NETL Gasification Program Overview

2019 Gasification Systems Project Review Meeting

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Solutions for Today | Options for Tomorrow
Gasification Program Overview

Program Goal:
Fossil Energy Power Systems
• Increase availability, efficiency, and reliability
• Maintain environmental standards through early-stage R&D

Benefits
• Energy & Economic security for stable energy foundation
  • Maintains coal in nation’s energy portfolio
  • Sustains grid stability and economic security.
• Enables pre-combustion CO₂ capture technology
Gasification Systems

Economic Challenges & Opportunities

Drivers

• Traditional IGCC reliance on economy of scale
• Large projects highlight high financial/project risk
• Huge investment risk for utilities, customers, and financial institutions

Challenges

• Low natural gas prices

Opportunities

• Coal syngas production/conversion = High value products
• Economic stability through diversified power sources
• Risk reductions possible via modular approach
Cost of Electricity Reduction Targets

- COE Reduction by:
  - Efficiency improvement
  - Capital cost reduction
  - RAM improvement

Cost targets context:
- Cost for greenfield sites
- Includes CO₂ capture & compression to 2215 psia
- Excludes CO₂ transport and storage costs

<table>
<thead>
<tr>
<th>COE Relative to Today's Coal with Capture (%)</th>
<th>IGCC or Supercritical PC</th>
<th>2nd-Generation Technology</th>
<th>Transformational Technology</th>
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</thead>
<tbody>
<tr>
<td>State-of-the-Art</td>
<td>0% Reduction</td>
<td>20% Reduction</td>
<td>30% Reduction</td>
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<tr>
<td>2025 Demo</td>
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<td>2030 Demo</td>
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Gasification Opportunities

In addition to power production

• Byproduct reuse
• Easier capture of CO₂
• Pathway to liquid fuels and chemicals
• New market opportunities via Modular approach
Gasification Systems Program
Key Technology R&D Areas

Gasification Systems Project Value by Key Technology

- Air Separation: $9.8M
- Market-Optimized Design: $7.0M
- Reactor Engineering Design: $4.4M
- Total: $23.2M

Gasification Systems Active Project Count

- Air Separation: 3 projects
- Market-Optimized Design: 4 projects
- Reactor Engineering Design: 3 projects
- Total: 13 projects
Gasification Systems Program
Key Technology R&D Areas

AIR SEPARATION

Oxygen

REACTOR ENGINEERING DESIGN

Clean Syngas for Polygeneration

Syngas cleanup/separation/conversion units and reactors

Syngas

Modular Reactors/Gasifiers

Coal and Biomass

MARKET-OPTIMIZED DESIGN

Product
Target market demand at site

Feedstocks
Low-cost/opportunity fuels at site

Scale
Modular right-sizing for site & market

Guides system design & enables economic viability

SYSTEMS INTEGRATION

RELIABILITY

AVAILABILITY

MAINTAINABILITY

OPERABILITY

PRODUCTIVITY

Electric grid load-following
Air Separation key technology objectives:
  • Reduce oxygen production cost
  • Accomplish process intensification
  • Integrate into modular design

Air Separation current focus include:
  • Membranes
  • Advanced sorbents
  • Oxygen carriers for coal-to-syngas
  • Novel cryogenics

13 active projects with 9 partners valued at $23.1M plus NETL in-house research
Reactor Engineering Design key technology objectives:

- Reduce cost
- Leverage computational tools for process optimization
- Innovations to reduce capital & operating costs – Process Intensification!
- Capability for modular design integration

Current research areas include:

- Modular gasification
- Chemical looping gasification

4 active projects with 3 partners valued at $7M plus NETL in-house research
Market-Optimized Design key technology objectives:

- Reduce cost
- Maximize local feedstock use
- Reduce risks for market viability
- Integrate into modular design

Current research areas include:

- Challenging environments
- Remote, rural areas

3 active projects with 2 partners valued at $4.4M plus NETL in-house research
Systems Integration Work

Active projects under Systems Integration key technology area

Systems Integration key technology objectives:

- Enabling technology for higher availability
- Greater operating flexibility
- Improved economics
- Addresses load following, no grid available, local feedstock use

Current research areas include:

- Modular advanced syngas cleanup
- Warm gas multi-contaminant removal

3 active projects with 2 partners valued at $9.8M
Modular Approach efficient for Technology Maturation

Smaller, Modular approach reduces risks in R&D phases

- **Prototype Development**
  - Achieved Sooner
  - More Cost Effective
  - More Development Cycles Possible
  - Encourages Innovative Technology
  - Technology Matured More Rapidly

- **Impact**
  - Lower Overall Financial Risk
  - Faster Development
  - Responsive to Short-lived Niche Opportunities

Coal to Liquids plant in Shanxi, China

**Traditional Approach**
- Many years to design/construct
- Significant investment ($100sM)
- Difficult to adapt technology advancements

**Modular Approach**
- Multiple designs in shorter time
- Lower investment ($10sM)
- Readily incorporate technology advancements

R&D modular example (U. KY)
2019 Planned FOA

Notice of Intent to Issue Funding Opportunity Announcement DE-FOA-0001994

“Next Generation Gasifier Concepts and Components to Advance Modular Coal Gasification”

• Advanced technology to implement coal gasification into small modular systems.

• **Topics:**
  1. Next Generation Gasifier Design and Prototype
  2. Enabling Technologies for Gasifier of the Future

Source: [https://www.fedconnect.net/fedconnect?doc=DE-FOA-0002121&agency=DOE](https://www.fedconnect.net/fedconnect?doc=DE-FOA-0002121&agency=DOE)
**Summary**

**NETL Gasification Systems Program**

- **Modular Gasification**
  - Advanced Manufacturing & Process Intensification
  - Increase availability, efficiency, and reliability
  - Alternative markets/uses for coal

- **Mature technologies by modular component R&D**
  - Utilize 4 key technology area framework
  - Quicker development at reduced cost

- **Sustain economic security by keeping coal in nation’s energy portfolio**
Questions?

Thank You!

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www.netl.doe.gov/research/coal/energy-systems/gasification