RCR ENERGY

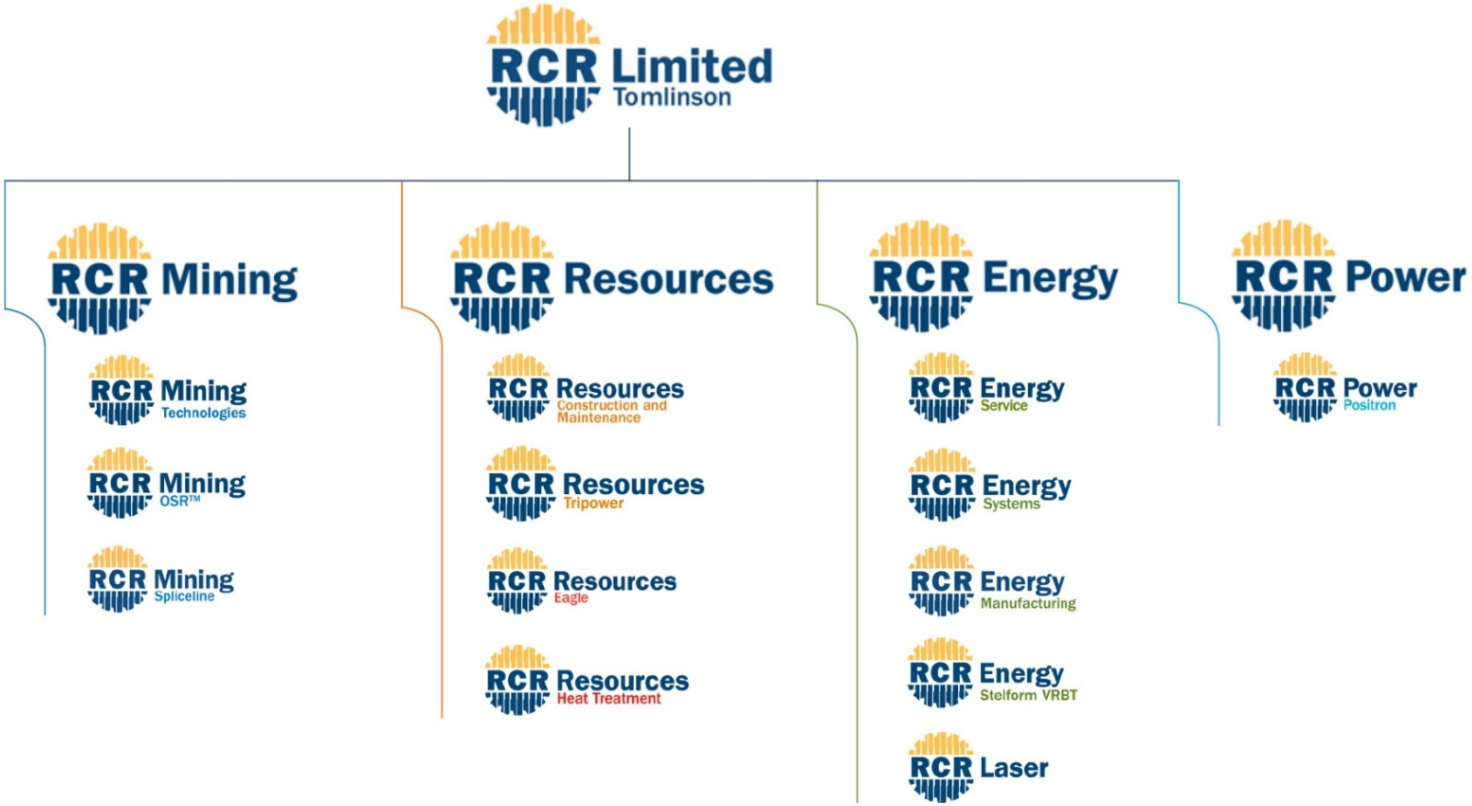
BFB Boilers for Bagasse, May 2011

Nick Holmes



RCR Energy

- RCR Tomlinson Ltd ("RCR") is a leading multi-disciplined Integrated Engineering Solutions company employing approx 2,500 fulltime staff and contractors.

