NETL Gasification Program Overview

2019 Gasification Systems Project Review Meeting

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Solutions for **Today** | **Options** for **Tomorrow**

Gasification Program Overview

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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 CO_2 capture technology

Gasification Systems

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Economic Challenges & Opportunities

Drivers

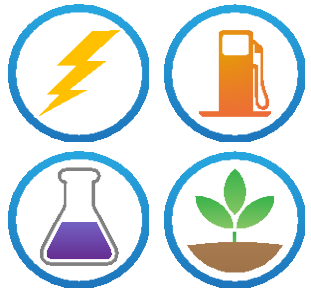
- Traditional IGCC reliance on economy of scale
- Large projects highlight high financial/project risk
- Huge investment risk for utilities, customers, and financial institutions

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



Goals and Timelines

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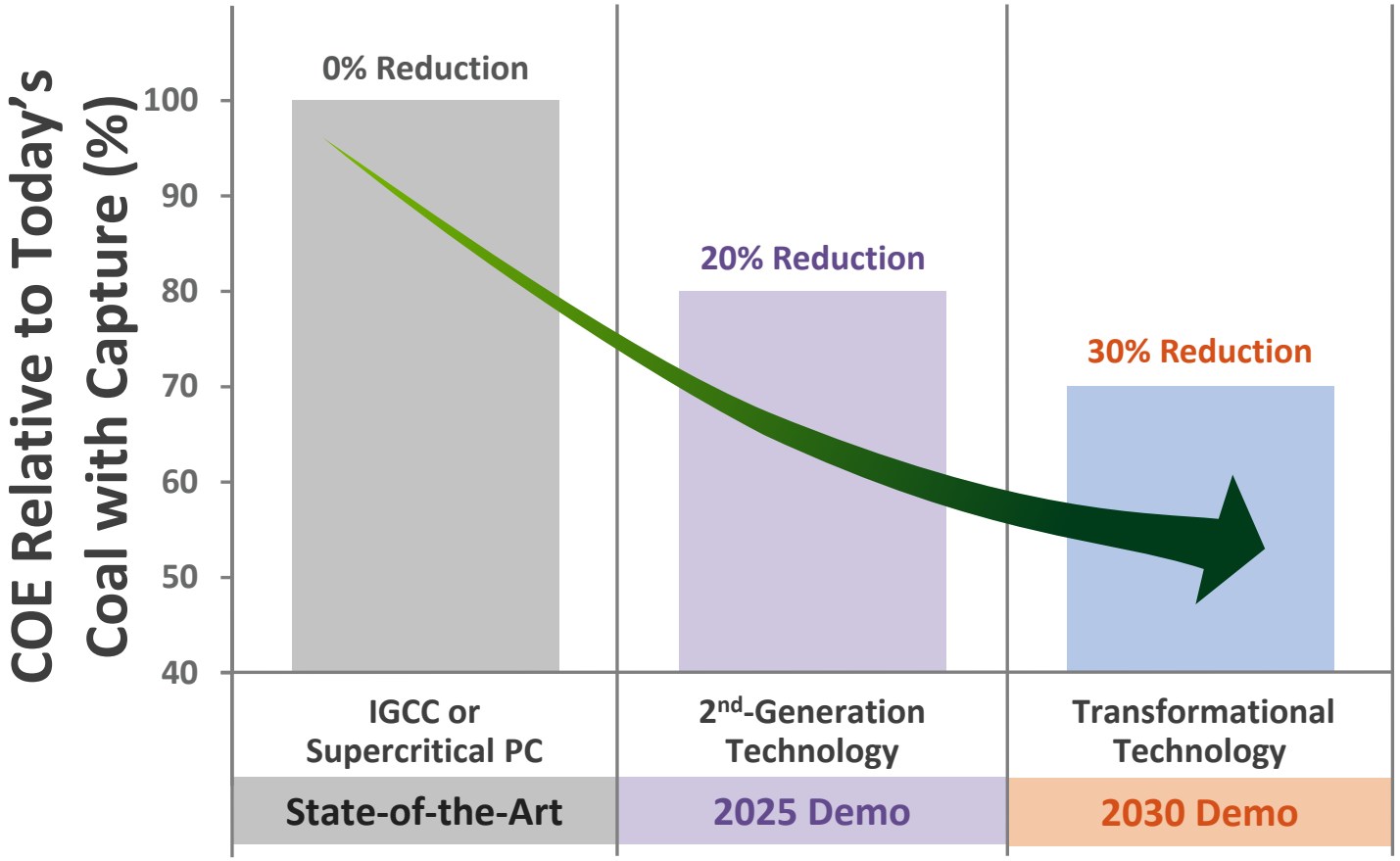
Established 2012

Cost of Electricity Reduction Targets



COE Reduction by:

- Efficiency improvement
- Capital cost reduction
- RAM improvement

Cost targets context:

