CFB offers potential solution to carbon emissions problem

Robert Giglio and Justin Wehrenberg investigate circulating fluidised bed technology as a potential solution to reducing greenhouse gas emissions.

Global warming and the emissions of greenhouse gases, like CO_2, to our atmosphere is a relatively new concern in the world.

Significantly reducing our carbon footprint while maintaining or improving our standard of living is probably the biggest challenge the human race has ever faced, since almost every thing we do from heating our homes, putting food on our tables, power our businesses, travelling, as well as, breathing, emits CO_2.

CO_2 is not normally harmful to any life forms. In fact, it is an integral part of nature's life cycle. Humans and animals breathe in oxygen and exhale CO_2, while plant life does the opposite.

Burning large amounts of fossil fuels (coal, natural gas, oil) in our power, transportation and industrial sectors has upset nature's CO_2 balance causing the level of CO_2 to increase in our atmosphere.

Significant concern

Since CO_2 is a greenhouse gas which can hold the sun's heat within our atmosphere, it contributes to global warming which is a significant concern in the world today.

The production of electricity is a significant source of greenhouse gas emission, contributing about 21 per cent to the total greenhouse gases we emit to the atmosphere. Unlike other pollutants, CO_2 is an essential by-product of the fossil fuel combustion process and can only be reduced by burning less fossil fuel.

Due to its ability to burn carbon neutral fuels like biomass, circulating fluidised bed (CFB) technology offers a solution to the CO_2 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

