Welcome Remarks & Gasification Systems Portfolio Overview

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DOE-NETL's 2021 FE R&D Virtual Project Review Meeting – Gasification

Gasification Program

Goals & Benefits

Enhance Fossil Energy Systems

- Maintain environmental standards through early-stage R&D
- Increase availability, efficiency, and reliability

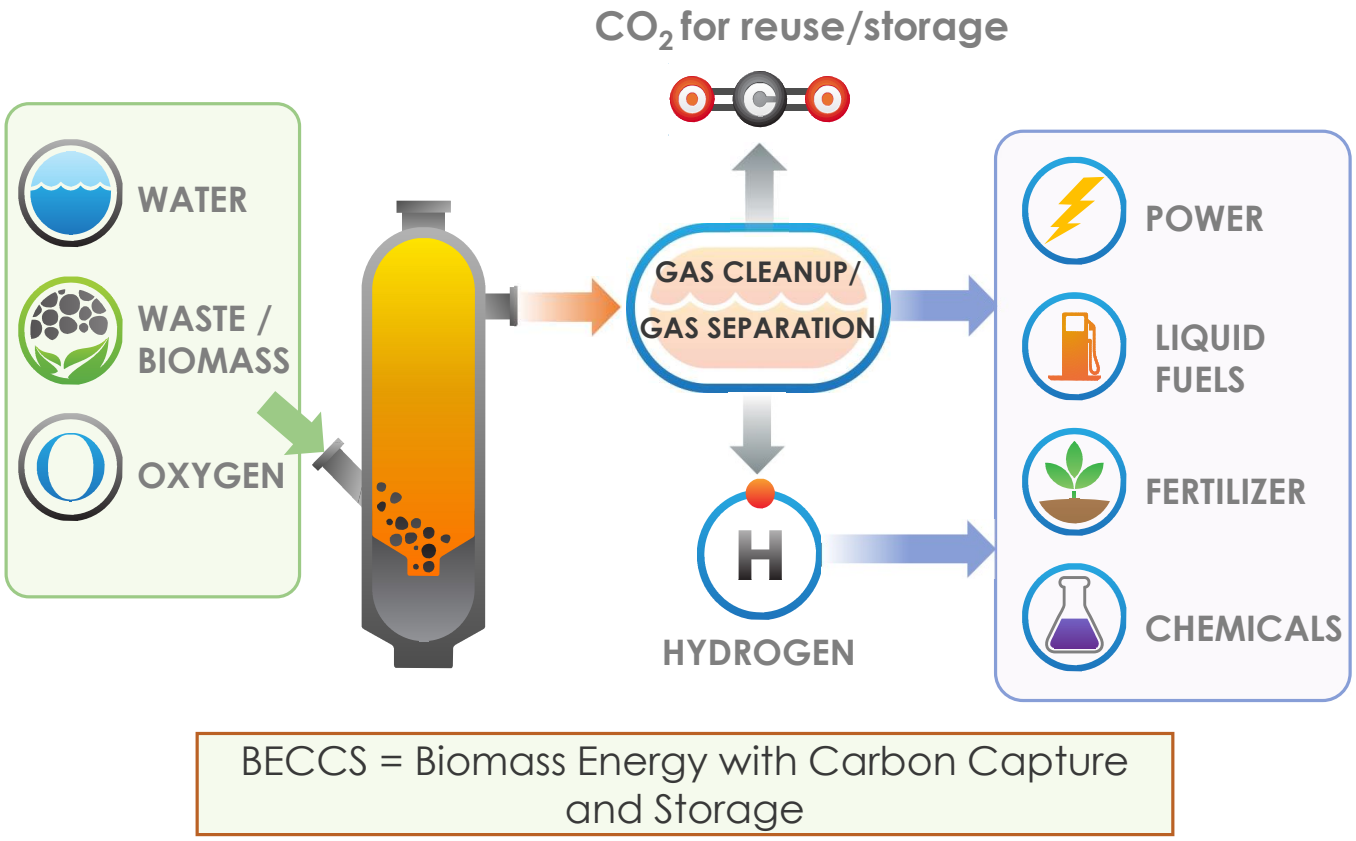
Benefits

- Net-zero carbon electricity when integrated with pre-combustion CO_2 Capture
  - Negative CO_2 Emissions if using BECCS
- U.S. economic security –
  - Maintains Fuel Diversity
  - Energy Resiliency