- Cost for greenfield sites
- Includes CO_2 capture & compression to 2215 psia
- Excludes CO_2 transport and storage costs

Gasification Opportunities

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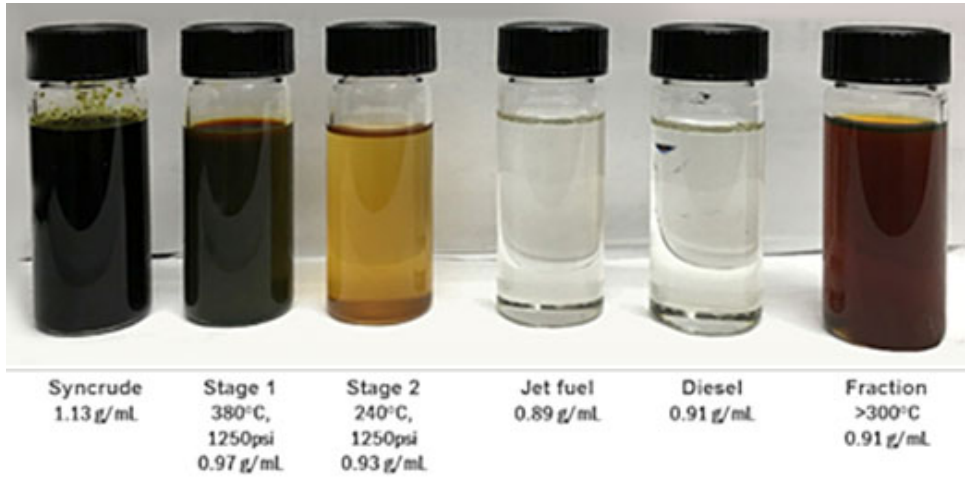
In addition to power production

- Byproduct reuse
- Easier capture of CO_2
- Pathway to liquid fuels and chemicals
- New market opportunities via Modular approach



Gasification Systems Program Key Technology R&D Areas

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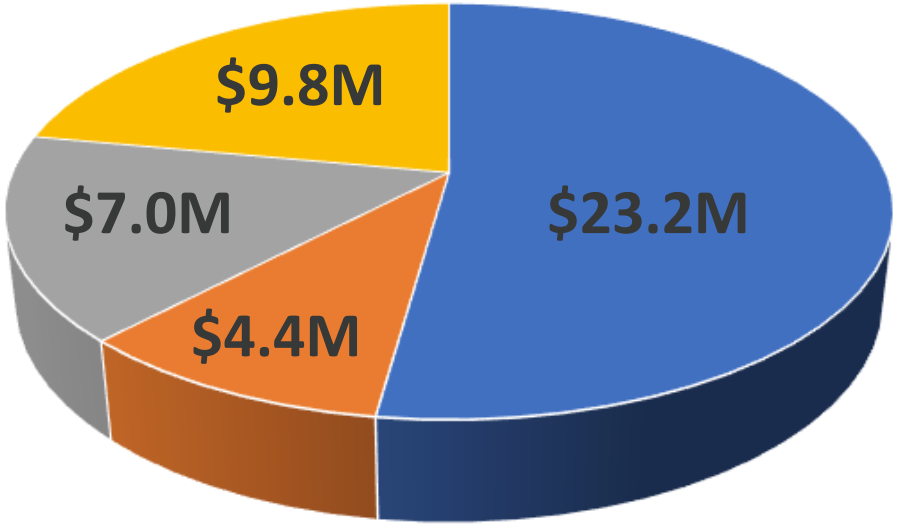
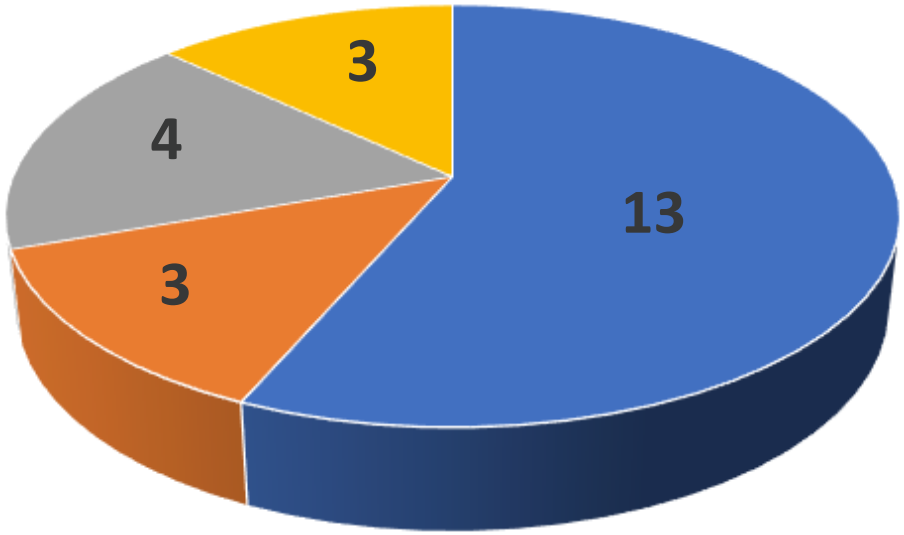
Gasification Systems Project Value by Key Technology



