

POWER FROM COAL AND BIOMASS VIA CFB

Robert Giglio, Justin Wehrenberg
Foster Wheeler Power Group
Clinton, New Jersey

Circulating Fluidized Bed technology uses fluidization technology to mix and circulate fuel particles with limestone as they burn in a low-temperature combustion process. Unlike conventional steam generators that burn the fuel in a massive high-temperature flame, CFB technology does not have burners or a flame within its furnace. The limestone captures the sulfur oxides as they are formed, while the low burning temperature minimizes the formation of nitrogen oxides.

The fuel and limestone particles are recycled over and over back to the process, which results in high efficiency for burning the fuel, capturing pollutants, and for transferring the fuel's heat energy into high-quality steam to produce power.

Due to the vigorous mixing, long burning time, and low temperature of the combustion process, CFBs are fuel flexible, which means they can cleanly burn traditional coal fuels, as well as "carbon neutral" biomass and waste fuels. This ability to cleanly burn virtually any combustible material greatly surpasses the fuel limitation of conventional combus-

tion processes. Unlike conventional steam generators, CFBs capture and control harmful pollutants during the burning process and do not need to rely on add-on pollution control equipment.

In addition, we have applied highly efficient vertical-tube, supercritical steam technology to our utility-scale CFB designs. Supercritical steam enables more of the fuel's energy to be transferred to the steam. This improves power plant efficiency, reducing the amount of fuel needed for electricity production and further reducing emissions.

The carbon issue

Due to its ability to burn carbon-neutral fuels such as biomass along with coal, CFB technology offers a unique solution to the CO₂ issue. Biomass is considered carbon neutral since it absorbs and stores carbon from the atmosphere during its growth cycle through the natural photosynthesis process. When biomass is burned, it releases the same carbon back to the atmosphere, resulting in nearly zero net carbon emitted to the atmosphere.

However, due to the world's limited and undeveloped biomass supply chain, existing biomass power plants are limited to about 25 to 50 MWe in size. The plant's small scale, coupled with its fuel supply limitation, translates into electricity costing

Circulating Fluidized Bed technology enables burning coal and biomass to generate power while reducing emissions at the same time.

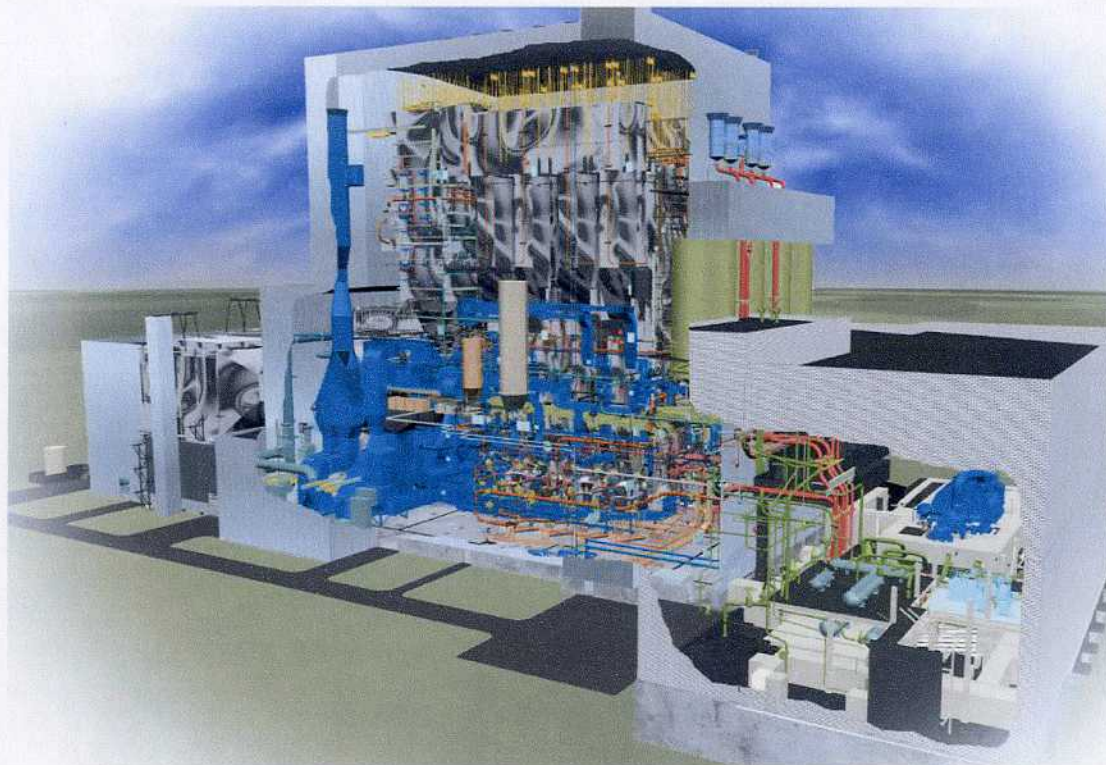


Fig. 1 — Foster Wheeler state-of-the-art 500 MWe supercritical circulating fluidized bed power plant.

about 20 to 30% more than that from conventional fossil power plants.

Again, the CFB offers a solution. Due to its fuel flexibility, a large scale (300 MWe or larger) CFB power plant can be built to burn a combination of coal and several types of biomass. This solution captures both the environmental benefit of reducing CO₂ emissions, and the economic benefit of providing affordable electricity. It is also flexible enough to utilize more biomass when it is available, or fall back on coal when it is not.