Gasification: Electricity & More

Gasification enables:

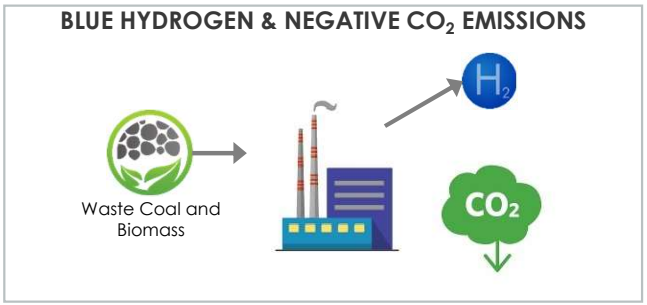
- Superior environmental performance
- Lowest cost carbon capture option
- Negative CO2 emission via BECCS
- Low value materials to power & fuels



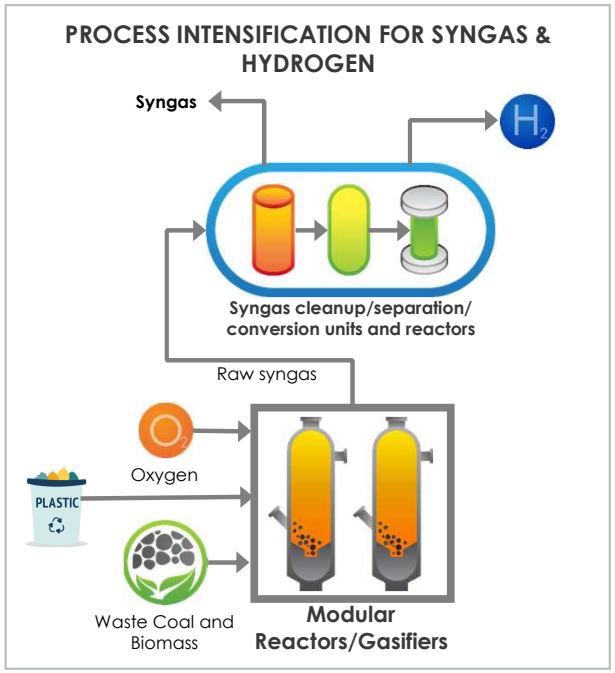
BECCS = Biomass Energy with Carbon Capture and Storage

Program Key Technology Areas

Modular ASUs for small-scale systems



Biomass blending enables BECCS



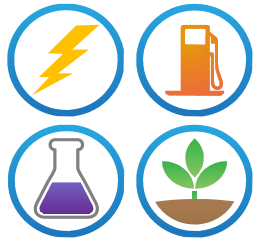
Gasifiers for small-scale systems

Modular Systems accommodate seasonal/ limited supply of biomass and MSW

Includes waste plastics

Gasification Systems

Opportunities



- Can utilize locally available fuels
  - Waste plastic, MSW, biomass
  - Hydrogen from coal, waste coal, & petroleum residuals
- Negative carbon emissions capability (e.g., BECCS)
- Gasification-based fuels & power expected to compete well in high-carbon capture future
- Gasification-based products to support jobs in rural and depressed markets
- Can produce near-zero CO_2 footprint biofuels
- Technology development with integrated CCS for export
  - Set stage for significant GHG reduction across globe

