Clean Coal Technology

What is Clean Coal Technology (CCT)?

Clean coal technologies are several generations of technological advances that have led to more efficient combustion of coal with reduced emissions of sulfur dioxide and nitrogen oxide. The U.S Department of Energy (DOE) administers the CCT program to encourage and support public/private partnerships to research, develop and demonstrate clean coal technologies that ultimately can be brought to large-scale commercial deployment. In the first generation of CCT, private industry was required to provide half of the funding for each project, but historically contributed significantly more. The clean coal technology program has resulted in more than 20 new, lower cost, more efficient and environmentally compatible technologies for electric utilities, steel mills, cement plants and other industries.

Energy and Environmental Benefits of CCT Today

Power plants being built today emit 90 percent less pollutants (SO2, NOx, particulates and mercury) than the plants they replace from the 1970s, according the National Energy Technology Laboratory (NETL). Regulated emissions from coal-based electricity generation have decreased overall by over 40 percent since the 1970s, while coal use has tripled, according to government statistics. Examples of technologies that are deployed today and continue to be improved upon include:

Fluidized-bed combustion –Limestone and dolomite are added during the combustion process to mitigate sulfur dioxide formation. There are 170 of these units deployed in the U.S. and 400 throughout the world.

Integrated Gasification Combined Cycle (IGCC) – Heat and pressure are used to convert coal into a gas or liquid that can be further refined and used cleanly. The heat energy from the gas turbine also powers a steam turbine. IGCC has the potential to improve coal's fuel efficiency rate to 50 percent. Two IGCC electricity generation plants are in operation in the U.S.

Flue Gas Desulfurization – Also called "scrubbers," and removes large quantities of sulfur, other impurities and particulate matter from emissions to prevent their release into the atmosphere.

Low Nitrogen Oxide (NOx) Burners – Reduce the creation of NOx, a cause of ground-level ozone, by restricting oxygen and manipulating the combustion process. Low NOx burners are now on 75 percent of existing coal power plants.

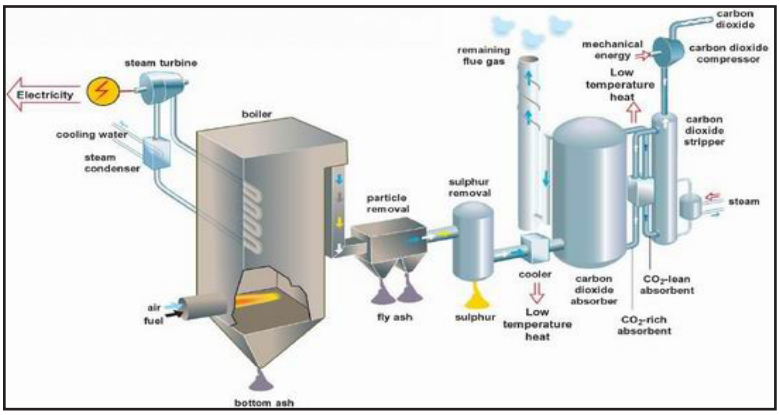
Selective Catalytic Reduction (SCR) – Achieves NOx reductions of 80-90 percent or more and is deployed on approximately 30 percent of U.S. coal plants.

Electrostatic Precipitators – Remove particulates from emissions by electrically charging particles and then capturing them on collection plates.

