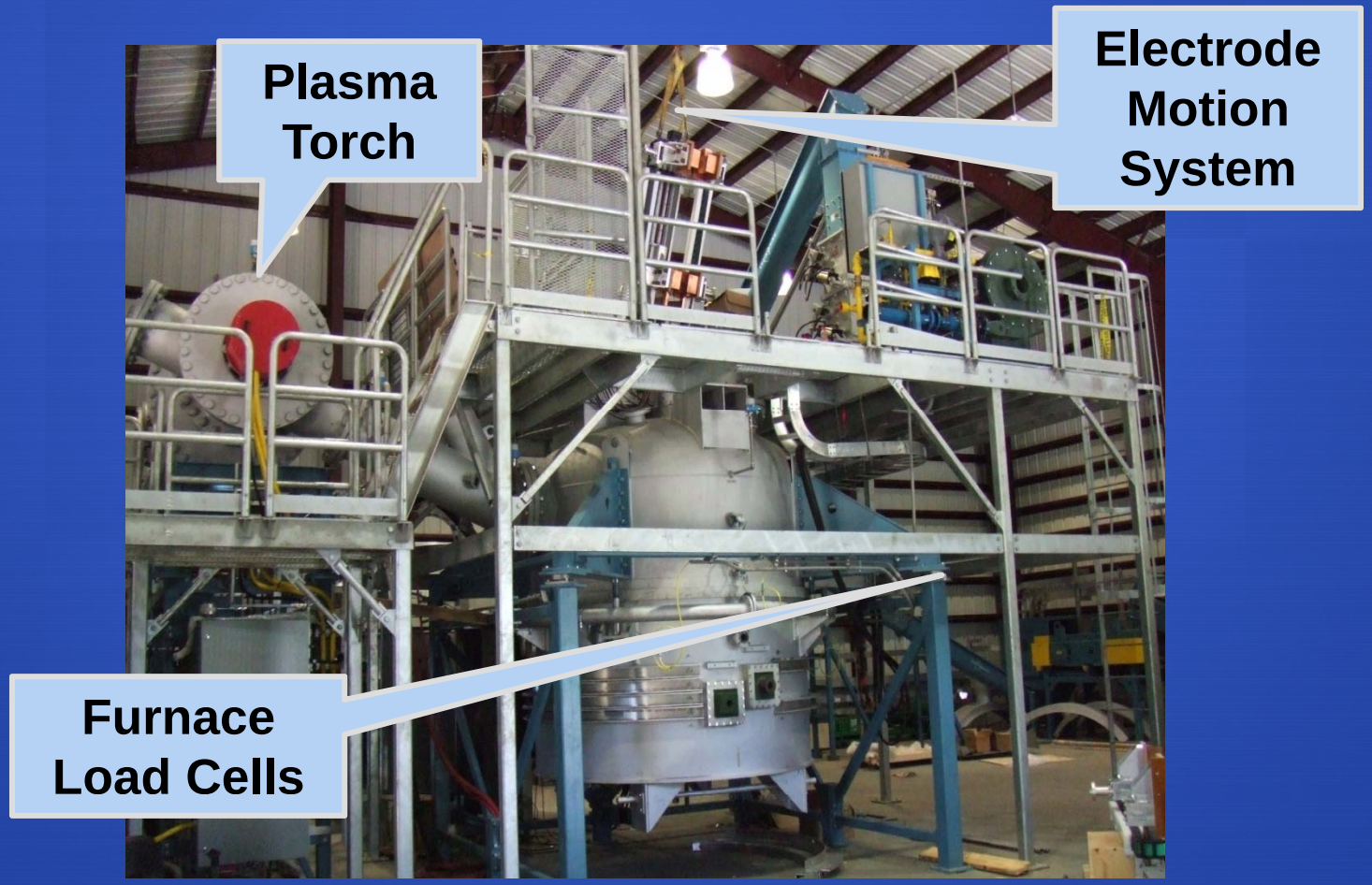
- *Hospital/Clinical*
- *Hazardous*
- *Industrial*
- *PCB's*
- *Municipal Waste*
- *Sludge*
- *Flammable liquids*
- *Chemical/biological*

***Successful test in Florida will launch larger scale applications***

- *Economic benefit to the taxpayer*
- *Good neighbor news story*
- *Advances technology for the Nation*