This concept can produce a substantial reduction in CO₂ emissions. As Fig. 2 shows, a supercritical 600 MWe CFB plant burning 20% biomass is estimated to produce 32% less CO₂ than a conventional coal plant. The good news is that this can be done today, while still producing affordable electricity.

Flexi-Burn technology

To take carbon reduction to the next level,

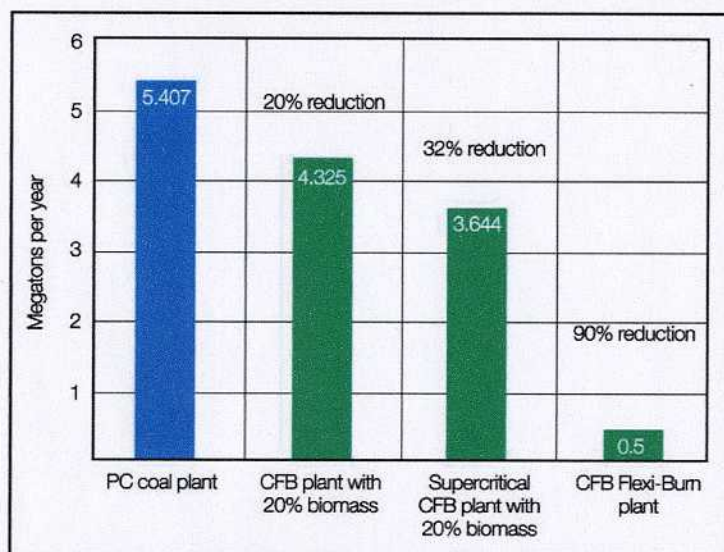


Fig. 2 — CO₂ emissions from a 600 MWe power plant, in megatons per year.

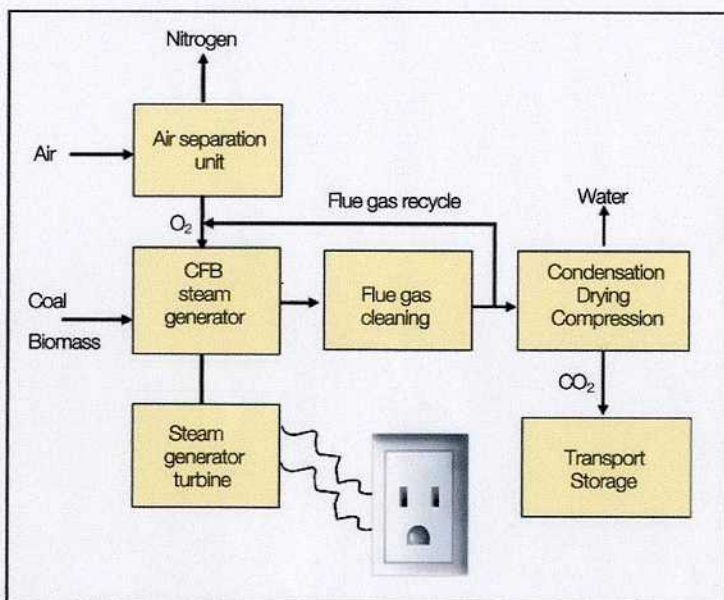


Fig. 3 — Flexi-Burn CFB technology diagram.

Foster Wheeler is developing Flexi-Burn CFB technology. This will allow the CFB to produce a CO₂ rich flue gas, and be part of a practical carbon capture and storage solution (CCS). The technology has the potential to reduce coal plant CO₂ emissions to the atmosphere by over 90%, while minimizing the cost impact and technology risk to consumers.

As Fig. 3 shows, Flexi-Burn technology burns a mixture of oxygen and recycled CFB flue gas. In this way, the flue gas becomes rich in CO₂ (containing over 90% CO₂ on a dry basis), rather than rich in nitrogen, as when air is used. Because the flue gas is nearly all CO₂, Flexi-Burn CFB technology does not need expensive and energy-intensive equipment to remove the CO₂, and has the potential to produce carbon-free electricity at a very low cost as compared to other technologies.

However, the challenge goes well beyond capturing CO₂ from coal power plants. Transporting and storing CO₂ in underground locations such as saline aquifers, is not proven and requires years of study to understand the cost and risks. And no one really knows how much consumers are willing to pay for (or can afford) truly carbon-free electricity. Due to the uncertainty of carbon regulation, the cost and risk of CCS technology, and consumer behavior, it is nearly impossible to predict when or if the market will accept CCS power plants.

To cope with the market uncertainty from a technology standpoint, Flexi-Burn has been designed for market flexibility. The plant can operate in either economical air mode (as all coal plants operate today) providing affordable and competitive electricity for today's market; or in CCS mode, without requiring any significant modification to the plant. This gives power producers the flexibility to adjust plant operation with a changing and uncertain market for carbon-free electricity, and will likely allow faster adoption of CCS technology.

Flexi-Burn also provides investment flexibility by allowing the plant to be built in functional stages. It can be built first for full functionality in the economical air mode, allowing power generators to defer the CCS portion of the capital investment until it is justified by market and policy conditions. This flexibility will allow investment into the power capacity we need to meet growing demand while giving investors the flexibility they need when facing uncertain carbon markets.

As we are seeing today, the uncertainty surrounding the carbon issue is preventing needed investment in our power generation infrastructure. Without new modern power plants coming onto the grid, power generators have no choice but to keep relying on old, inefficient and polluting power plants. Circulating fluidized bed technology is an important part of the solution to meet the world's energy needs while conserving natural resources and preserving our environment. ●

For more information: Justin Wehrenberg, Foster Wheeler Power Group, Clinton, NJ 08809; tel: 908/713-2115, Justin-wehrenberg@fwc.com; www.fosterwheeler.com.