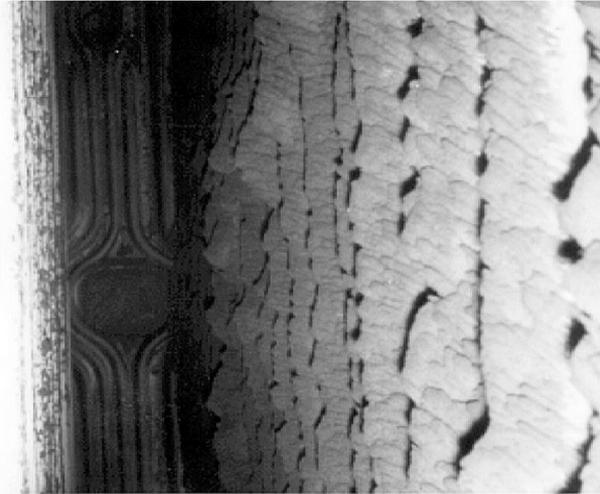


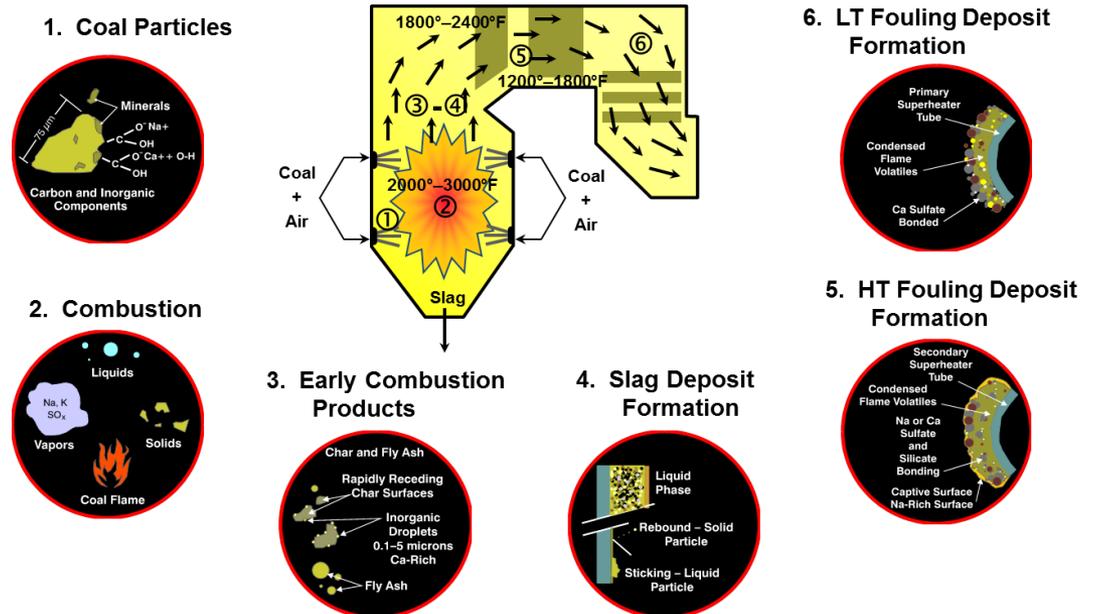
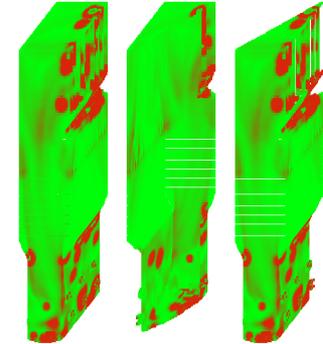
# Long Rich History of Addressing Challenges for North Dakota Lignite

From the beginning:

- Addressing unique properties – high moisture, ash, and alkali /sodium.
- Ash formation and deposition in utility boilers.
- Addressing operational issues – managing slagging and fouling, heat transfer, cleanability, erosion, corrosion, ...



