



# Gas Technology Institute

*University Coal Research/Historically Black Colleges  
and Universities and Other Minority Institutions*

Contractors Review Conference

June 7, 2005

**gti**<sup>SM</sup>

Creating  
technology solutions  
with **impact**

across the  
**energy** spectrum



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Energy is the life-blood of our economic  
and social well-being

*GTI is building technology bridges to a safe and  
sustainable energy future*



Creating  
technology solutions  
with **impact**

across the  
**energy** spectrum



# Mission: To Provide Safe & Sustainable Energy for Now and the Future

- > Diversify energy resource
- > Clean & efficient technologies
- > Affordable



# Gas Technology Institute

- > GTI is an independent not-for-profit R&D and education & training organization
- > GTI focuses on energy & environmental issues
  - Specialize on fossil and renewable energies
- > Our main facility is an 18-acre campus near Chicago
  - Over 350,000 ft<sup>2</sup>
  - 300 Employees



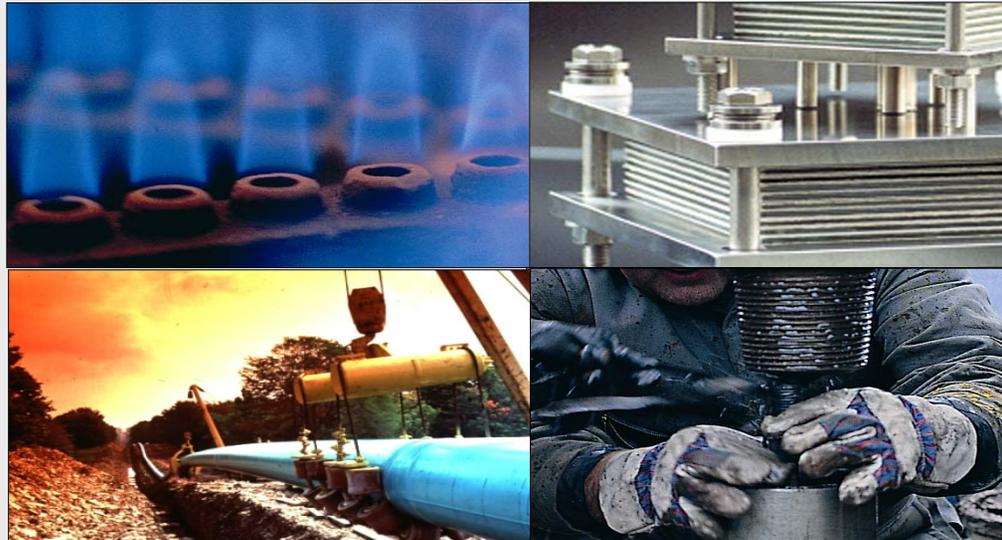
GTI's Main Research Facility



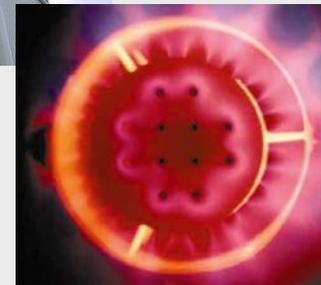
GTI's Energy & Environmental Technology Center

# GTI

- > GTI is an industry-led organization with over 60 years of experience developing technology solutions for consumers, industry, and government
  - More than 800 patents have resulted from GTI research
  - More than 400 products incorporating GTI-developed technology have been introduced
- > Our R&D partners include: Private industries, Universities, National laboratories, Federal and State governments