***Will allow Federal Agencies to exceed many EO 13423/13514 mandates***

# Electrode Motion System Installation



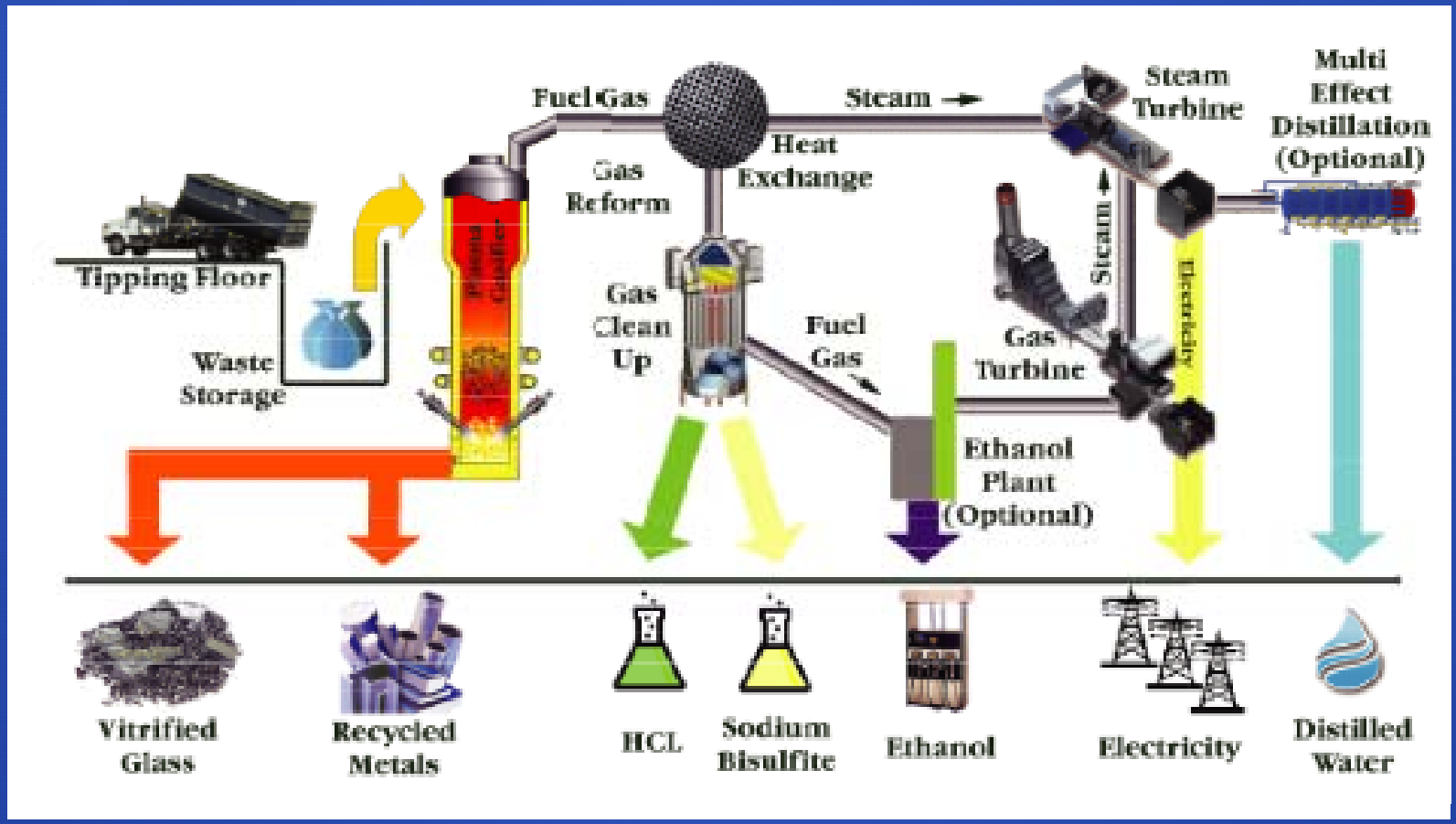
# Removable Crucible

# Molten Metal Oxides

# Thermal Shock to the Slag Produces Inert Aggregate

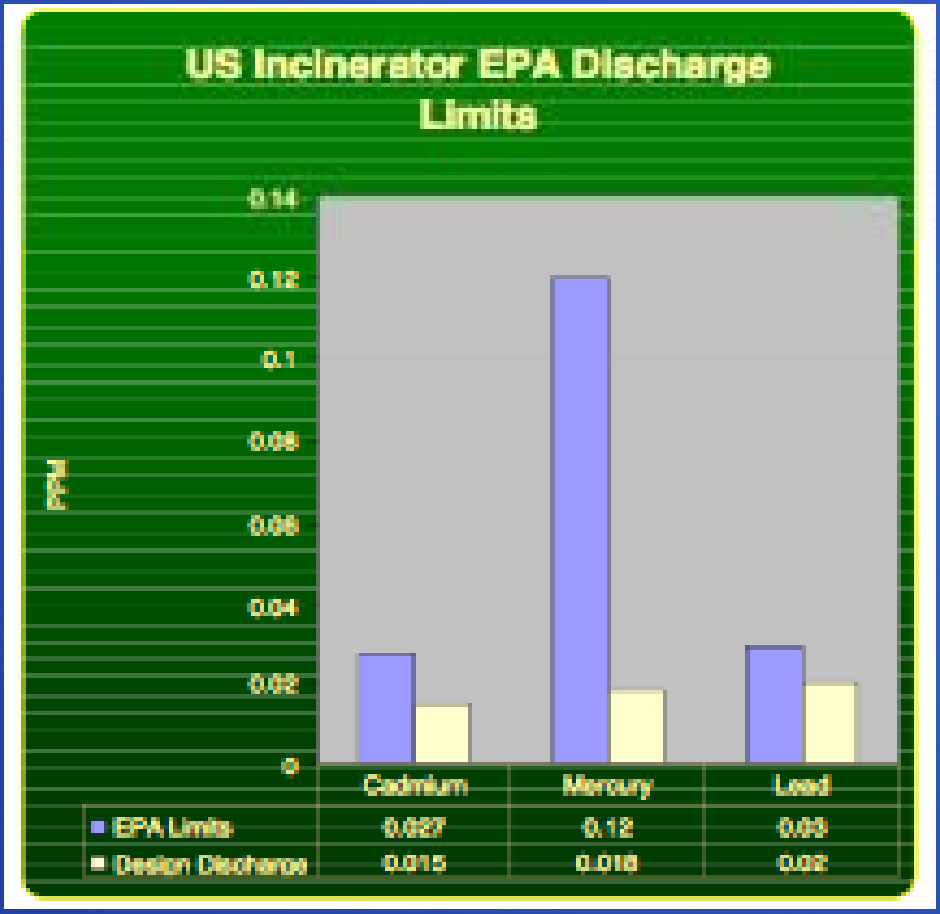
# Metal Oxides After Thermal Shock

# Process Flow




Credit: *Recovered Energy Systems*

# *Benefits of the Technology*




USEPA, Discharge Standards under AP 42 5th Ed, Vol 1, Ch 2, Se 2.1 June 2002

This is **NOT** incineration!

Gasification is a much cleaner technology

The USEPA and FDEP results demonstrate that the slag produced is much cleaner that incineration

Air emissions significantly less than USEPA standards

# *Environmental Considerations*

- 95% reduction in Mercury
- 60% reduction in Nitrogen Oxide
- 95% reduction in Sulfur Dioxide

- This is not an energy project
  - We take a waste management problem into an energy generating solution
- We achieve a fixed cost from a non-volatile source of energy

# *Inert Slag from Plasma Furnace*

The vitrification furnace produces an inert slag which can be used as an aggregate for construction materials and can be recovered in many forms. The TCLP results demonstrate that the slag produced is well below regulations.

| METAL | Units | Sample Result | Detection Limit | Regulation |
|---|---|---|---|---|
| Arsenic (As) | mg/L | ND | 0.3 | 5.0 |
| Barium (Ba) | mg/L | ND | 0.1 | 100 |
| Boron (B) | mg/L | ND | 0.3 | 500 |
| Cadmium (Cd) | mg/L | ND | 0.05 | 0.5 |
| Chromium (Cr) | mg/L | ND | 0.05 | 5.0 |
| Lead (Pb) | mg/L | 0.2 | 0.05 | 5.0 |
| Selenium (Se) | mg/L | ND | 0.3 | 1.0 |