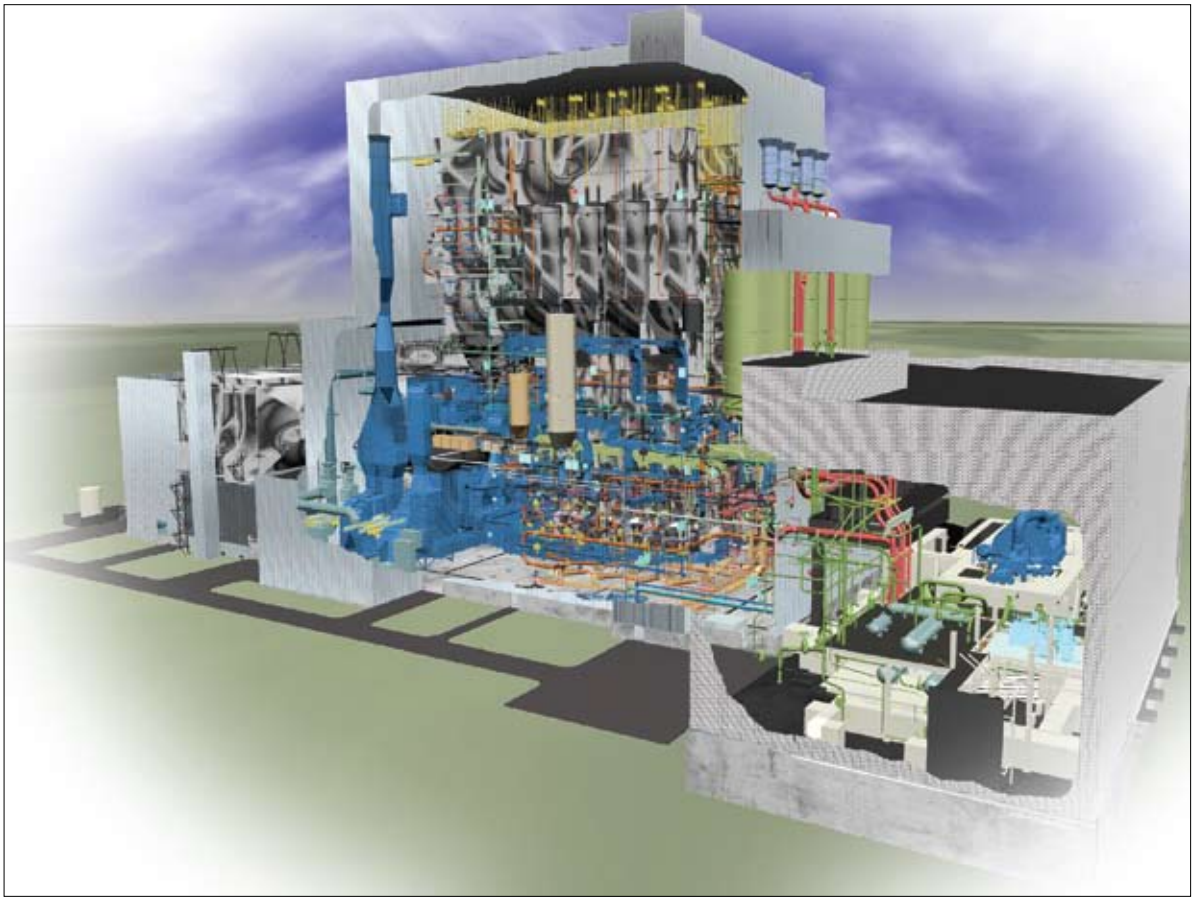

Fig. 1. Foster Wheeler"s 500MWe Supercritical Circulating Fluidised Bed Power Plant.

carbon back to the atmosphere, resulting in nearly no net carbon emission to the atmosphere.

However, due to the world's limited and undeveloped biomass supply chain, biomass power plants are practically limited to about 25-50MWe in size.

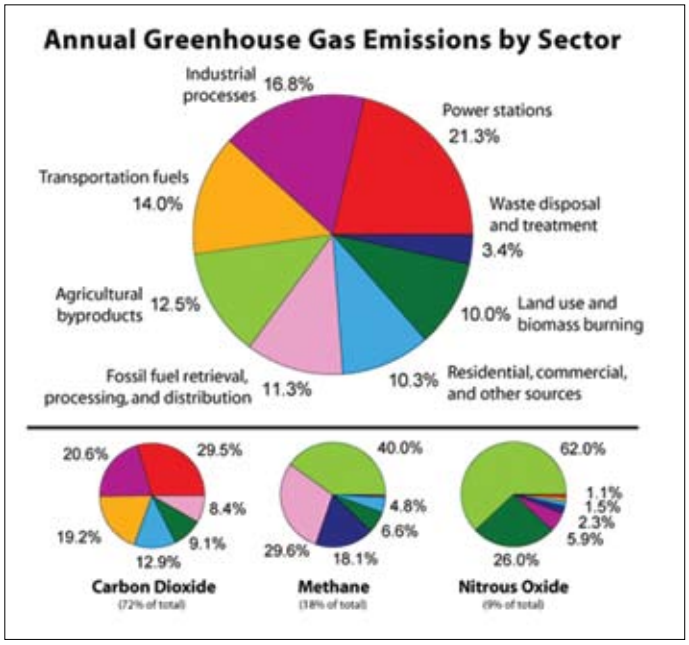

Fig. 2. Annual greenhouse gas emissions by sector in 2007.

The plant's small scale, coupled with its fuel supply limitation translates into electricity costing about 20-30 per cent more than that from conventional fossil power plants.

Again, the CFB offers a solution. Due to its fuel flexibility, a large scale (300MWe 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 CO_2 emissions and the economic benefit of providing affordable electricity. It is also flexible enough to utilise more biomass when it is available or fall back on coal when it is not to meet consumer demand.