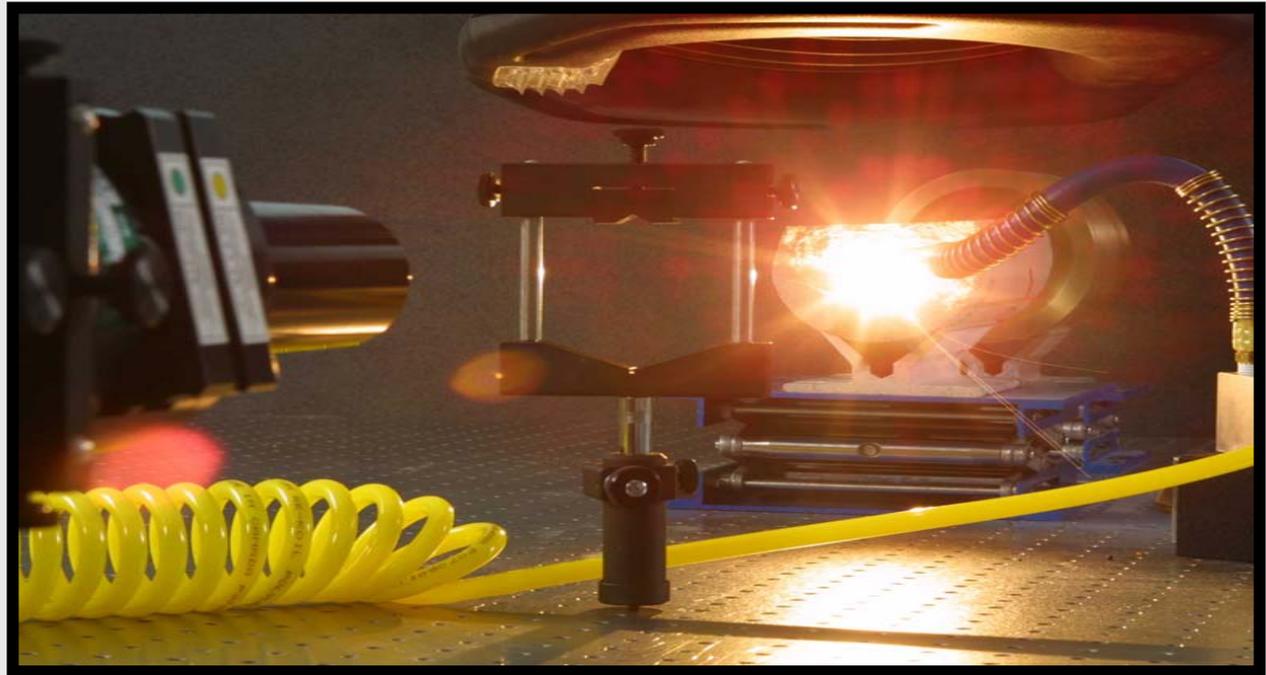
# GTI Serves the Energy Industry, from the Wellhead to Burnertip...



Performing:

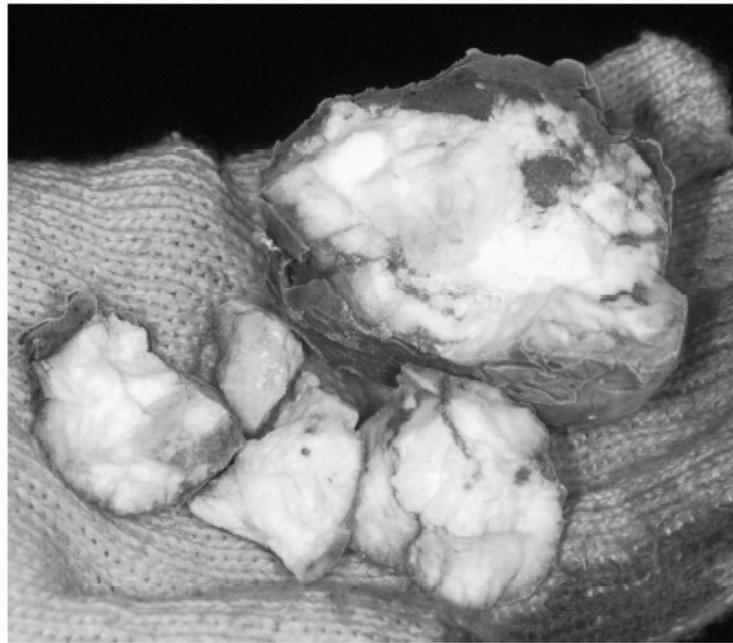
- > Contract Research
- > Program Management
- > Technical Services
- > Education and Training

# High Power Fiber Laser Technology



- **Multiple Applications – Down Hole Drilling & Pavement Cutting**

# Methane Hydrates



# Materials Testing and Analysis

## > Improved Field Applied Coatings Performance

- 3,000 feet of 8" and 24" dia. pipe buried in clay, sand, rocky soil
- 504 buried coated joints, plus 70 "control" joints for immediate testing
- 65 field applied coating systems from 20 North American & International vendors
- Removed for testing after 1, 2 and 3-5 years



# Nondestructive Evaluation (NDE) Technology

“Enhance pipeline safety”