# Carbon Credits

Technology Early Action Measures (TEAM)
Fourth TEAM Progress Report 2005–2008

CLEAN ENERGY AND CLIMATE CHANGE SOLUTIONS FOR CANADA AND THE WORLD

Canada

INT-049

**INT-049 PyroGenesis Canada**

Plasma resource recovery system turns waste into energy

In this project, PyroGenesis Canada will enhance its existing design towards commercial scale and demonstrate a 10 tonne-per-day plasma resource recovery system (PRRS) that turns waste into syngas, vitrified rock and metal. Syngas can be used to generate electricity and heat while the "glassy rock" can be used as an aggregate for construction and metals can be sold for recycling. This project will use a wide range of waste streams from the United States Military, including municipal solid waste, hazardous waste and bio-medical waste.

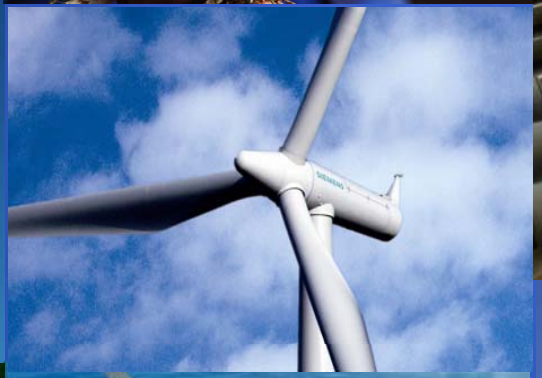
Greenhouse gas reduction:

- 83,037 t $CO_2e$ per year
- 25.66 t $CO_2e$ per tonne of waste processed

**Partner:**

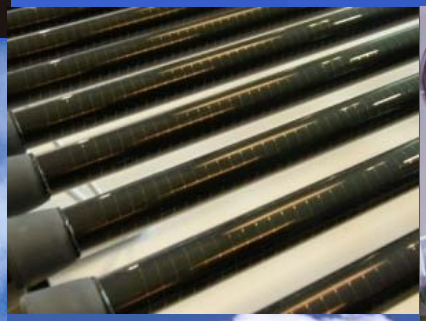
- The United States Military

# Benefits of the Technology



Lots of ways to generate energy

So what's the problem?



# *Benefits of the Technology*

Lots of ways to generate energy

Many sources of RE are intermittent

Some require precious metals that are in short supply (unsustainable)

Oftentimes the resources is far from where people live (line loss)

Plasma Waste-to-Energy technology offers "dependable" energy **AND** solves the solid waste problem

# Summary

- *Plasma Waste-to-Energy technology can:*
  - *Save taxpayer dollars*
  - *Convert waste to energy, i.e. electrical and heat*
  - *Recover beneficial products waste stream*
  - *Significantly reduces greenhouse gas emissions*
  - *Divert waste from landfills*
  - *Mine and reclaim legacy landfills*
  - *Help agencies exceed EO 13423 & 13514 goals*
- *Opens the door for future federal/state/local applications*
- *Help solve tough war fighter problems!*

# Energy Technology Center

# Green Jobs Incubator: STEMS

# The First-of-its Kind Zero 4 Facility

# Building Sustainable Installations

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# BACK UP SLIDES

# Shameless Plug

# E3 Summit

ENERGY, ECONOMICS, & the ENVIRONMENT

## REenergizing *the Gulf Coast*



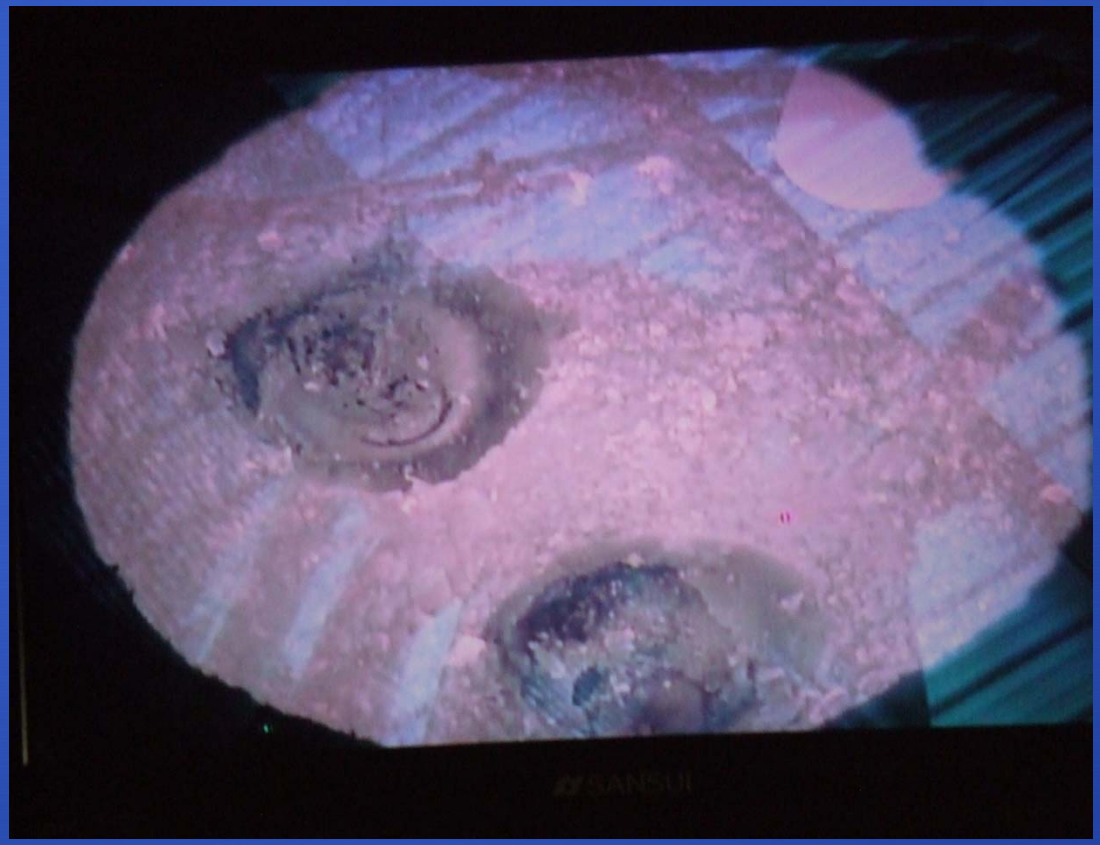

THE E3 SUMMIT promotes input from all sectors regarding the current and future challenges facing these communities in an effort to identify the resources and strategies necessary to build a resilient GULF COAST.