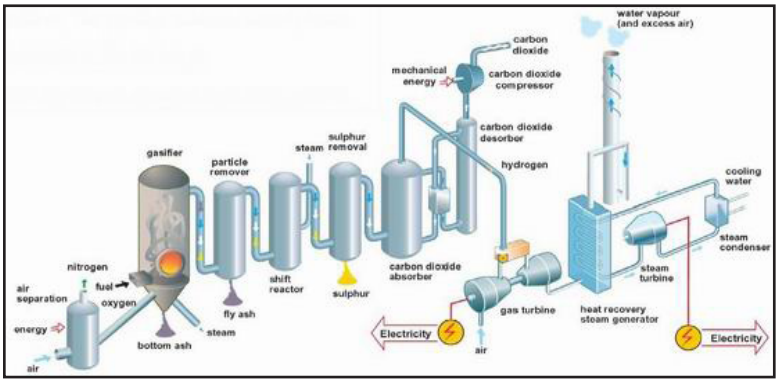
Clean Coal Technologies on the Horizon

New federal programs, such as the Clean Coal Power Initiative (CCPI), focus on eliminating emissions of pollutants, including particulates and mercury; improving technologies to increase efficiency and thereby reduce carbon dioxide and other emissions; and reducing carbon dioxide emissions through carbon capture and storage. Other technologies such as coal liquefaction and gasification are being pursued to produce low cost, secure alternatives to oil and natural gas for use in electricity generation and transportation. Focus areas for new technology R&D include:

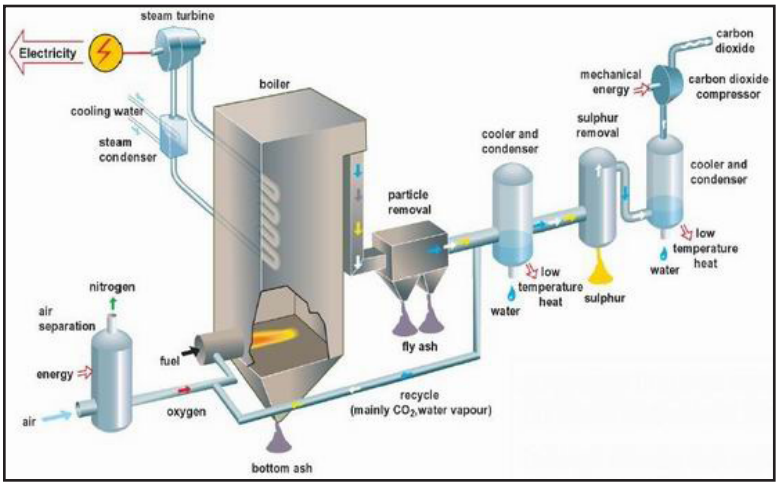
- **Efficiency Improvements** – To raise plant efficiency and reduce carbon dioxide (CO2) and other emissions. While some efficiency technologies are commercially available, others, such as Ultra Supercritical Pulverized Coal (USPC) and IGCC require continued research, development and demonstration. Improved efficiency at an existing plant can reduce CO2 emissions by 10-16 percent, and by 2025, new units could reduce CO2 emissions by as much as 30 percent.



Post-Combustion Capture



Pre-Combustion Capture



Oxy-Coal Combustion

- **High-efficiency fuel cells** – To operate on a range of domestic fuels with virtually emissions-free performance at unsurpassed efficiencies.
- **Advanced high-efficiency combustion** - For generating systems with increased operating temperatures, new computerized controls, improved burner designs and higher performance turbines
- **Hydrogen production** – A clean energy carrier—via gasification
- **Carbon Capture and Storage (CCS)** – Captures and stores CO2 emissions in geologic formations or deep in the ocean where it dissolves under pressure. CCS technologies under development include:
- Post-combustion capture from flue gas using an amine solvent and chilled ammonia
- Pre-combustion capture using IGCC to isolate and capture CO2 before it is released
- Oxy-Coal combustion using pure oxygen in the boiler to significantly reduce the dilution of CO2 in the exhaust gas stream

Funding Support Needed for New Clean Coal Technologies

CCT research and development will allow for the continued use of America's abundant domestic coal resources and the affordable energy it provides to business and consumers. Clean coal technologies are required to continue improving energy efficiency and to meet increasingly stringent environmental challenges and expectations, especially in the areas of mercury control and carbon capture and storage, while continuing to reduce emissions of SO2 and NOx. A key objective of the program is the development of a zero emission coal-based hydrogen production facility incorporating carbon sequestration (FutureGen).

While industry will finance significant portions of each CCT project, it is critical that the federal government provide funding through the appropriations process for the Department of Energy's clean coal programs and the FutureGen project. Sufficient funding is needed to assure continued research, development and demonstration of a new generation of advanced technologies that are promising but too high-risk to be financed solely by private industry. A strong federal commitment to clean coal technology will allow America to take full advantage of its vast 235 year supply of coal reserves to meet growing demand for electricity and supporting economic growth while meeting critical environmental objectives.