Advanced Coal Technologies

A Diverse Range of Technologies Advancing
Abundant and Affordable Electricity for the World

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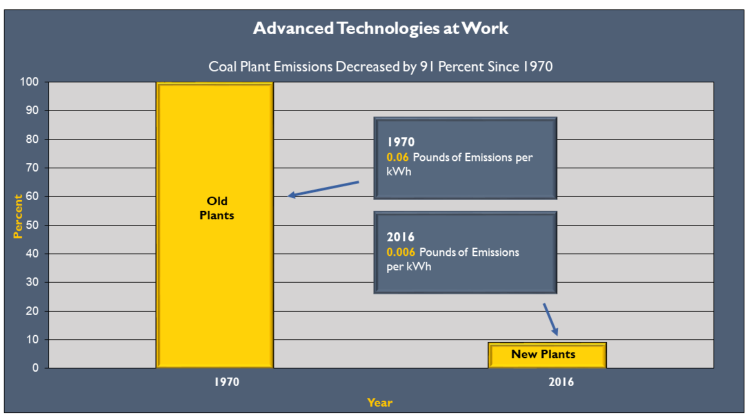
What are Advanced Coal Technologies?

Advanced coal technologies — also referred to as clean coal technologies — are state-of-the-art emission control devices and boiler technologies that over several decades have led to steady increases in energy efficiency and lower emissions from coal electricity generation.

Environmental Benefits of Advanced Coal Technologies

Today's power plants emit more than 90 percent fewer pollutants (SO_2, NO_x, particulates and mercury) per unit of electricity generated than the plants they replace from the 1970s, according to data from the U.S. Environmental Protection Agency and U.S. Energy Information Administration. These reductions have occurred at the same time low-cost reliable coal generation has more than doubled, according to government statistics. High efficiency, low emissions (HELE) technologies eliminate nearly all regulated emissions and significantly reduce CO_2 emissions.



Sources: EPA; EIA
2016 data are preliminary

Energy and Economic Benefits

The diverse electricity generation portfolio in the U.S. saves consumers $93 billion annually and lowers the volatility of their utility bills by half (Source: IHS). Electricity generating power plants using advanced coal technology employ more people to build and operate than power plants fueled by natural gas, wind or solar. Coal technology options create more than twice the number of permanent jobs than natural gas technology, four times more than wind and eight times more than solar per dollar invested. (Sources: EVA; NETL; DOE JEDI 3 Model.)

Examples of Advanced Coal Technologies

Today, thanks to a range of proven technologies, the commercial use of coal for electricity generation is cleaner than ever. More than 90 percent of coal-fired power plants in the U.S. have installed advanced emission controls. According to IEA, using available HELE technologies will increase the current average efficiency rate of the coal fleet from 33 to 40 percent and reduce emissions by between 14 and 21 percent.

Examples of current advanced coal technologies include:

High Efficiency, Low Emissions (HELE) technologies such as Supercritical and Ultra-supercritical combustion technologies are used in new pulverized coal combustion systems to operate at increasingly higher temperatures and pressures and achieve higher efficiencies than conventional units, and with significant CO_2 reductions.

Fluidized-bed combustion utilizes limestone and dolomite 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) plants utilize heat and pressure 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 to generate power. IGCC has the potential to raise coal's fuel efficiency rate to 50 percent.

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

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

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

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

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In addition to what exists today, other technological advancements can further increase efficiency and reduce emissions. Ultra-supercritical technologies are continually being improved, resulting in units operating at even higher efficiencies than the current ultra-supercritical systems, potentially up to an efficiency rate above 50 percent.

Carbon Capture and Storage (CCS) technology also holds promise. CCS captures CO_2 emissions from the use of fossil fuels in electricity generation and industrial processes and stores them in geologic formations or deep in the ocean where they dissolve 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 CO_2 before it is released; and oxy-coal combustion using pure oxygen in the boiler to significantly reduce the dilution of CO_2 in the exhaust gas stream.

Like renewable energy sources such as wind and solar in their early days, these technologies require substantial investment to become commercially viable, and should receive the same kinds of investment, policy parity and support.

Advanced Coal Technologies at Work in the U.S.

The *John W. Turk, Jr. Power Plant* is a 600-megawatt facility in Fulton, Arkansas, that began operation in December 2012 as the first U.S. ultra-supercritical unit in operation. Its advanced coal combustion technology uses less coal and produces fewer emissions, including carbon dioxide, than traditional pulverized coal plants. State-of-the-art emission control technologies and the use of low-sulfur coal enable the Turk Plant to meet emission limits that are among the most stringent for a pulverized coal unit.

The *Prairie State Energy Plant* in Marissa, Illinois, uses supercritical boilers and a range of emissions reduction technologies including: nitrogen oxide controls, selective catalytic reduction, dry electrostatic precipitators, sulfur dioxide scrubbers and wet electrostatic precipitators. Its technologies remove 85 percent of NO_x, 98 percent of SO_2, 99 percent of particulate matter and 90 percent of mercury. Prairie State's generating units use less coal to produce more energy, with a heat rate that is 11 percent better than the Illinois average and 15 percent better than the national average.

The *Virginia City Hybrid Energy Center (VCHEC)* entered commercial operation in July 2012 in St. Paul, VA. The 600-megawatt station, which produces enough electricity to power about 150,000 homes, is a circulating fluidized bed (CFB) unit that uses coal and up to 20 percent biomass (up to 537,000 tons/year) for its fuel. The technology also allows for the use of coal, waste coal and renewable energy sources. CFB technology combined with modern post-combustion controls has low emissions of sulfur dioxide, nitrogen oxide, particulate matter and mercury.

Petra Nova is a project from NRG Energy and JX Nippon Oil & Gas Exploration Corp. outside of Houston, Texas, that first captured carbon dioxide from the process of coal combustion in September 2016. The plant can capture more than 90 percent of the carbon dioxide released from the equivalent of a 240 megawatt, or million watt, coal unit, which translates into 5,000 avoided tons of carbon dioxide per day or over 1 million avoided tons per year. At Petra Nova, carbon capture occurs after the coal has been burned.