THE E3 SUMMIT serves as a forum to promote the sharing of information that will serve as a foundation for future initiatives to REENERGIZE THE GULF COAST!

THE E3 SUMMIT provides a platform for : Scientists, Engineers, Researchers, Industry Leaders, Scholars, Practitioners, Analysts, Designers, Service Providers, Legislators, Manufacturers and anyone involved in energy, economic, and environmental strategies supportive of a clean global economy.

GULF COAST ENERGY NETWORK
A NON-PROFIT FLORIDA CORPORATION

# Camera View Inside Crucible

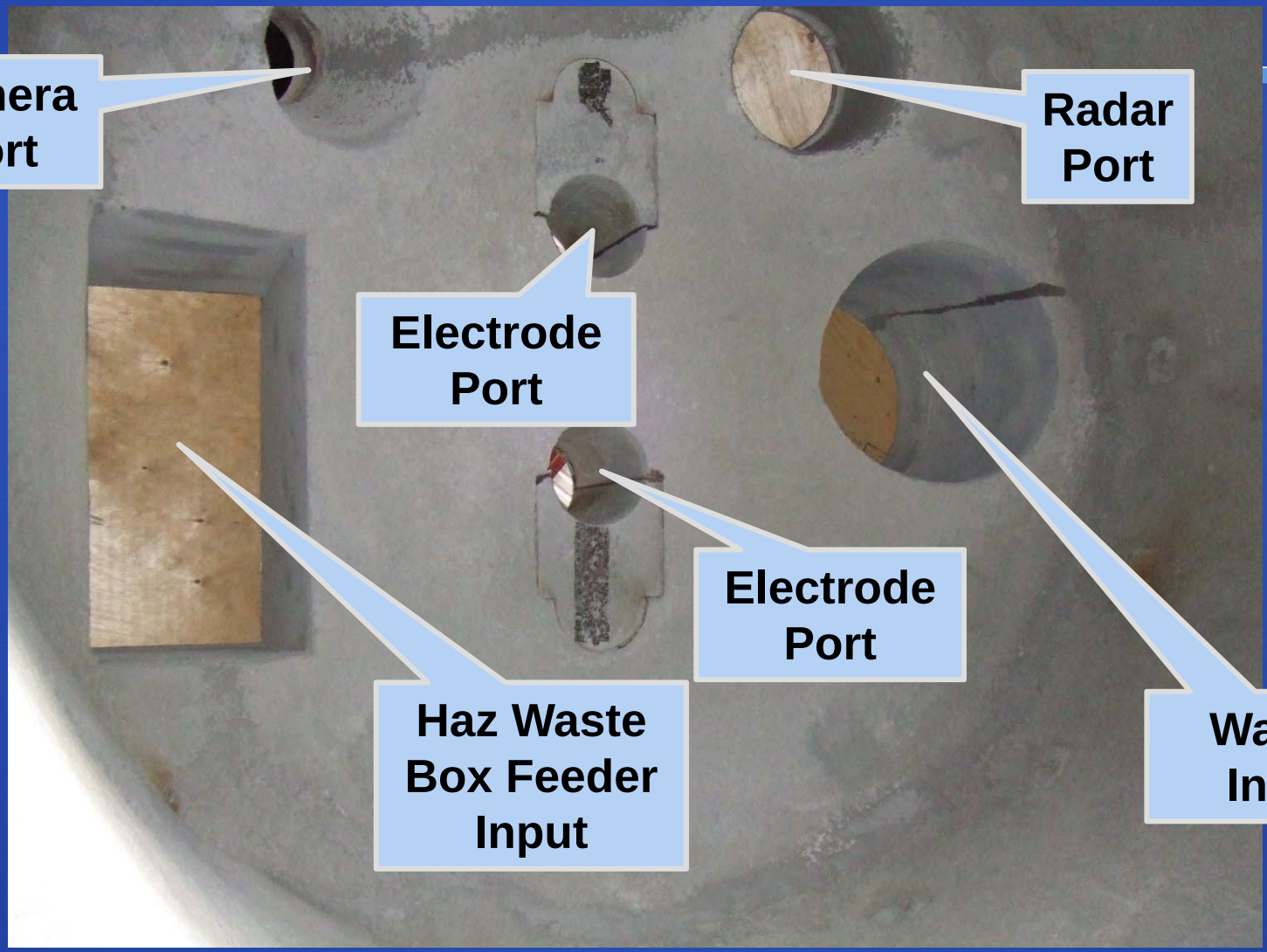


