



Modular Gasification Systems – Coal-Based Energy Systems for New Applications

K. David Lyons, Technology Manager – Gasification Systems
National Energy Technology Laboratory, Morgantown, WV

Abstract:

Small-scale, modular power systems offer distinct advantages amid a changing energy landscape. Among other benefits, they expedite technology development, cut investment and operating costs, improve availability, reduce environmental impacts, and offer flexibility in meeting location-specific needs.

In contrast to large coal plants (much greater than 100s of megawatts [MW]), which have relied on economies of scale for cost-effectiveness, modular gasification systems will pursue different paths to implementation, such as mass production and learning-curve effects in lieu of traditional technology scale-up. These systems will make heavy reliance on advanced manufacturing, sophisticated modeling and simulation, and reaction and process intensification, enabling competitive costs and environmental impacts, even at reduced scales. In so doing, the possibility is opened for accessing new markets, such as remote areas that are subjected to high electricity costs. Modular systems are expected to increase deployment opportunities by affording lower capital investment and reducing investment risk, and are tailored in size and characteristics to locally available fuels and feedstocks, including low-value coal, waste coal, and supplemental opportunity feedstocks such as biomass refuse-derived fuel.

The research and development (R&D) work underway at the U.S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL) has a strong emphasis on modular systems technology, specifically in the following areas:

- Modular Gasification – Technology for modular gasifier units or components for combined heat and power that could produce clean syngas from coal and produce power via conversion of syngas in a fuel cell, combustion turbine, or other heat engine. Currently, gasifiers, burners, and syngas cleanup are under investigation.
- Modular Air Separation Technologies – Oxygen production units to support the oxidant feed of an oxygen-blown modular gasifier scaled to a range of 1 to 5 MW.



In addition to small units for gas-phase oxygen production, DOE continues to investigate oxygen carriers and chemical looping routes to directly supply oxygen to gasification reactions.

- Field Pilot Studies – Front-End Engineering Design (FEED) studies of small/modular gasification systems fueled by coal or coal-biomass mixtures, co-producing power and heat or high-value fuels/chemicals. There is interest for these in remote locations that exhibit much higher electricity costs than the U.S. national average, consistent with the idea of matching development efforts to likely market opportunities for modular gasification.

This paper will provide an overview of DOE’s Gasification Program, will feature DOE/NETL’s Radically Engineered Modular Systems (REMS) Initiative, and will provide detailed discussion of advances in technologies that will serve as the foundation for future low-cost, coal-based energy systems that will enable new applications for coal in the United States.