

Research & Development

- There is no challenge regarding the use of coal as a clean, efficient fuel that has not been met by technology
- Nearly 90% of criteria pollutants from US coal-based power plants are now captured or reduced through the use of technology
- Over the last 2 years, coal use worldwide has increased significantly
- Clean Coal Technologies as defined by Congress in the mid-1980s are technologies to reduce sulfur dioxide and nitrogen oxides
 - Technologies that increase efficiencies and reduce emissions on a per unit energy basis
- The Lignite Research Council's R&D program is an industry/government partnership
 - For every state dollar, six dollars is invested from industry & other sources in lignite related R&D projects
- Consumption of North Dakota lignite can be broken down by:
 - 79% Electric Power Generation
 - 13.5% Synthetic Natural Gas
 - 7.5% Specialty Products
- Tangential fired boilers use pulverized coal and are based on a concept of a single flame envelope and project both fuel and combustion air from the corners of the furnace. The flames are directed on a line tangent to a small circle lying in a horizontal plane at the center of the furnace. This action produces a fireball that moves in a cyclonic motion and expands to fill the furnace.
- Cyclone furnaces use several water cooled horizontal burners to produce high temperature flames that circulate in a cyclonic pattern. The coal is not pulverized but instead crushed to a 4-mesh size. The crushed coal is fed tangentially, with primary air, to a horizontal cylindrical combustion chamber. In this chamber, small coal particles are burned in suspension while the larger particles are forced against the outer wall. The high temperature of the coal ash, causes the ash to form a molten slag, which is drained from the bottom of the furnace through a slag tap opening.
- Fluidized bed boiler technology uses air to suspend coal particles and an inert bed material. Burns at a significantly lower temperature which reduces the production of thermal NOx. The bed material can be an alkali or alkaline earth material that will capture SO2.
- Future generating technologies:
 - Advanced Pulverized Coal – 3500 PSI Steam, Up to 1300 MW/Unit, 35-40% efficient, almost 17% reduction in CO2 and other emissions
 - Oxy-fuel Combustion – uses pure oxygen not air for combustion. This allows the flue gas to be basically CO2 and water and allows for different strategies for CO2 capture.
 - Integrated Gasification Combined Cycle (IGCC) - chemical process that converts coal into a synthetic gas, this gas is used as a fuel. Highly efficient because the exhaust from the gas turbine is hot enough to boil water. The steam is then used to drive a turbine that creates a second source of electricity.
 - Poly-generation refers to creating multiple products from coal

- Allam Cycle uses supercritical CO₂ as the working fluid and high pressure oxyfiring to release the chemical energy. Very high efficiency and capture 100% of the CO₂.
- Gasification products:
 - Electric power
 - Synthetic natural gas
 - Liquid transportation fuels
 - Hydrogen
 - Chemicals
- Coal-to-Liquids – will gasify coal and convert it to ultra-clean gasoline, LPG, propane & electricity
 - 12 million tons of coal to produce 30,000 barrels of gasoline per day
- Coal-to-hydrogen Power – Gasify lignite and convert it to hydrogen for use in combustion turbine.
 - Will use 2.4 million tons of lignite/year
- Emission Control Technologies
 - Dry Scrubber
 - Baghouse
 - Electrostatic Precipitator
 - Wet Scrubber
 - Overfire Air (low NO_x burners, injection of ammonia)
- Carbon Capture is the process of separating relatively pure carbon dioxide gas as a by-product of industrial processes and electricity generated from fossil fuels

Summary

U.S. needs more sources of energy & needs to lessen dependence on foreign sources

Lignite is a valuable source of energy & chemical products

R&D is critical in the wise use of this abundant resource