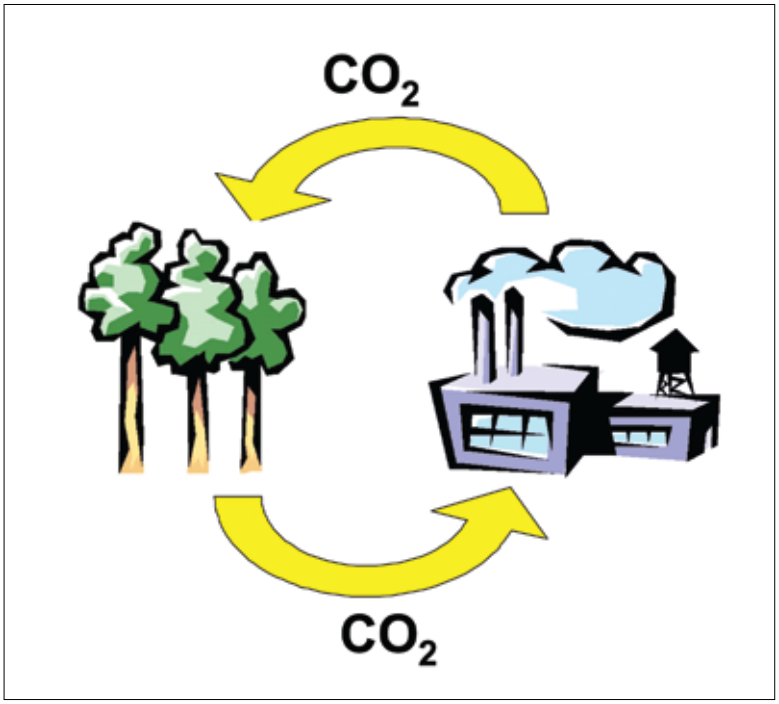

Fig. 3. Biomass power CO_2 Cycle.

This concept can produce a substantial reduction in CO_2 emission. A supercritical 600MWe CFB plant burning 20 per cent biomass is estimated to produce 32 per cent less CO_2 emission than conventional coal plant. The good news is that this can be done today while still producing affordable electricity.

While a 30 per cent reduction in CO_2 emissions is a big step in the right direction, projections show that we need to do much more to significantly reduce the risk of global warming.

What makes this task so challenging is that our CO_2 emissions are tied to our energy use and to realise any reduction in CO_2, we must first offset all new emissions connected to the growth in our energy use.

To take carbon reduction to the next level, Foster Wheeler is developing Flexi-Burn CFB technology. Flexi-Burn will allow the CFB to produce a CO_2 rich-flue gas and be part of a practical carbon capture and storage solution (CCS).

The technology has the potential to reduce coal plant CO_2 emissions to the atmosphere by over 90 per cent while minimising the cost impact and technology risk to consumers.

Further, by combining Flexi-Burn's CCS capability with its biomass cofiring capability can actually result in a net reduction in atmospheric CO_2. Instead of using air in the CFB combustion process, Flexi-Burn technology uses a mixture of oxygen and recycled CFB flue gas. By doing this, the flue gas becomes rich in CO_2 (containing over 90 per cent CO_2 on a dry basis), rather than rich in nitrogen as when air is used.

Since its flue gas is nearly all CO_2, Flexi-Burn CFB technology does not need expensive and energy intensive equipment to remove the CO_2 from its flue gas and has the potential to produce carbon free electricity at a very low cost as compared with other technologies.

But the challenge goes well beyond capturing CO_2 from coal power plants. Transporting and storing CO_2 in underground locations, like saline aquifers, is not proven at the scale required to store CO_2 from power plants and requires years of study to understand the cost and risks of doing this. 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 behaviour, it is nearly impossible to predict when wide scale market acceptance of CCS power plants will occur.

To cope with the market uncertainty from a

technology aspect, 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 to 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. The plant can be built first for full functionality in the economical air mode, allowing power generators to defer the CCS portion of the plant's capital investment until it is justified by market and policy conditions. This flexibility will allow investment into the power capacity we need to meet our growing demand while giving investors the flexibility they need when facing uncertain carbon markets.

Investment uncertainty

As we are seeing today, the uncertainty surrounding the carbon issue is preventing needed investment in our power generation infrastructure. This hurts not only the consumer but the environment as well. 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 to meet consumer demand.