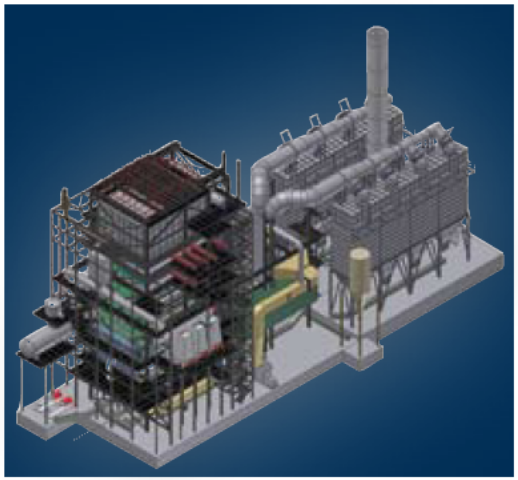


RCR Energy Systems

RCR Businesses

RCR Mining	RCR Energy	RCR Resources	RCR Power
			
Business Focus			
Leader in the design and manufacture of materials handling and process equipment for the mining industry	Turnkey energy solutions for energy, power generation and process plants boiler manufacture for both industrial and commercial clients	Engineering and construction specialist for SMP in mining and oil & gas projects	End to end engineering and construction services for electrical distribution, instrumentation & control for resource and infrastructure sectors
Key Activities			
• Materials Handling • Mobile Mining • Off-site Repair • Specialist Manufacturing and Machining	• Power Plants • Packaged Boilers • Industrial and Renewable • Energy Plants • Laser Cutting • Boiler and Turbine • Servicing & Maintenance	• Construction – SMP for mining & petroleum • Mechanical Installation • Regional Workshops • Maintenance • Heat Treatment	• E&I Specialist HV • Regional Workshops • Maintenance • Manufactured Electrical Product (substations & switchboards for both above & below ground)

RCR Energy Systems



THERMAL POWER PLANTS

Heat and power plants fired on gas, liquid or solid fuels including biomass and coal
Boiler "island" or full scope turnkey electricity generation station



STOKER FIRED BOILERS

Babcock & Wilcox, Towerpak® and Stirling® boilers
RCR Steampac range
(to 25tph steam output; ~15MW)
Coal and Biomass fired



FLUIDIZED BED BOILERS

Babcock & Wilcox, Towerpak® and Stirling® boilers
Bubbling and Circulating Fluidized Bed designs
Coal and Biomass fired

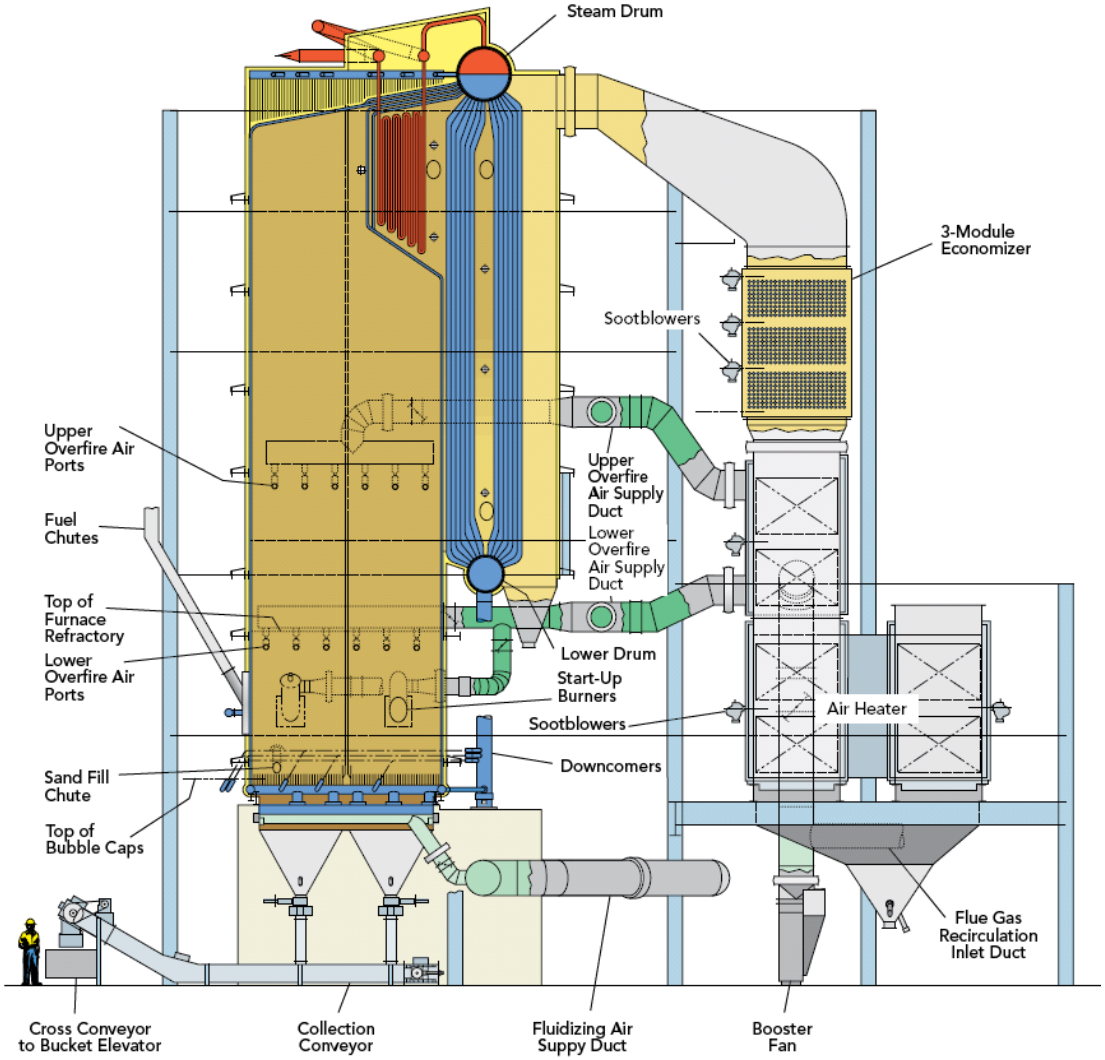
B&W babcock & wilcox power generation group