Overfire Air (OFA)



# NORTH DAKOTA MERCURY SUPPORT – BASIC SCIENCE, MEASUREMENT, AND CONTROL

Over several decades of work, the EERC advanced technology to understand, measure, and reduce coal-fired mercury emissions.

- Performed over 110 field tests.
- Drove capture costs from \$80,000/lb down to a few thousand.
- Received two LEC Distinguished Service Awards.
- Supported development of nearly every mercury measurement technique.

Antelope Valley Station – [www.basin.com](http://www.basin.com)



- Created spin-off companies such as Midwest Energy Emissions (ME<sub>2</sub>C), bringing innovation and technology to the market.

*Expertise gained in Mercury and Hazardous Air Pollutant measurement and control will help North Dakota meet future regulations and implement advanced coal utilization systems.*

# KEY EERC HISTORY AND EXPERIENCE

## Over 60 years of Experience with Gasification Technologies

### **OVER 60 YEARS OF EXPERIENCE**

in resource, product and by-product management, including coal, ash, water, fuels, and chemicals.

**WORLD LEADER** in understanding the operational challenges and opportunities associated with the inorganic components of coal and renewables.

**PARTNERED WITH MOST** major manufacturers of gasification systems in the world and many developers of liquefaction systems.

**EXTENSIVE KNOWLEDGE** of technologies specifically related to producing liquid fuels from coal and other feedstocks.



# KEY DEMONSTRATIONS FOR NORTH DAKOTA

- Demonstrated new gasification technologies for lignite.
  - Entrained flow
  - Transport reactor
- Largest demonstration of hydrogen separation membrane in the world on North Dakota lignite.
- Advanced cleanup technologies for lignite.



# UPCOMING GASIFICATION ACTIVITIES

- Demonstration of liquid fuels production using lignite via gasification.
- New technology demonstrations involving emission reduction.
- Advanced lignite-fired power cycles with integrated CO<sub>2</sub> capture.