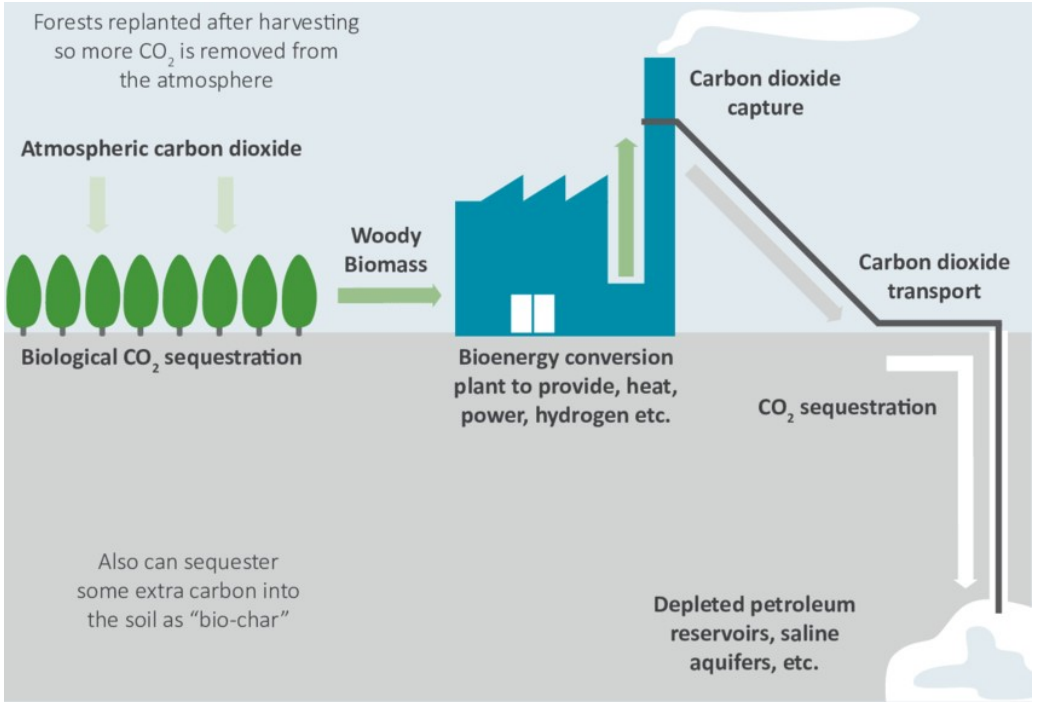
Coal-Based Negative Emissions

Gasification using coal/biomass – pathway for negative carbon technology

- Integrated w/ CCUS – potential for negative emissions

Technology Gaps

- Affordable small-scale gasifier at location
- Affordable CCS integration



Administration Priorities & Anticipated Approaches

- 50-52 percent reduction in economy-wide new greenhouse gas pollution from 2005 levels by 2030
- Carbon pollution-free electricity sector by 2035
- Address environmental justice and job creation
- Zero-carbon economy by 2050
  - BECCS/Gasification enables net negative carbon emissions – necessary to offset difficult-to-decarbonize sectors

"We have the tools to put America on an irreversible path to achieve net-zero carbon emissions by 2050."

-Jennifer M. Granholm
Secretary of the U.S. Department of Energy

Gasification of Wastes

Addressing environmental justice and job creation

Environmental Benefits

- Reduce landfill burdens
- Sustainable waste to energy

Waste feedstocks opportunity

- MSW, Plastics, Coal Waste
- Provides environmental justice
- Job creation in disadvantaged communities

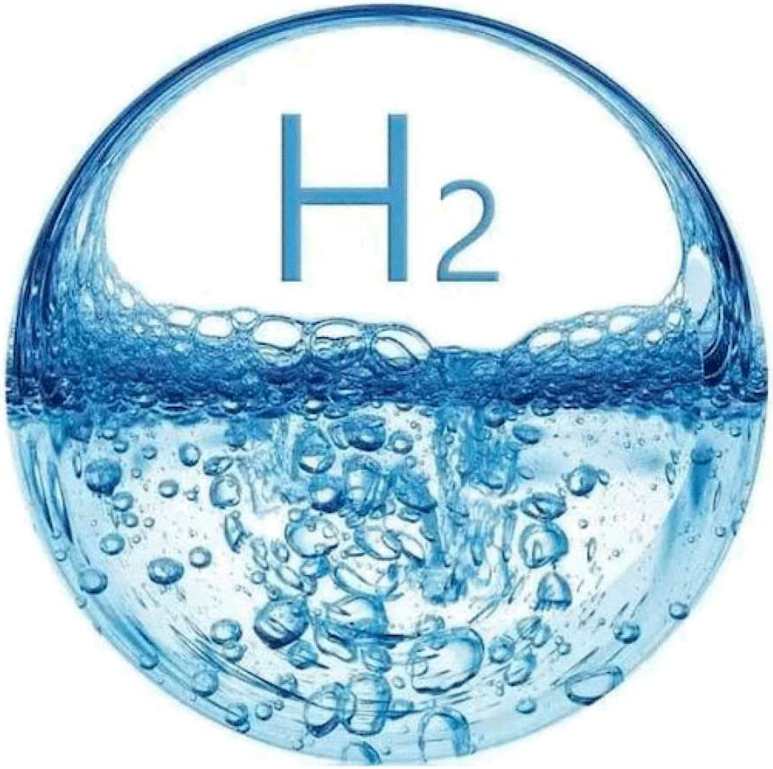
Blue Hydrogen provides:

- Net-zero carbon heat and power
- Carbon-free fuel and energy storage

Gasification is Key to H_2 Economy

Addressing zero-carbon economy by 2050

- Use CCUS to decarbonize traditional fuels
- Biomass feed implements BECCS
- Gasification allows use of wastes (MSW, plastic, biomass, etc.) as feedstock
- Modular gasification at waste impoundments promotes environmental justice
  - Distributed deployment near feedstock
- Cost reduction via modularity and process intensification



Hydrogen RFI Summary & Key Takeaways

NATIONAL ENERGY TECHNOLOGY LABORATORY

Barriers and Challenges

- Infrastructure, reliable, affordable supply
- Regulatory/Safety, technology readiness
- Data availability of plant, pipeline & subsurface
- Unknowns in H2 properties & interactions
- Unproven/ Unvalidated materials & costs

R&D Opportunities

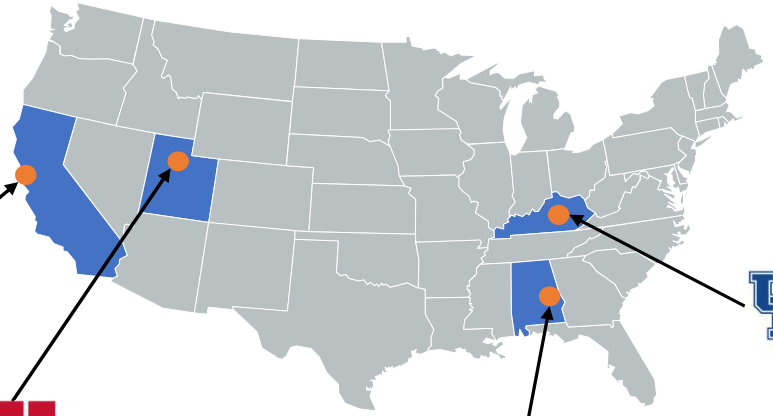
- Novel technology testing and validation
- Technology leveraging existing infrastructure
- Model and Simulation Improvement
- Advance & validate novel materials
- Long-term material testing
- Geological/ engineering studies

-There is widespread interest and optimism for advancing hydrogen technologies-

Recent Project Selections

Enabling Gasification of Blended Coal, Biomass and Plastic Wastes to Produce Hydrogen

- Co-gasification of coal with biomass and plastic wastes, to enable net-negative carbon dioxide emission
- Alleviates concerns of seasonal feedstock availability



EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Performance Testing of a Moving-Bed Gasifier Using Coal, Biomass, and Waste Plastic Blends to Generate White Hydrogen

