# SOLID OXIDE FUEL CELL TEST CENTER (SOFCTC) DEVELOPMENT AND DEMONSTRATION



GOAL

**BUILD SOFC DEVELOPMENT & DEMONSTRATION TEST CENTER** (SOFCTC) to help NETL achieve its mid-2020s target of 10-MWe SOFC demonstration with coal-derived syngas and carbon capture, utilization, and storage.



• Design SOFC development and demonstration test center with the tools needed to advance system- and component-level SOFC performance.

- Build and validate SOFC test facility.
- Perform component- and system-level SOFC testing using a variety of fuels.

## FUEL PRODUCTION, CLEANUP, AND STORAGE TECHNOLOGY

### SOFC DEVELOPMENT AND DEMONSTRATION TEST CENTER AT THE EERC









1-kW Stack Test Station

**Fiaxell Test Station** 

Electronic Load & EIS

	1-kW Stack Test Station	Multicell Test Station	Fiaxell Test Station	Button Cell Test Stand
Test Rig Configuration	Single cell or stack	Multiple single cells or stack	Single cell or short stack	Button cell
Cell Type	Planar	Planar or tubular	Planar	Planar
Fuel Type	Any fuel from gas storage and bottle gas	Any fuel from gas storage and bottle gas	Any fuel from gas storage and bottle gas	Any fuel from gas storage and bottle gas

# **EERC GASIFICATION CAPABILITY | THREE GASIFIERS**

### **ALL GASIFIERS**

- Wide range of feedstocks: coal, biomass, other solid or liquid feedstocks
- Bench-scale warm-gas cleanup train
- Gas-sweetening absorption system – Additional gas cleanup and acid gas removal
- Produce up to 120 scfh of syngas
- Syngas storage and delivery system
- Wide range of H<sub>2</sub>/CO ratio
- Low-contaminant level





Pressurized Fluidized Gasification (PFB)

Downdraft Fixed Bed **Entrained Flow Gasification** Gasification (DFB) (EFG)

# **COAL-DERIVED SYNGAS QUALITY**

#### EERC Syngas Composition Mole % Syngas Gas Component 59.5% Hydrogen 0.9% Carbon Dioxide 0.0% Ethane 0.4% Argon 32.5% Nitrogen Methane 5.2% Carbon Monoxide 1.7%

# CONTAMINANT LEVEL | EERC Syngas vs. Industrial Syngas

ERC Coal-Derived, Cleaned Syngas				Industrial Gasifier		
	Syngas Gas Contaminant	Concentration		Syngas Gas Contaminant	Concentration*	
	Antimony (Sb)	< 1 ppbv		Antimony (Sb)	25 ppbv	
	Cadmium (Cd)	< 0.5 ppbv	Cadmium (Cd)	N/A		
	Arsine (AsH <sub>3</sub> )	< 5 ppbv		Arsine (AsH <sub>3</sub> )	150-580 ppbv	
	Hydrogen Sulfide (H <sub>2</sub> S)	< 5 ppbv		Hydrogen Sulfide (H <sub>2</sub> S)	~500 ppbv	
	Phosphine (PH <sub>3</sub> )	< 0.5 ppbv	<b>~</b>	Phosphine (PH <sub>3</sub> )	1900 ppbv	
	Hydrochloric Acid (HCl)	< 100 ppbv		Hydrochloric Acid (HCl)	< 1000 ppbv	
	Selenium (Se)	< 0.5 ppbv		Selenium (Se)	150 ppbv	
	Silicon (Si)	< 1 ppbv		Zinc (Zn)	9000 ppbv	
	Zinc (Zn)	2.5 ppbv		Chromium (Cr)	25 ppbv	
	Benzene (C <sub>6</sub> H <sub>6</sub> )	< 15 ppmv		Mercury (Hg)	25 ppbv	
Xylene (C <sub>8</sub> H <sub>10</sub> )		< 10 ppmv		*Eastman Chemical Company's system at Kingsport		

## **EERC GASIFICATION CAPABILITY | CARBON CAPTURE**

#### SOFC PERFORMANCE VS. TEMPERATURE AND FUEL COMPOSITIONS





# **EERC GASIFICATION CAPABILITY | FUEL STORAGE**

**STORAGE TANK CAPACITY** | 20,900 scf at 2600 psi

### **FUEL OPTIONS:**

- Syngas from EERC gasifier (coal, biomass, waste, blend)
- Natural gas (desulfurized)
- Bottled gas (single or blends of H<sub>2</sub>, CO, CH<sub>4</sub>,  $CO_2$ , N<sub>2</sub>, other)
- Added contaminants

# **FUEL DELIVERY SYSTEM**









First upset - power failure

# **MATERIALS ANALYTICAL CAPABILITIES**

• Methane reformer







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