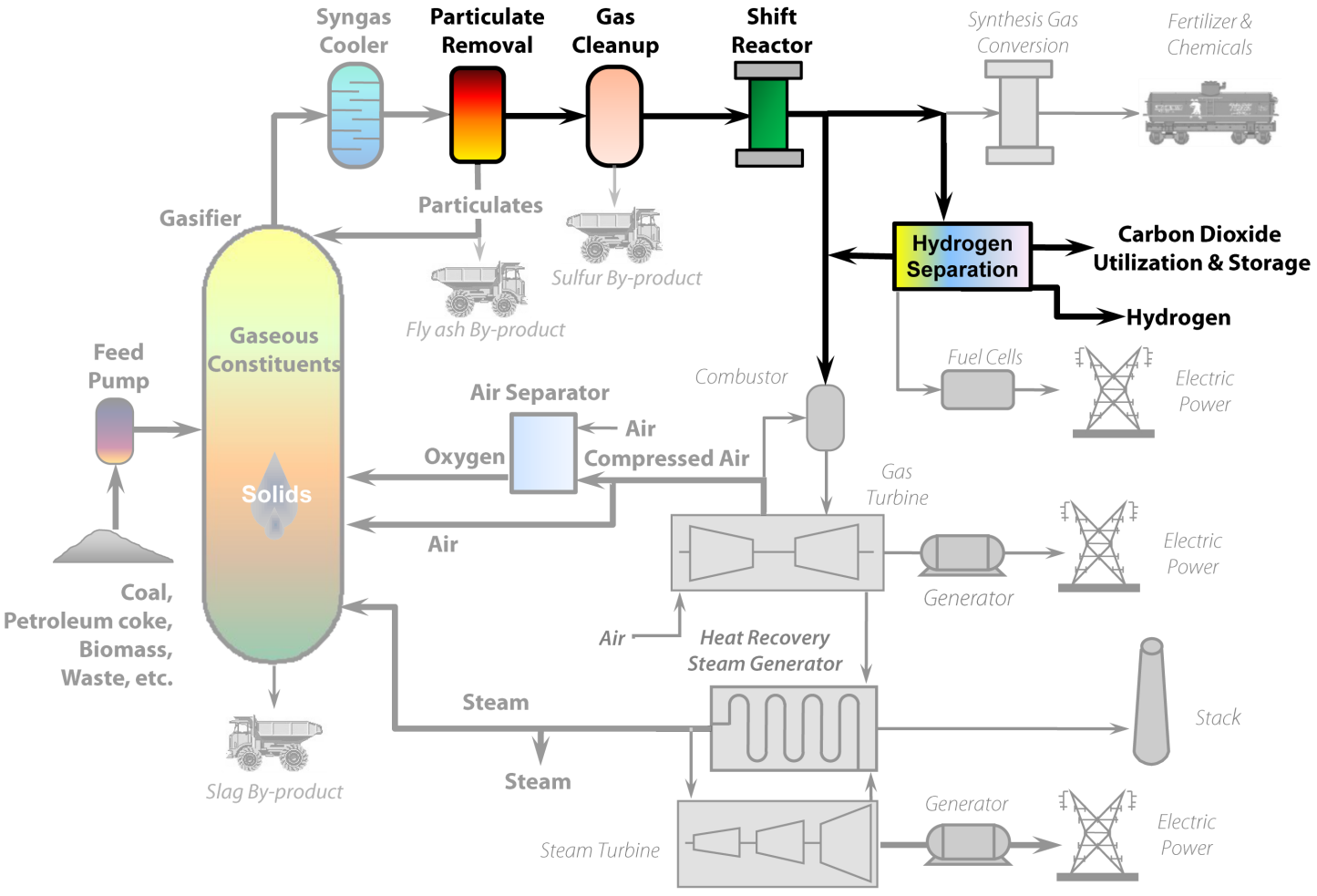
SYNGAS PROCESSING SYSTEMS

Part of the DOE Gasification Systems Program to

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

Conventional methods for removing sulfur and other contaminants from syngas typically rely on chemical or physical absorption processes operating at low temperatures. When cooled to low temperatures, nearly all of the steam present in the syngas condenses. After contaminant removal, the gas has to be reheated prior to its use in a gas turbine or other chemical synthesis process; in the case of downstream hydrogen production, additional steam needs to be added back to the syngas. These process swings adversely impact the plant's thermal efficiency and cost. Techno-economic analysis shows that gas-cleaning processes amenable to higher operating temperatures could significantly reduce this efficiency loss and improve the gasification plant's commercial viability. It is also critical that, while improving efficiency and reducing cost, the gas cleaning removes a wide variety of coal contaminants (including ammonia, hydrogen chloride,