Circulating fluidised bed technology is an important part of the solution to meet the world's energy needs while conserving natural resources and preserving our environment. ❍

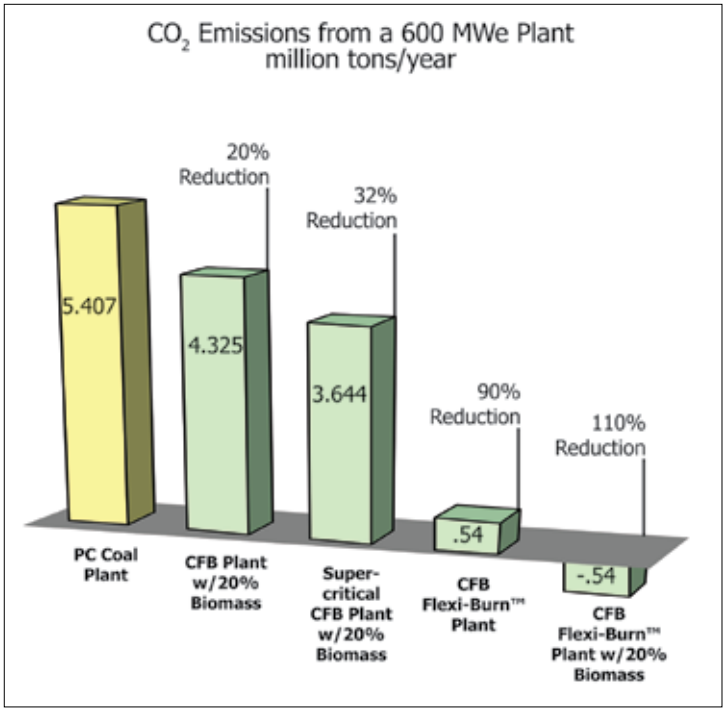

Fig. 4. CO_2 Emissions from a 600MWe Plant – millions tons/year.

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MODULAR STEAM BOILER

The steam boiler development Universal Modular Boiler (U-MB) is an innovative shell boiler. With a steam output ranging from 200kg/h to 2t/h it is particularly attractive for medium-sized industry and trade companies.

The modular boiler is designed as three-pass shell boiler and the complete equipment, for example, the programmable touch screen control and the remote serviceability will be identical to standard industrial boiler equipment.

The boiler has some important innovations in respect of control and regulation. Easy to use is the buzz phrase for the new boiler.

Besides the intuitive touch screen interface, the boiler provides the option of fully automatic operation.

Loos Deutschland GmbH also developed a program for automated start-up of the steam generator from the cold state via an automated start-up function at the push of a button or via an external start signal. Overload protection is also a new feature. It ensures top steam quality also with unfavourable consumer behaviour.

The boiler is made up of several modules which can be selected according to each specific order.

The relevant elements can be configured to meet the necessary requirements in respect of emissions, steam quality and energy efficiency.

Thus the steam boiler is, says Loos Deutschland GmbH, perfectly suitable for all applications.

It can be modularly combined with all system components for fuel and water supply, wastewater disposal, water analysis and heat recovery.

This includes multiple use of design elements in a manner similar to that in which identical platforms for different types of vehicles are used in the car industry.

Thanks to the modular design and consistent use of structural elements it has been possible to achieve top quality at what thw company claims is an 'unbeatable price/ performance ratio'.

Markus Tuffner, Head of Marketing Services at Loos Deutschland GmbH, says of Universal Modular Boiler: "With the LoosUniversal U-MB, we have succeeded in developing a steam boiler using the shell structure with three-pass technology in the performance range up to 2000 kg/h which is ultra-modern in terms of efficiency and automation and which is characterised by low-investment costs."

The boiler was launched at the recent ISH trade fair in Frankfurt, Germany. ❍

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