- In-line inspection technologies for unpiggable pipelines
  - ✓ Gas Coupled Ultrasonic
  - ✓ Remote Field Eddy Current



# Environmental Science & Forensic Chemistry

## Applied Research



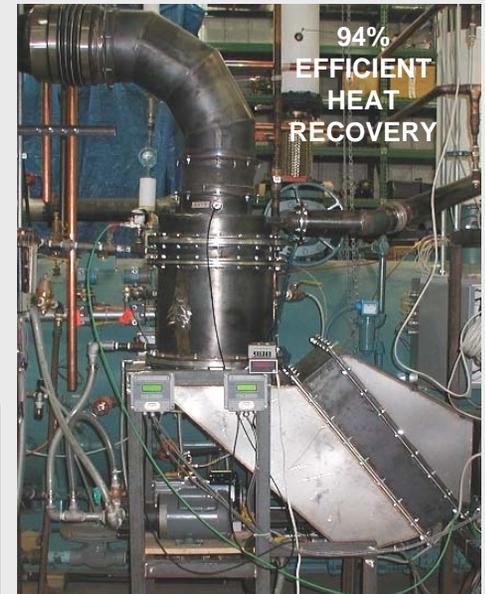
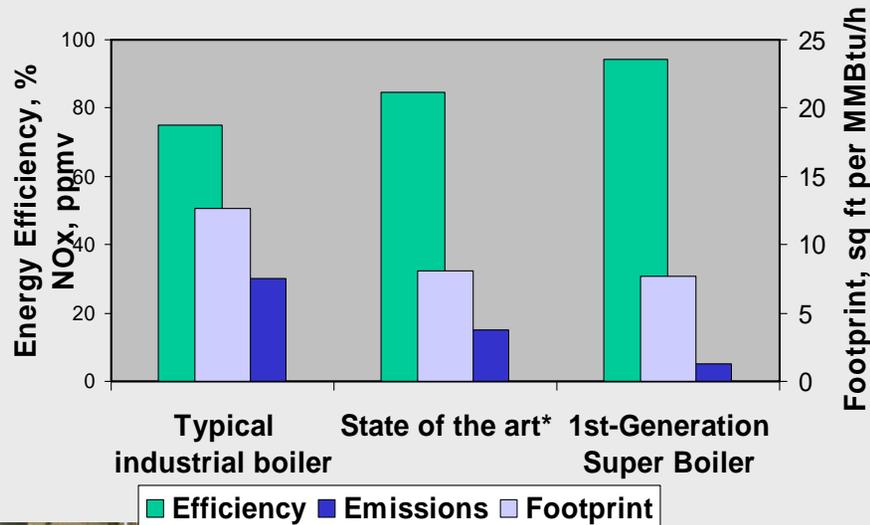
- Microbial Induced Corrosion (MIC) Mitigation
- Phytoremediation
- Forensic Chemistry Database

## Services

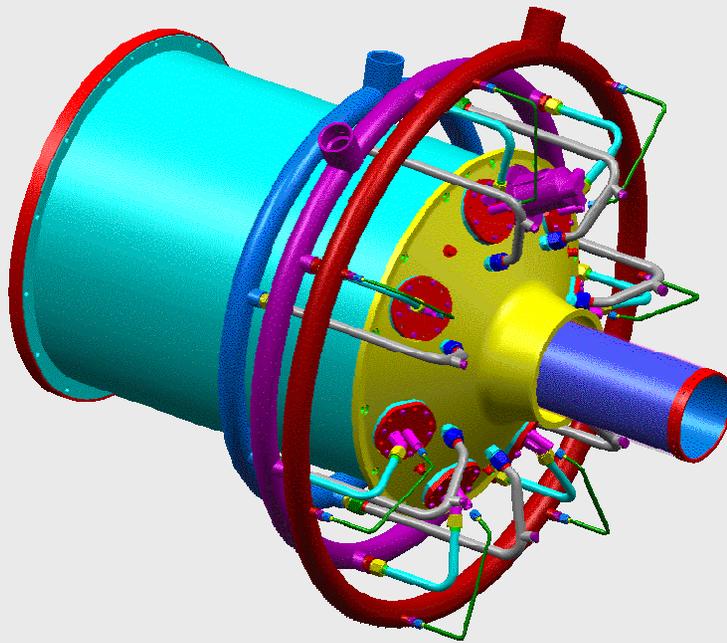


- Chemical Fingerprinting
- Rapid MIC Assay
- MGP Remediation Design Support

# Combustion: Super Boiler



# Partial Oxidation Reformer (POR)



# GTI Has Extensive Industrial Combustion Experience



- > Oxy-Gas Burners
- > METHANE de-NOX with Waste Fuels
- > Oscillating Combustion
- > Radiant Tube Burners
- > Enhanced heat-exchangers
- > IR Heaters
- > Paper Dryer
- > Condensing Water Heater