THE UNIVERSITY OF UTAH

Enabling Entrained-Flow Gasification of Blends of Coal, Biomass and Plastics

AUBURN UNIVERSITY

Fluidized-Bed Gasification of Coal-Biomass-Plastics for Hydrogen Production

University of Kentucky | UNIVERSITY OF KENTUCKY RESEARCH FOUNDATION

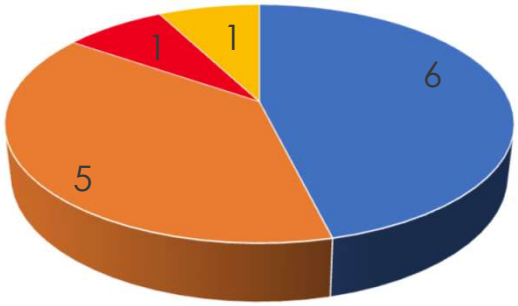
Development and Characterization of Densified Biomass-Plastic Blend for Entrained Flow Gasification

Current Overall Project Portfolio

13 Extramural Projects & Intramural RIC ARS Tasks

$33.6M budget in total

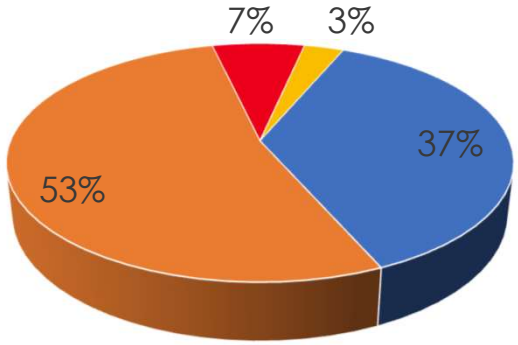
Gasification Systems Active Projects & Tasks
(Count by Key Technology)



- Air Separation Technology
- Process Intensification for Syngas and H2
- Blue H2 and Negative CO2 Emissions
- Other

13 projects/tasks in total

Gasification Systems Active Projects & Tasks
(Funding by Key Technology)



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- Other

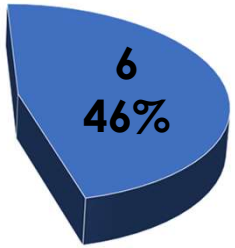
Air Separation/Oxygen Production

Objectives:

- Reduce oxygen production cost
- Process intensification enabling small-scale
- Cost reduction via modular integration

Current focus includes:

- Membranes
- Advanced sorbents
- Oxygen carriers
- Novel cryogenics



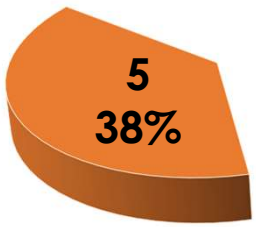
6 projects/tasks valued at $12.5M

Process Intensification for Syngas & H_2

NATIONAL ENERGY TECHNOLOGY LABORATORY

Objectives:

- Leverage process intensification to reduce cost of H_2 production
- Modular design integration capability



5 projects/tasks valued at $17.7M

Current focus includes:

- Modular gasification
- Chemical looping gasification
- Advanced Manufactured ceramic on metal
- Microwave-assisted gasification

UNIVERSITY OF KENTUCKY

NATIONAL ENERGY TECHNOLOGY LABORATORY

UAF UNIVERSITY OF ALASKA FAIRBANKS

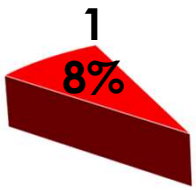
SR SOUTHERN RESEARCH

TDA RESEARCH

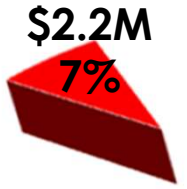
Blue H_2 and negative CO_2 Emissions

Objectives:

- Reduce GHG emission
- BECCS capability



1 project valued at $2.2M



Current focus includes:

- WGS w/ CO_2 Capture
- Warm syngas multi-contaminant removal

Summary

- Well positioned to address administration challenges for net-zero carbon electricity sector and overall economy
- Active portfolio includes 7 Extramural Projects, 1 NETL FWP, and 5 FWPs to other national labs.
- Active portfolio total value $33.6M
- New projects to be initiated within the next year
  - 4 selections from FOA 2376 "Enabling Gasification of Blended Coal, Biomass and Plastic Wastes to Produce Hydrogen"
  - New projects anticipated from FOA2400 "Fossil Energy Based Production, Storage, Transport and Utilization of Hydrogen"

Agenda—Sessions

2021 R&D Virtual Project Review Meeting – Gasification

Tuesday 5/4 10:00AM Eastern

Air Separation Technologies

Session 1 Moderator—Evelyn Lopez, NETL

Session 2 Moderator—Andrew (Drew) O'Connell, NETL

Process Intensification for Syngas & Hydrogen

Moderator—Andrew (Drew) O'Connell, NETL

Wednesday 5/5 10:00AM Eastern

Process Intensification for Syngas & Hydrogen

Moderator—Steve Markovich, NETL

Blue Hydrogen & Negative CO2 Emissions

Moderator— Diane Revay Madden, NETL

Questions?