# Tapping the Inorganic Fraction

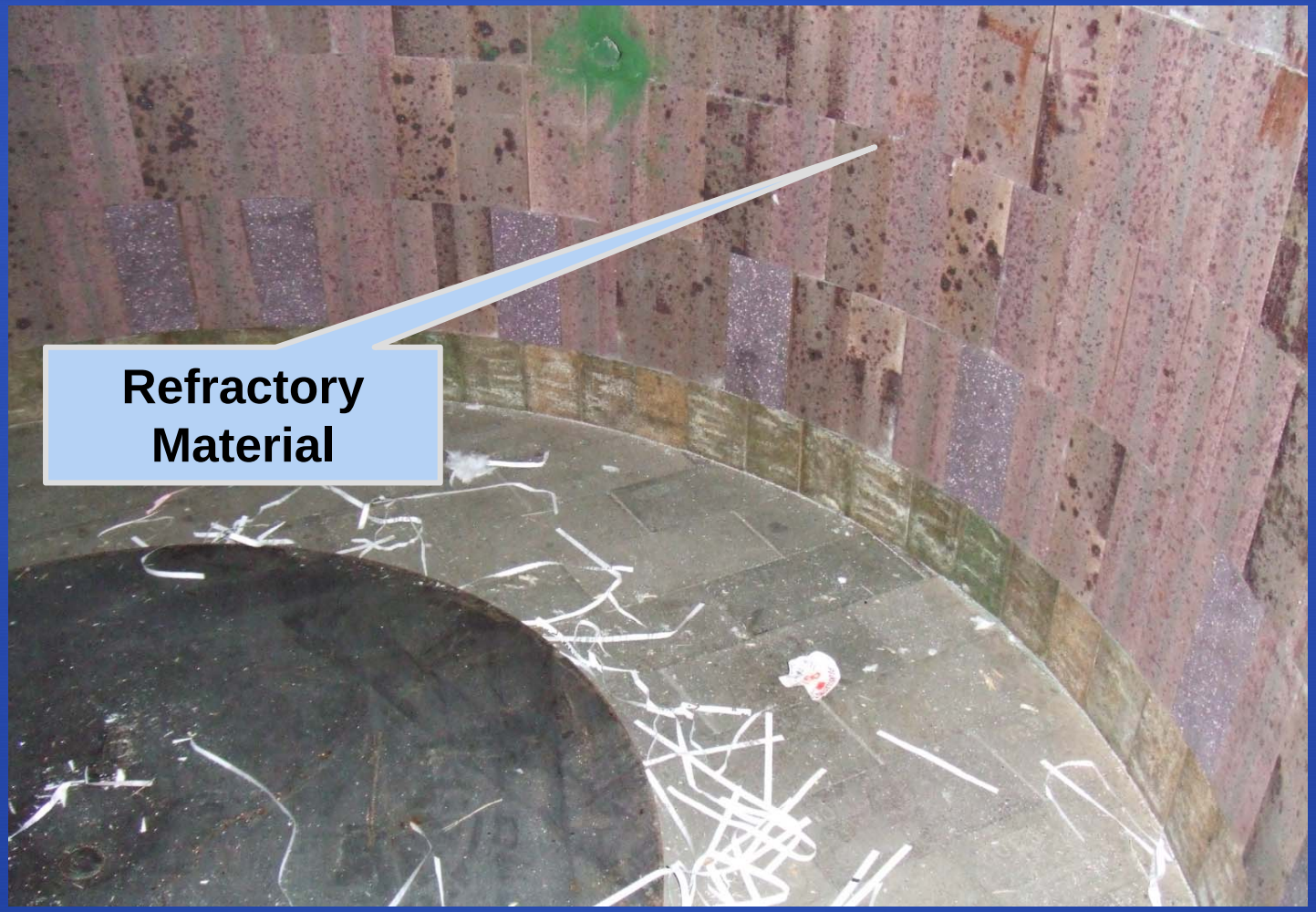
# Solidified Inorganic Material

# Plasma Furnace Spool

# Refractory Unit

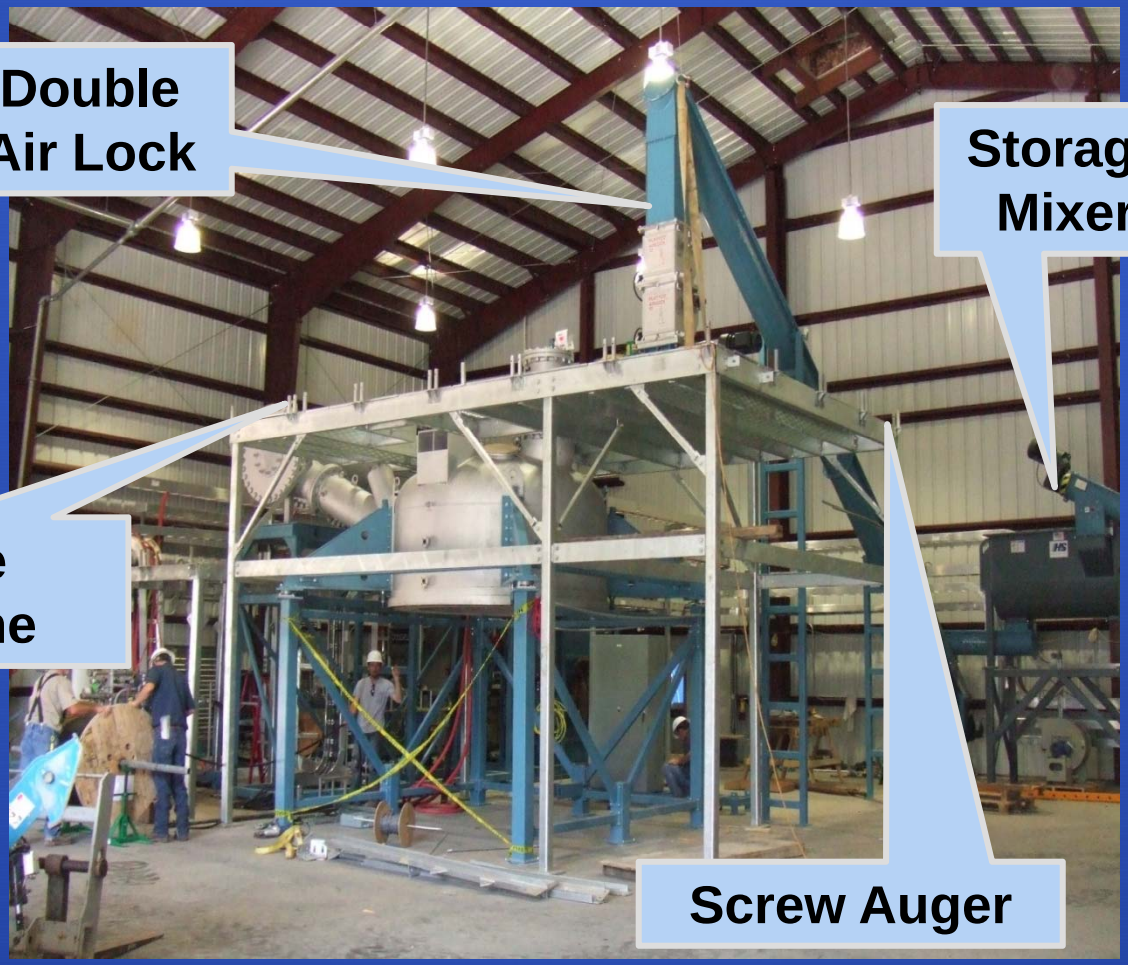


# Crucible Refractory



# Storage Mixer and Screw Augers

# Furnace Mezzanine

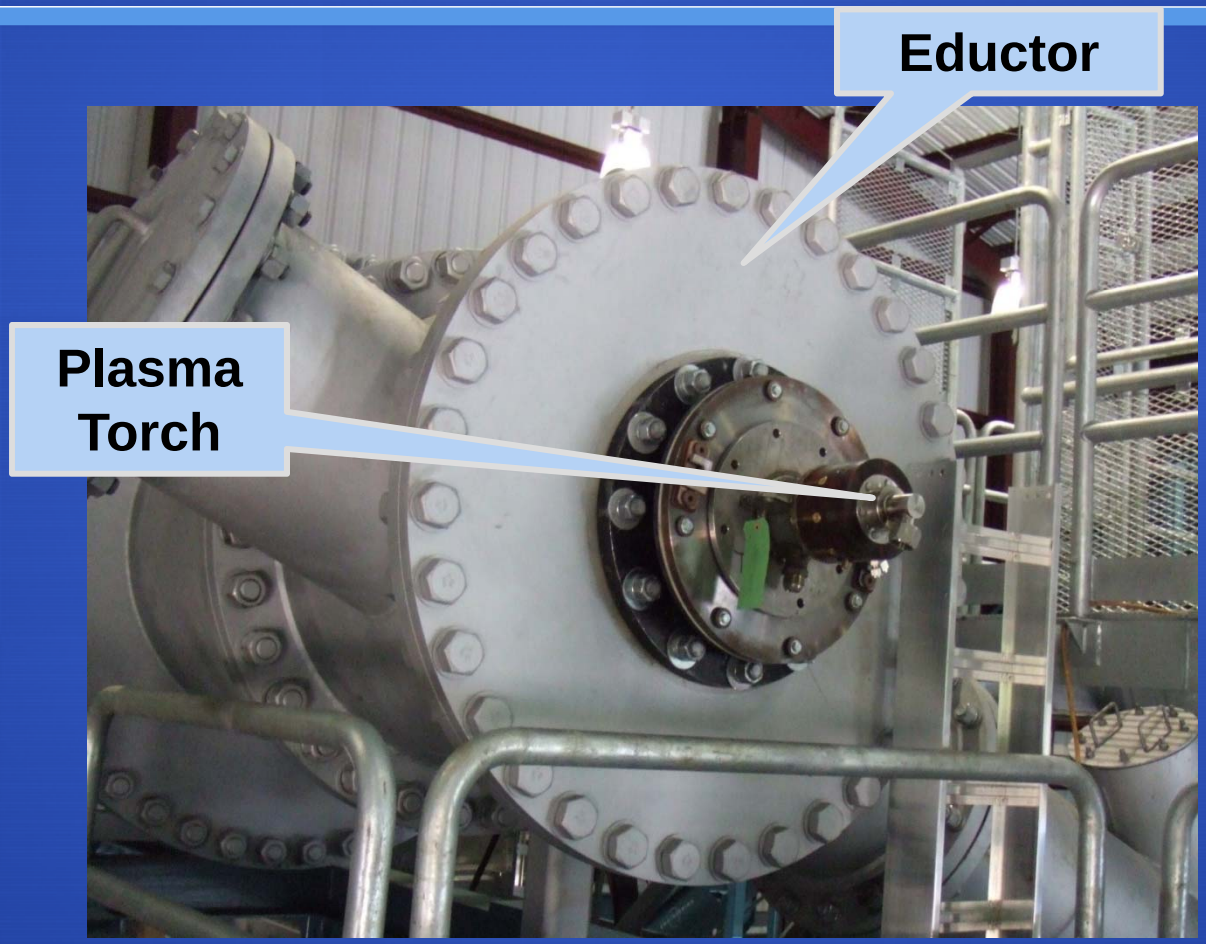