## PEM Fuel Cells



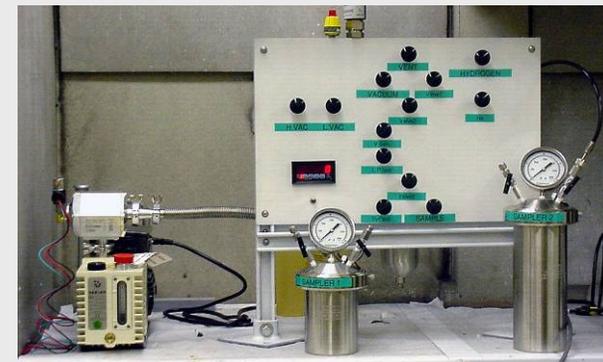
## Solid Oxide Fuel Cells



## Hydrogen Systems

# Hydrogen & Natural Gas Storage

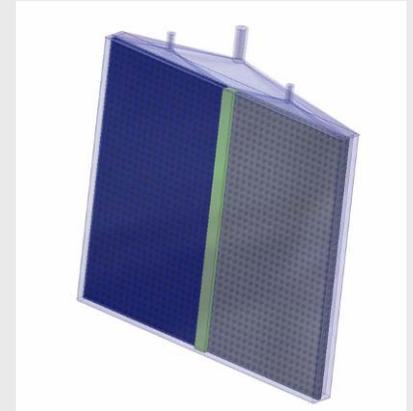
- > High-pressure gas, solid state materials, cryogenics, accessories (valves..)
- > Two H<sub>2</sub> storage projects with USDOE
  - Novel modified graphite for H<sub>2</sub> storage
  - Underground LH<sub>2</sub> storage evaluation



# Novel Solar and Thermochemical H<sub>2</sub> Initiatives

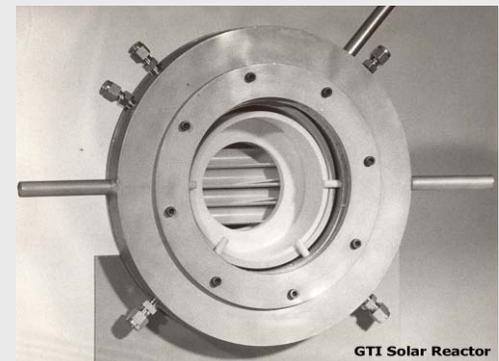
## Solar Photo-electrolysis

- > Unique approach to making solar hydrogen
- > Combines GTI's unique electro-chemistry with solar cells



## Thermo-chemical Hydrogen

- > Working with team to develop and demonstrate new cycles
  - Copper Chloride Cycle
  - Solar, nuclear energy sources