Thank You!

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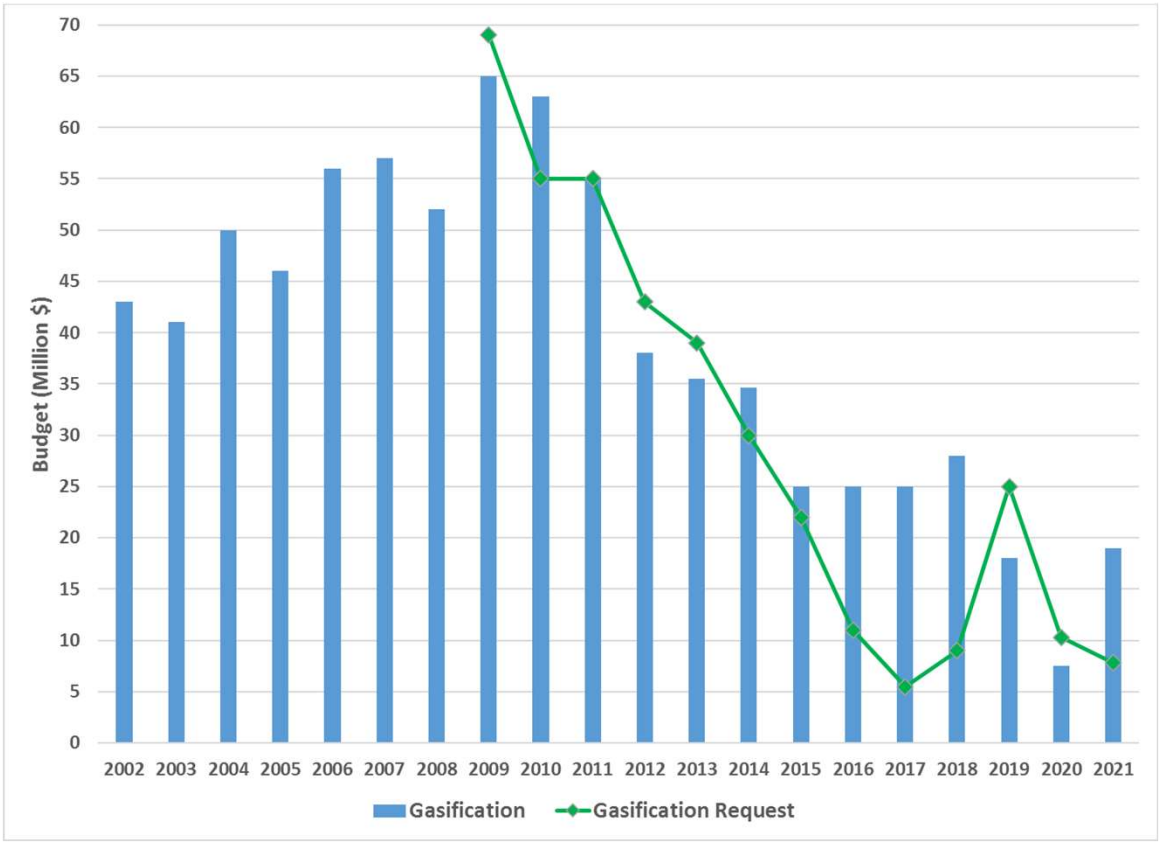
Additional information can be found at:
https://www.netl.doe.gov/coal/gasification

Budget Status



Gasification Program Funding ($M)	
FY 21 Requested	FY 21 Enacted
7.8	19