# Electrode Motion System Installation

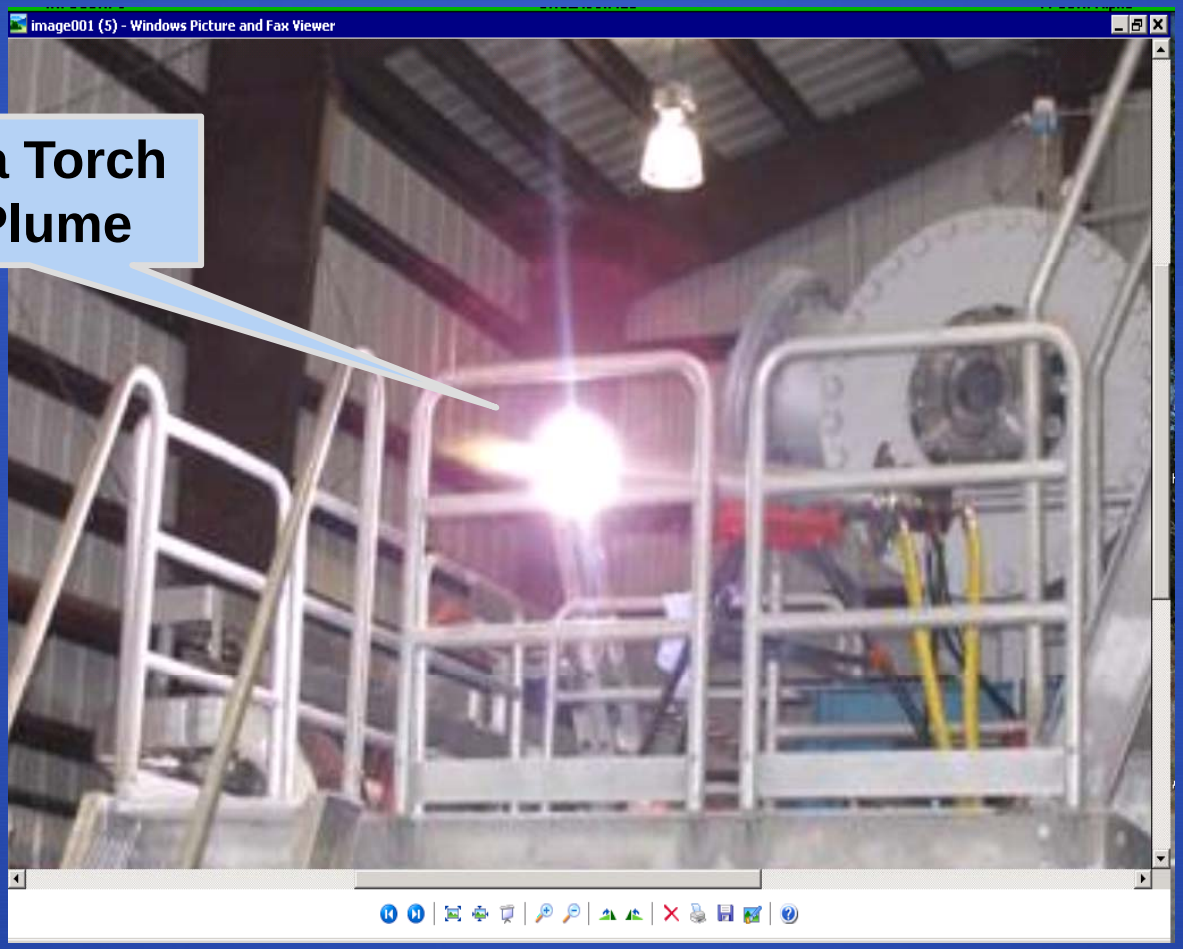
# DI Water Cooling System

# Plasma Torches

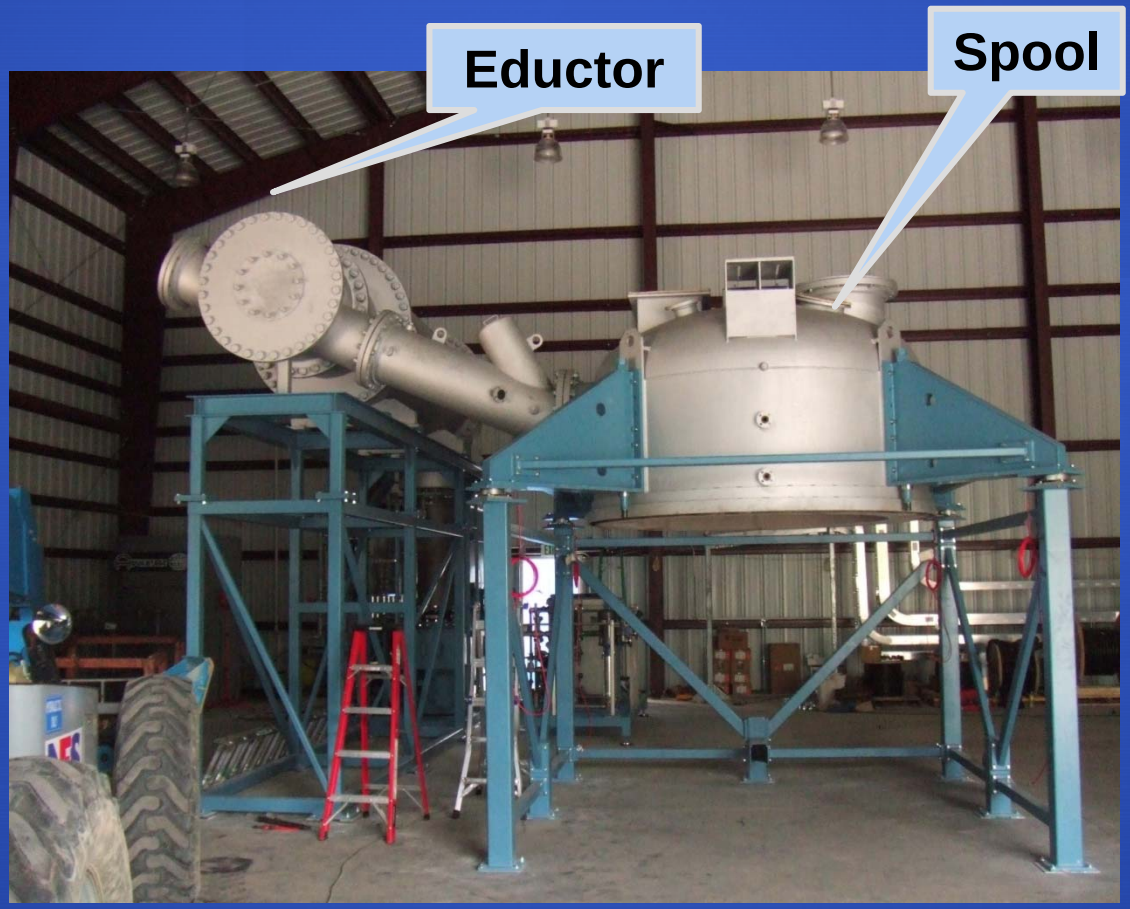
# Plasma Torch Installed



# Plasma Torch Test

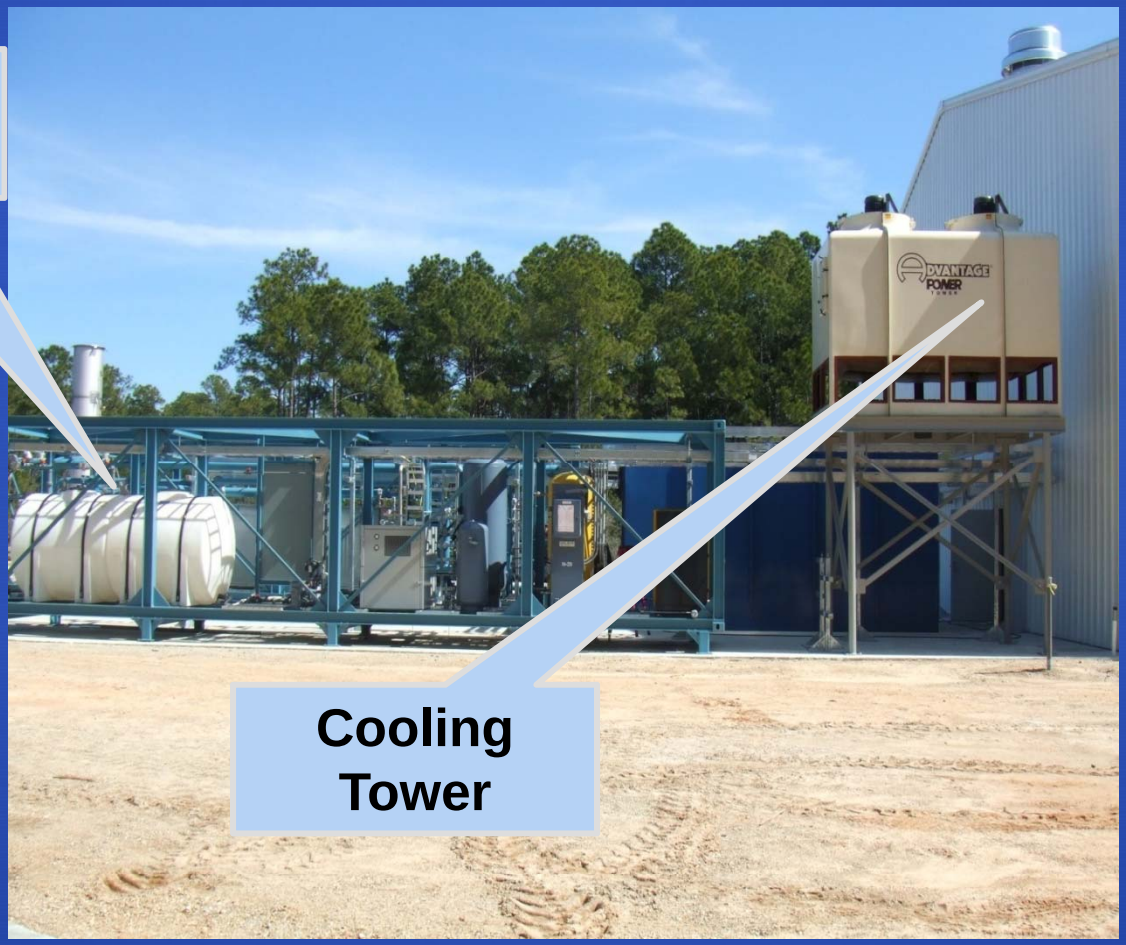


