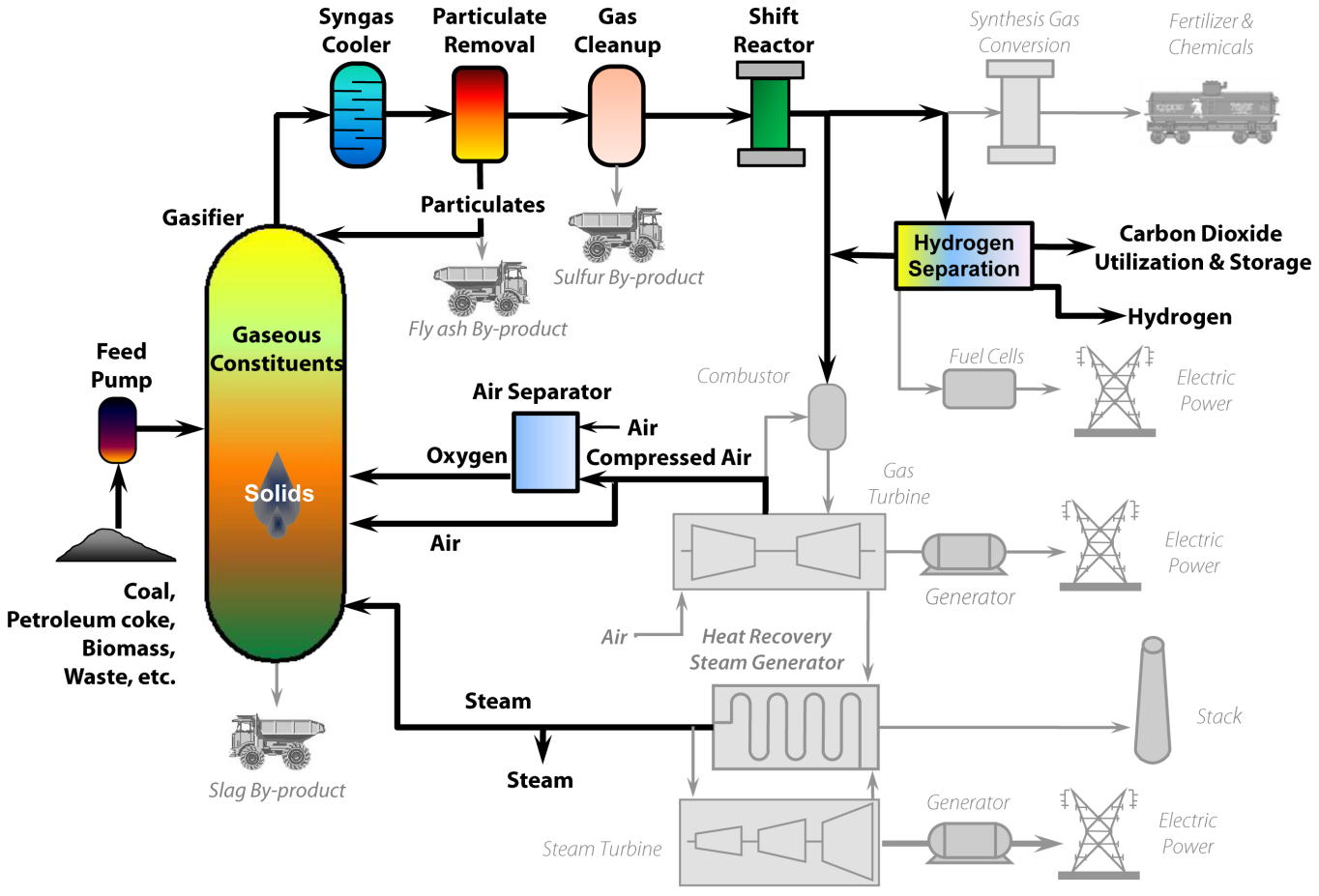
GASIFICATION SYSTEMS PROGRAM

- Reduce gasification costs so coal can support U.S. economic growth
- Ensure excellent environmental performance for coal gasification