# Evaluation of DG Components and Systems



**Reciprocating Engines**



**Micro Turbines**



**Fuel Cells**



**Absorption Chillers**

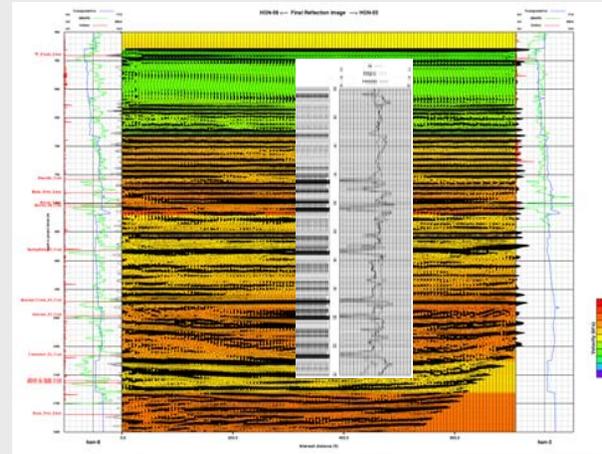


**Dehumidification**

# Carbon Sequestration Activities

Final Crosswell Reflection Image

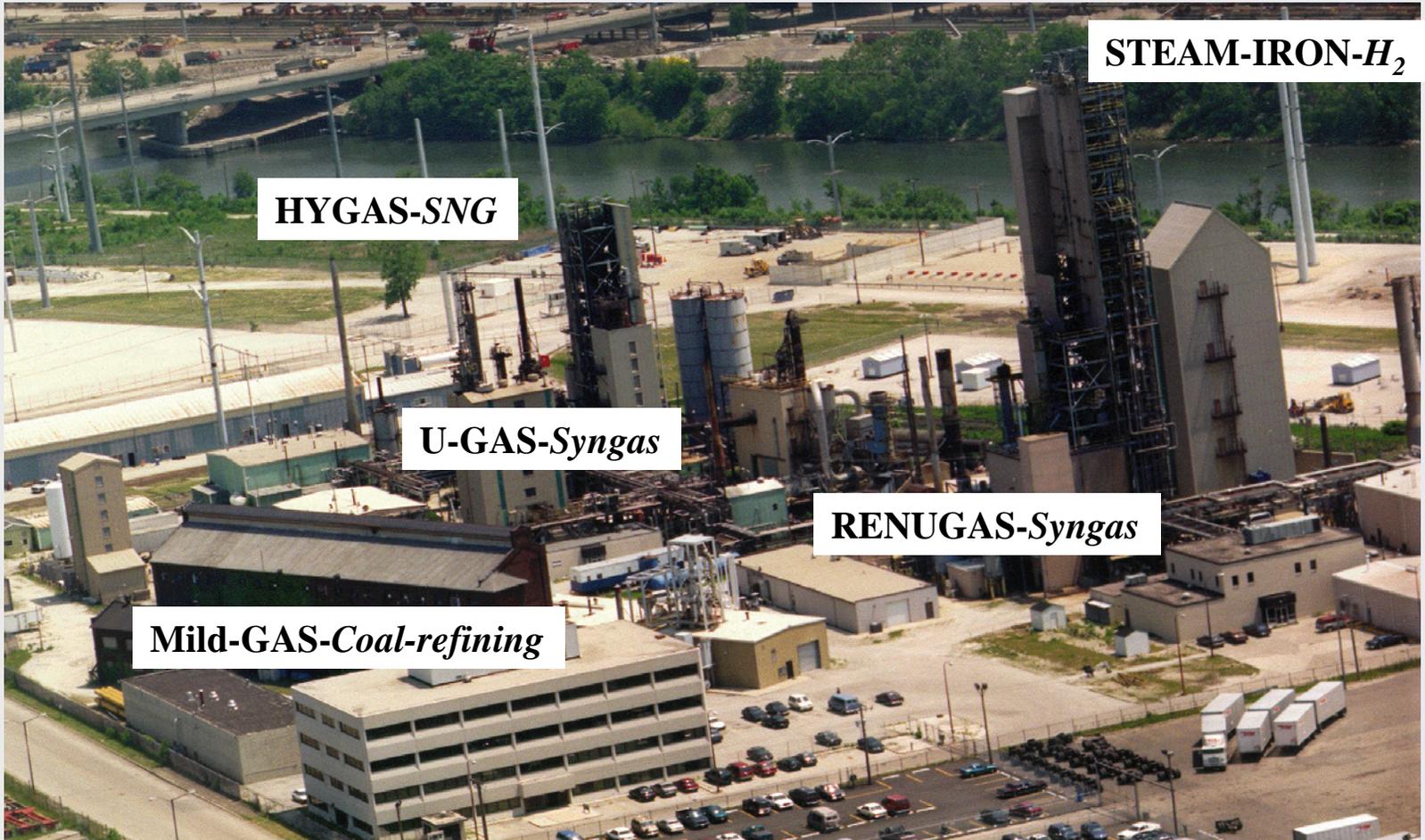
- Develop customized seismic survey techniques for CO<sub>2</sub> sequestration site selection



- Investigate the viability of monitoring CO<sub>2</sub> front in coal seams.