# Crucible Spool and Eductor

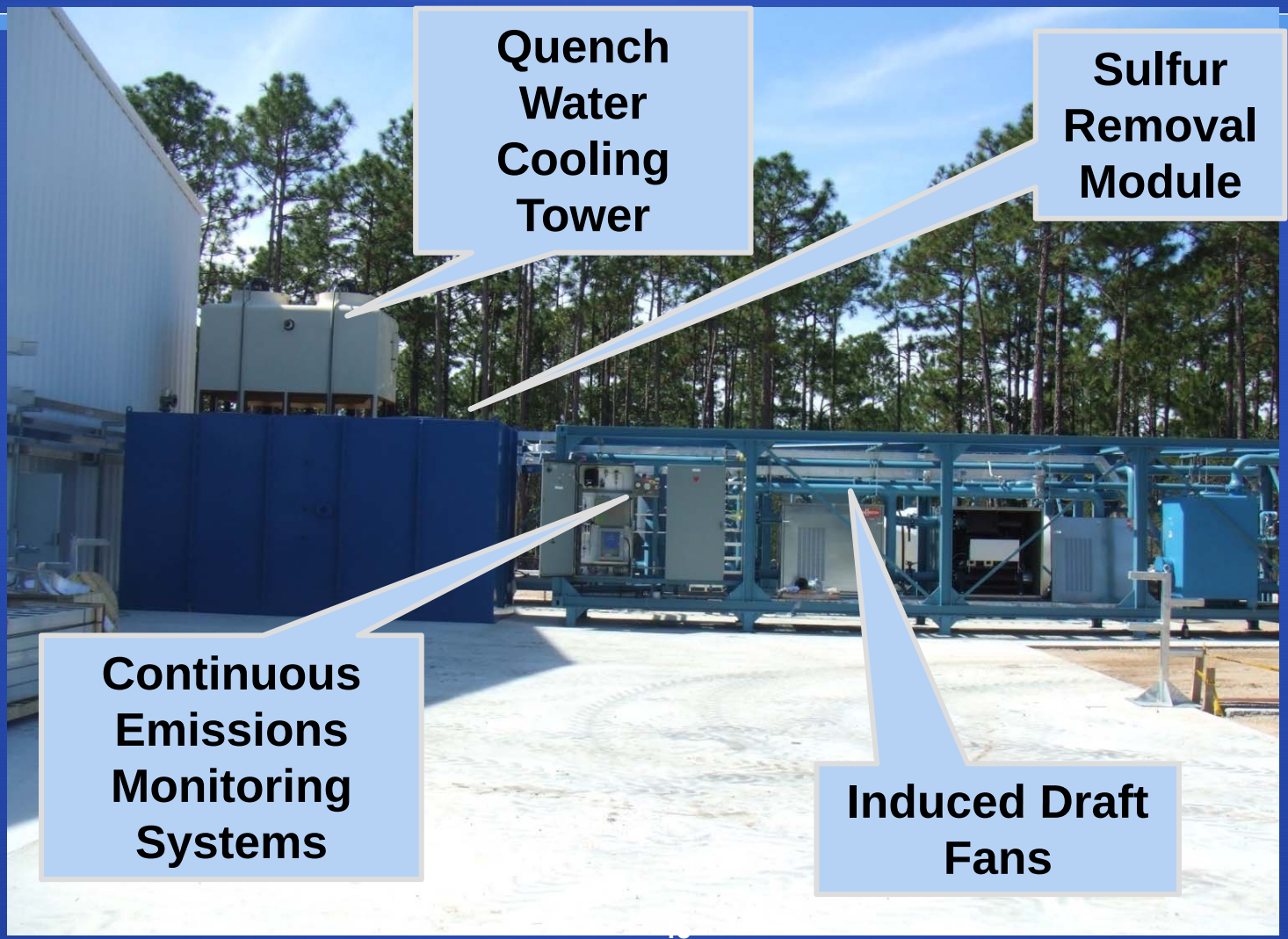


# Eductor Being Connected to Quench System

# Quench Water Storage Skid



# Syngas Cleaning Equipment



# Quench Water Treatment System

# Syngas Flaring Tower

# GE Jenbacher 12 Cylinder

# Electrical Conditioning Module