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

hydrogen sulfide, and carbonyl sulfide, as well as various forms of trace metals, including arsenic, mercury, selenium, and cadmium) to extremely low levels. Accordingly, the research and development approach in this area focuses on the development of high-efficiency processes that operate at moderate to high temperatures and provide multi-contaminant control to meet the highest environmental standards.

Hydrogen is often the desired product of the gasification process, given its importance as primary feedstock for fuels synthesis, fertilizer and chemicals synthesis, or power generation in 90% carbon dioxide (CO_2) capture scenarios. In this case, inexpensive post-gasification separation of hydrogen from CO_2 following (or along with) the shifting of gas composition is needed. For effective integration with advanced gasification technologies, and to realize the full advantages of high-temperature gas cleaning technologies, hydrogen and CO_2 separation must be accomplished at high process temperatures. High temperature operation also offers the possibility of enhancing the water-gas-shift process through integration with advanced membranes operating at similar temperatures. Technologies that are capable of producing both hydrogen and CO_2 at high pressure can avoid significant recompression costs that would further enhance plant economics, particularly in the case of carbon storage which requires very high compression of the CO_2.

Research projects in this area of syngas cleanup and CO_2/hydrogen separations include the following:

HIGH-TEMPERATURE SYNGAS CLEANUP TECHNOLOGY

A sorbent-based technology operating at relatively high syngas temperatures for removing hydrogen sulfide and carbonyl sulfide from syngas has been developed and was successfully field tested (RTI's Warm Gas Cleanup technology). Detailed design of a scale-up for a 50 MWe demonstration at Tampa Electric's Polk Power Station is underway.

WARM GAS MULTI-CONTAMINANT REMOVAL SYSTEM

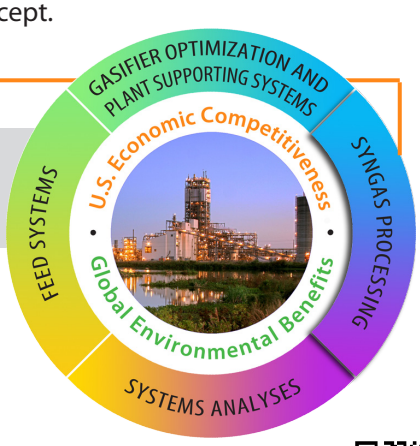
Research involves testing and developing palladium sorbents for the capture of the trace metals selenium, phosphorus, arsenic, and mercury from fuel gases.

HYDROGEN-RECOVERY MEMBRANES

The hydrogen transport membrane, which uses metal or metal alloy materials with surface exchange catalysts to separate hydrogen from CO_2, is being aggressively developed. Several projects have developed hydrogen membranes that have achieved fluxes and hydrogen purity high enough to encourage continued development of this cutting edge technology. These technologies operate at temperatures designed to integrate at increased efficiency with advanced warm syngas cleanup technologies.

ADVANCED CO_2 SEPARATION INTEGRATED WITH WATER GAS SHIFT

Lab-scale work integrating a CO_2 capture sorbent and a water-gas-shift catalyst have been initiated. This scoping study will conclude with a systems analysis to show potential benefit of this concept.



For more information on this R&D Area, visit this section of our website:
http://www.netl.doe.gov/research/coal/energy-systems/gasification/syngas-processing

Other Key R&D areas in the Gasification Systems program are Feed Systems and Gasifier Optimization and Plant Supporting Systems. 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 the NETL website:

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

Or Google "Gasifipedia"

April 2014