# GTI Gasification Technologies



**HYGAS-SNG**

**U-GAS-Syngas**

**Mild-GAS-Coal-refining**

**RENUGAS-Syngas**

**STEAM-IRON-H<sub>2</sub>**

# Scale-up Projects



**80 ton per day Gasification Pilot Plant  
in Tampere, Finland**



**100 ton per day Bioenergy Demo Plant in  
Hawaii**



**1000 ton per day U-GAS<sup>®</sup> Industrial fuel gas  
in Shanghai, China**

# GTI Flex Fuel Test Facility (FFTF)

- > GTI's World-Class State-of-the-Art Gasification Pilot Plant Test Platform
- > Flexible Fuel Capability
  - Coal: ~ 10-20 tons/day
  - Biomass: ~ 20-40 tons/day
- > Operational Flexibility
  - Pressure ~ 400 psig
  - Air/Oxygen Operation
- > Plug-and-play capable



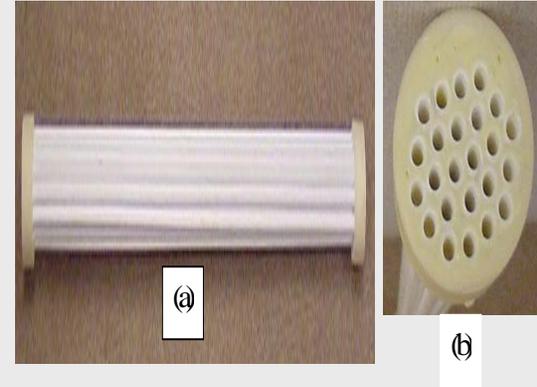
# Dr. Henry Linden Flex Fuel Gasification R&D Facility

- > Solids feed system
- > Gasifier
- > Cyclones
- > Gas conditioning unit
- > Emissions Control



# Syngas Clean-Up and Purification Systems

- > Elevated Temperature Gas Clean Up
  - Multi pollutants removal,  $H_2S$ ,  $HCl$ ,  $NH_3$ ,  $CO_2$ ,  $Hg$ , particulates,
    - > Sorbents/filters
    - > POM membrane
    - > Lime-based membrane
- > Low-Temperature Gas Separation Membranes
  - Solvents & novel polymer membranes



*Warm Gas Clean Up*



*Low temperature Acid gas Clean up*

# Analytical Instruments

Comprehensive, continuous, sensitive and accurate measurements at key points in the process are essential

Sampling  
Conditioning  
Systems



IMACC FT-IR



SRS  
Mass Spec



Varian  
GC/PFPD



Agilent GC/MSD/FID/SCD



# Major Coal Gasification Projects



**Membrane Gasifier for Hydrogen Production, US DOE FE, IDCEO, AEP**

**Indian 100 MWe Clean Coal IGCC Project, USAID**

**Boeing-Rocketdyne Advanced Gasifier Development, US DOE FE**

**Headwaters Technology Innovation Inc.-CTL, US DOE FE**



# Major Biomass Gasification Projects



**2 ton per day Biomass Gasification in  
UM, Minnesota, Xcel Energy LLC**



**60 ton per day Chicken Litter Gasifier in  
Georgia, US DA, ERI**



**Biomass Gasification Tar and Oil  
Decomposition, US DOE EE**



# GTI HBCU/OMI Energy Internship: Training the Next Generation

- > GTI initiated Careers in Energy Technology program in 2003 to increase minority participation in energy-related R&D and education.
- > Since then we have approximately 50 students participated in 10-week R&D internships at GTI.





# Electroplating of Manganese

> Phyderica Tracy  
Chemistry Education  
Major, South Carolina  
State University

Supervisor: Robert Remick,  
Hydrogen Energy Systems



Consortium:  
Alcorn State  
University;  
California State  
University, Fullerton;  
California State  
University, San  
Bernardino;  
Dillard University;  
Fisk University;  
Florida International  
University;  
Jackson State  
University;  
North Carolina  
Central University;  
South Carolina State  
University;  
Tennessee State  
University;  
Tuskegee University.

# Objectives

- > To electroplate manganese onto SOFC stainless steel current collectors to mitigate the impact of chromium poisoning.
  
- > Chemicals used
  - $\text{MnSO}_4 \cdot \text{H}_2\text{O}$
  - $(\text{NH}_4)_2\text{SO}_4$
  - $\text{NH}_4\text{SCN}$
  - $\text{MnCl}_2$
  - $\text{NH}_4\text{Cl}$
  - $\text{H}_2\text{SeO}_3$

Setup of Fuel Cell with electroplated current collector



**You are all welcome to visit!!**



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[www.gastechnology.org](http://www.gastechnology.org)