Gasification is used to convert a solid feedstock, such as coal, petcoke, or biomass, into a gaseous form, referred to as synthesis gas or syngas, which is primarily hydrogen and carbon monoxide. Pollutants can be captured and disposed of or converted to useful products more easily with gasification-based technologies compared to conventional combustion of solid feedstocks. Gasification can generate clean power, and by adding steam to the syngas and performing water-gas-shift to convert the carbon monoxide to carbon dioxide (CO_2), additional hydrogen can be produced. The hydrogen and CO_2 are separated—the hydrogen is used to make power and the CO_2 is sent to storage, converted to useful products or used for enhanced oil recovery (see figure below). In addition to efficiently producing electric power, a wide range of transportation fuels and chemicals can be produced from the cleaned syngas, thereby providing the flexibility needed to capitalize on the changing economic market. As a result, gasification provides a flexible technology option for using domestically available resources while meeting future environmental emission standards. Furthermore, polygeneration plants that produce multiple products are uniquely possible with gasification technologies.



Gasification Systems Program Research and Development Areas are in Color.
Grey sections are part of other closely aligned DOE/NETL Research Technology Programs.

The Gasification Systems program is developing technologies in three key areas to reduce the cost and increase the efficiency of producing syngas: (1) ***Feed Systems***, (2) ***Gasifier Optimization and Plant Supporting Systems***, and (3) ***Syngas Processing Systems***:

FEED SYSTEMS

Research is underway to reduce the cost and increase the efficiency, through design and advanced plant integration, of fuel and oxygen feed to commercial gasifiers. High-pressure solid feed systems will expand the use of our Nation's Western low-cost, low-rank coals for high-pressure gasifiers (currently limited to more expensive fuel), enable co-feeding of coal with other advantageous fuels (such as biomass), and encourage higher pressure (and therefore more efficient) operation of dry feed gasifiers. Advanced air separation technologies, such as ion transport membrane (ITM) technology, will lower the cost of oxygen production through reduced capital costs, and result in more efficient integrated gasification combined cycle power plants through turbine integration, as compared to today's commercially available, energy intensive technology for oxygen production—cryogenic air separation.

GASIFIER OPTIMIZATION AND PLANT SUPPORTING SYSTEMS

Gasifier Optimization and Plant Supporting System technologies under development are targeted at increasing gasifier availability and efficiency, improving performance, and reducing the capital and operating costs of advanced gasification plants. Ongoing research and development projects are developing more durable refractory materials, creating models to better understand the kinetics and particulate behavior of fuel inside a gasifier, and developing practical solutions to mitigate the plugging and fouling of syngas coolers. Future work will focus on the development of a cutting-edge gasifier, which will start with multiple competing concepts to support the most aggressive and successful technologies being developed, both in the Gasification Systems program, and other Department of Energy programs. Possibilities include advanced concepts to efficiently gasify low-rank coals, hybrid coal-natural gas gasifiers, and catalytic gasification for use with fuel cells for power production. Future work will also aim to reduce the amount of water used in gasification plants and integrate technologies throughout the plant and beyond in a holistic approach to increase efficiency and reduce costs.

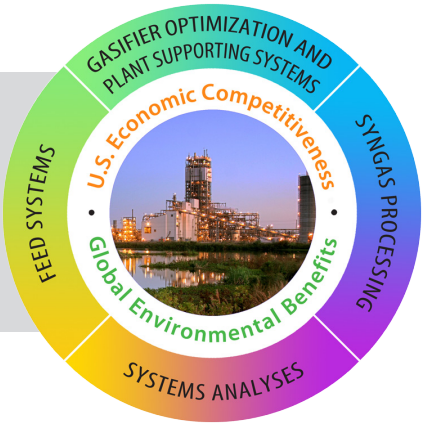
SYNGAS PROCESSING SYSTEMS

Gas separation unit operations represent major cost elements in gasification plants. Gasification-based energy conversion systems rely on two gas separation processes: (1) separation of oxygen from air for feed to oxygen-blown gasifiers; and (2) post-gasification separation of hydrogen from CO_2 following (or along with) the shifting of gas composition when CO_2 capture is required, or hydrogen is the desired product. The advanced gas separation systems being developed operate at elevated temperatures, thereby reducing the parasitic energy penalty associated with conventional technologies.

More information on Gasification Systems Program R&D, on how systems analysis supports the program, on the benefits of gasification, and on individual projects can be found at at the NETL website:

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

Or Google **"Gasifipedia"**



April 2014