Increasing the Efficiency of Existing Coal-Fired Power Plants

Coal has long been the major fossil fuel used to produce electricity. However, coal-fired electric power plants are one of the largest sources of air pollution in the EU, with greenhouse gas (GHG) emissions from burning of fossil fuels believed to be the major contributor to global climate change. Regulations under implementation and development would impose new requirements on fossil-fueled (mostly coal-fired) power plants (CFPPs) to control GHG emissions. The first of these requirements refers to the control of carbon dioxide (CO_2) emissions from new electric generating units burning fossil fuels. Towards that, efficiency improvements can be an important contributor.

The overall efficiency of a power plant encompasses the efficiency of the various components of a generating unit. Minimizing heat losses is the greatest factor affecting the loss of CFPP efficiency, and there are many areas of potential heat losses in a power plant. Efficiency of older CFPPs becomes degraded over time, and lower power plant efficiency results in more CO_2 being emitted per unit of electricity generated. The options most often considered for increasing the efficiency of CFPPs include equipment refurbishment, plant upgrades, and improved operations and maintenance schedules.

Cost of the improvements is often compared to the expected return in increased efficiency as a primary determinant of whether to go forward with a program. A study[1] by the Asia-Pacific Working Group (APWG) found that at the low to medium end of cost expenditures are combustion, steam cycle, and operations and maintenance improvements. Replacing the older CFPPs with new power plants was not generally seen as being practical because the expenditure for a new plant could not be justified by the improved performance. Instead, efficiency and operational improvements were seen as a possible alternative considering a range of equipment upgrades and refurbishment options to various CFPP systems. If GHG emissions reduction was a goal, then heat rate efficiency improvements could enable a power plant to generate the same amount of electricity from less fuel and decrease CO_2 emissions.

Towards increased efficiency, the retirements of lower efficiency units combined with increased generation from higher efficiency refurbished units, and advanced refurbishments with improved operation and maintenance, would be necessary to achieve this goal. These improvements would generally be considered low to medium cost upgrades. However, at the higher cost end are major plant retrofits and upgrades (i.e., conversion of subcritical CFPP units to super- or ultra-supercritical CFPP units), which would raise efficiencies more substantially.

One possible approach to achieve fleet-wide efficiency improvement might be to use the top decile of CFPP efficiency as a benchmark for the E.U. fleet and establish an "*efficiency frontier*" that would be revisited periodically to reset the benchmark. This could be combined with possible incentives to improve efficiency or retire less efficient power plants. Other trans-European approaches could use tax incentives to encourage greater efficiency or employ energy efficiency standards focused on improving

1 Asia-Pacific Economic Cooperation Working Group, Costs and Effectiveness of Upgrading and Refurbishing Older Coal-Fired Power Plants in Developing APEC Economies, Energy Working Group Project EWG 04/2003T, June 2005, http://www.egcfe.ewg.apec.org/projects/UpgradePP_Report_2005.pdf.

efficiency of CFPPs. The overall cost of these or other programs to increase CFPP efficiency has yet to be determined.