Gasification Systems Active Project Count



- Air Separation
- Market-Optimized Design
- Reactor Engineering Design
- Systems Integration

Gasification Systems Program Key Technology R&D Areas

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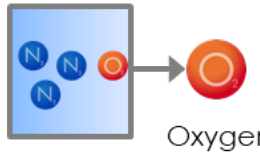
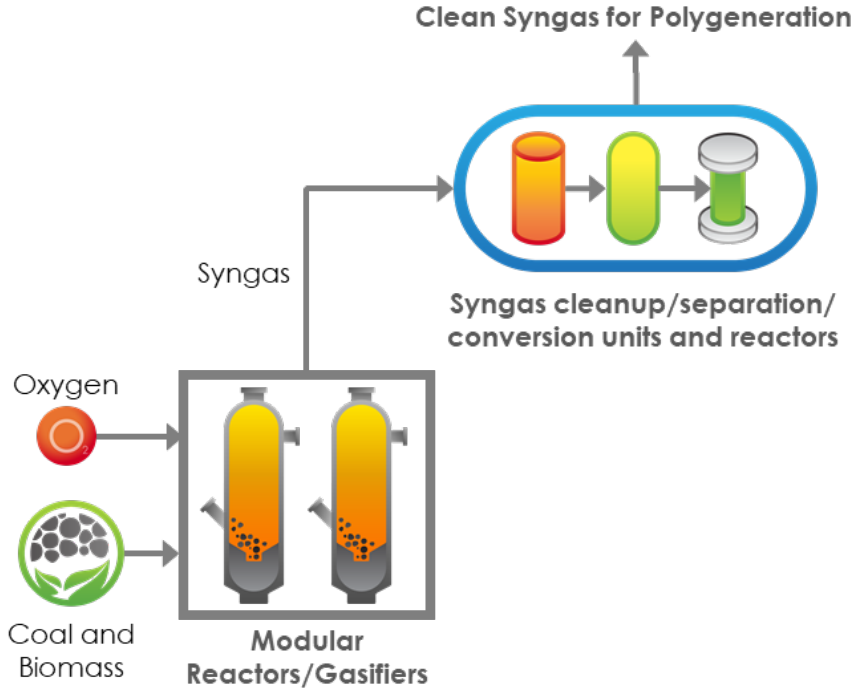
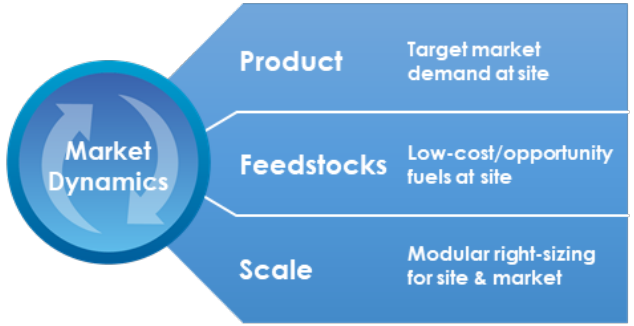
AIR SEPARATION



REACTOR ENGINEERING DESIGN

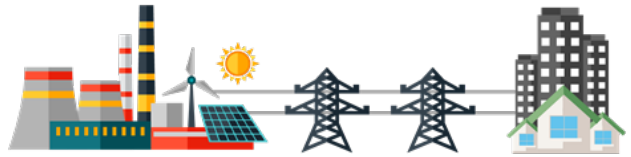


MARKET-OPTIMIZED DESIGN



Guides system design & enables economic viability

SYSTEMS INTEGRATION



Electric grid load-following

Oxygen Technologies in Development

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Active projects under Air Separation key technology area

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

Los Alamos NATIONAL LABORATORY EST. 1943

AIR PRODUCTS

UNIVERSITY OF SOUTH CAROLINA

UNIVERSITY OF KENTUCKY

NC STATE UNIVERSITY

RTI INTERNATIONAL

THERMOSOLV LLC

Pacific Northwest NATIONAL LABORATORY

INL Idaho National Laboratory

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Reactor Engineering Advancements

Active projects under Reactor Engineering Design key technology area

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 Studies Underway

Active projects under Market-Optimized Design key technology area

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

RTI INTERNATIONAL

TDA RESEARCH

Modular Approach efficient for Technology Maturation

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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

R&D modular example (U. KY)

Modular Approach

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

2019 Planned FOA

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Anticipated Release FY19 Q3

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.**
- **<u>Topics</u>:**
  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

Summary

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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**

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