# PARTNERSHIP FOR CO<sub>2</sub> CAPTURE (PCO<sub>2</sub>C) SPONSORS

**HITACHI**  
Inspire the Next



**MIDWEST  
GENERATION™**  
AN EDISON INTERNATIONAL COMPANY

**TransAlta**

**SaskPower**

**PSE** PUGET SOUND ENERGY  
The Energy To Do Great Things

**C-QUEST**



**Nebraska Public Power District**  
Always there when you need us



**HUNTSMAN**  
Enriching lives through innovation

**Portland General  
Electric**



**metso  
power**

**Constellation  
Energy**

**BAKER  
HUGHES**



**AVISTA**

**BASIN ELECTRIC  
POWER COOPERATIVE**  
A Touchstone Energy® Cooperative

**ATCO  
Power**



**PACIFICORP**  
A MIDAMERICAN ENERGY HOLDINGS COMPANY

**Shell Cansolv**

**NorthWestern  
Energy**

**Tri-Mer  
CORPORATION**

**BLACK & VEATCH**



**SULZER**

**KCRC** Korea Carbon Capture & Sequestration R&D Center



**minnesota power**  
AN ALLETE COMPANY

**CO<sub>2</sub>  
SOLUTIONS**

**BR  
PETROBRAS**



**SUNCOR  
ENERGY**

**TALLEN  
ENERGY**

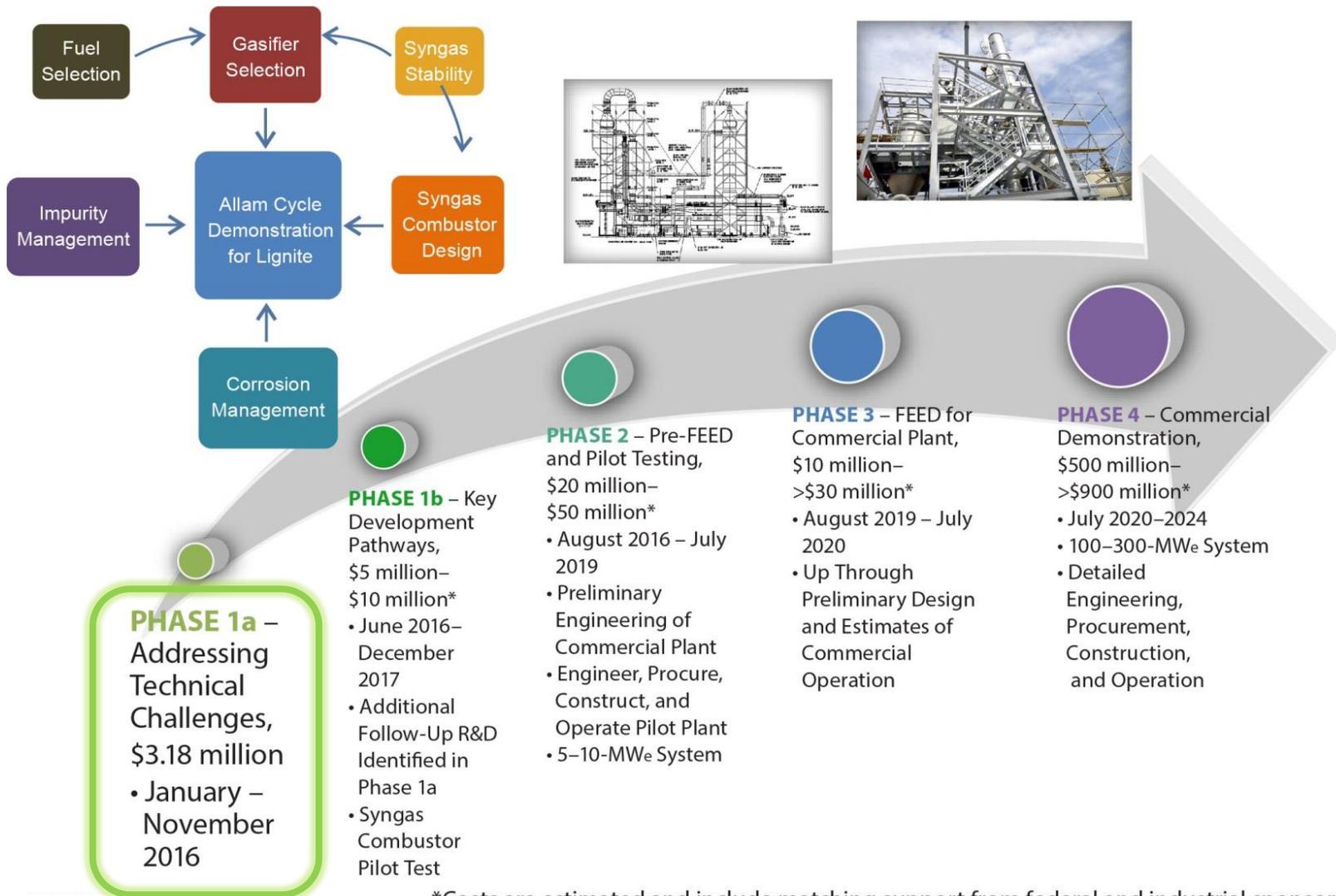


**State of  
Wyoming Clean  
Coal Technology  
Fund**



# ALLAM TECHNOLOGY DEVELOPMENT ROAD MAP

## Lignite-Based Allam Cycle Technology Development Road Map



\*Costs are estimated and include matching support from federal and industrial sponsors.

# ALTERNATIVE FUELS AND RENEWABLE ENERGY



## BIOMASS

- Straws and grasses
- Forest wood and manufacturing residues
- Municipal wastes
- Food residues
- Algae
- Oil seed crops



## ALTERNATIVE FUELS

- Green diesel and jet fuel
- Green gasoline and fuel additives
- Renewable chemicals
- Hydrogen (fossil and renewable)



## WIND AND SOLAR

- Resource assessment
- Small wind systems
- Hydrogen from wind
- North Dakota solar photovoltaic resources