Tomlinson Boilers
Heat Transfer and Combustion Technology

Easteel
ENERGY SYSTEMS

JOHN THOMPSON
PACKAGED BOILERS

RCR Energy Systems

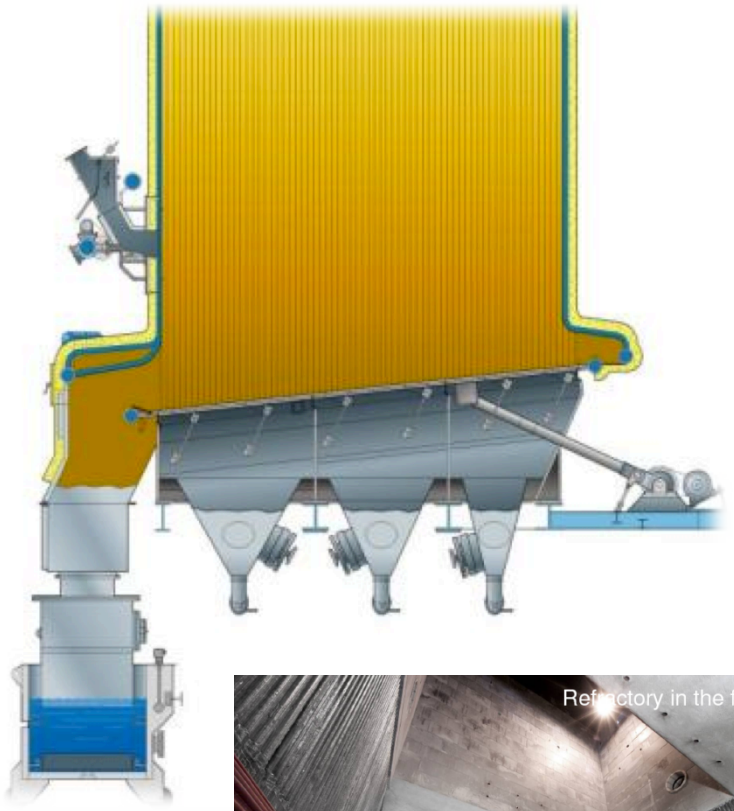


B&W Towerpak® & Stirling® Boilers

- The two-drum generating bank is provided for low-pressure applications where a large amount of generating bank surface is required.
- Higher pressure applications require less generating bank surface and often use a one-drum design.
- Bottom supported so that boiler support steel requirements are minimized. Only platform support for access to the boiler and associated equipment is necessary.
- High capacity units are top supported.

B&W babcock & wilcox power generation group

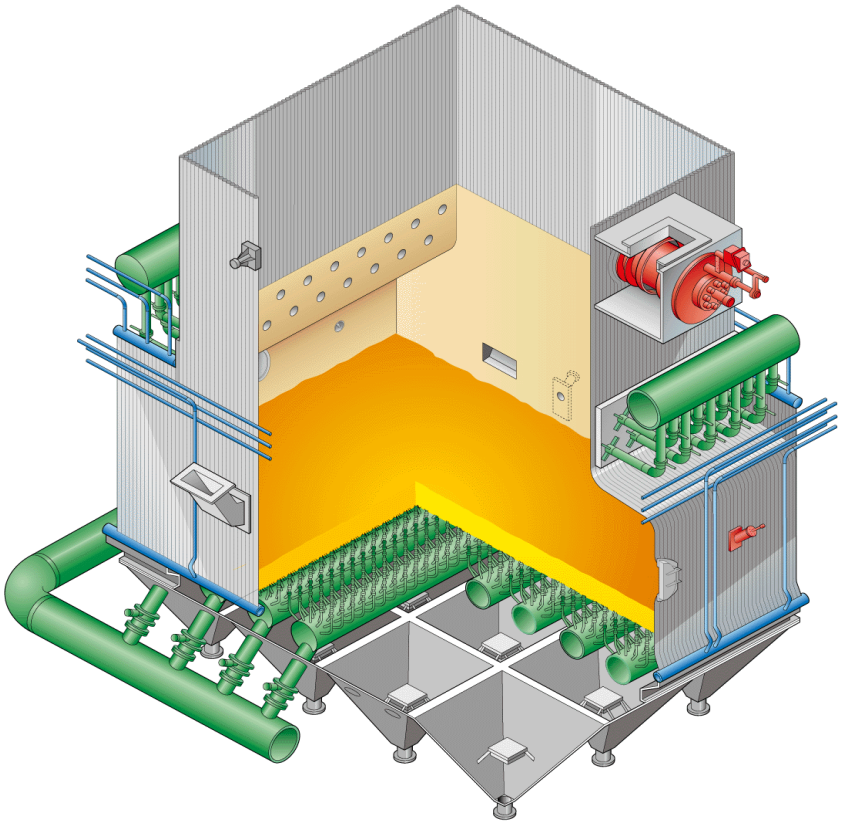
RCR Energy Systems





Stoker & Grate Technology

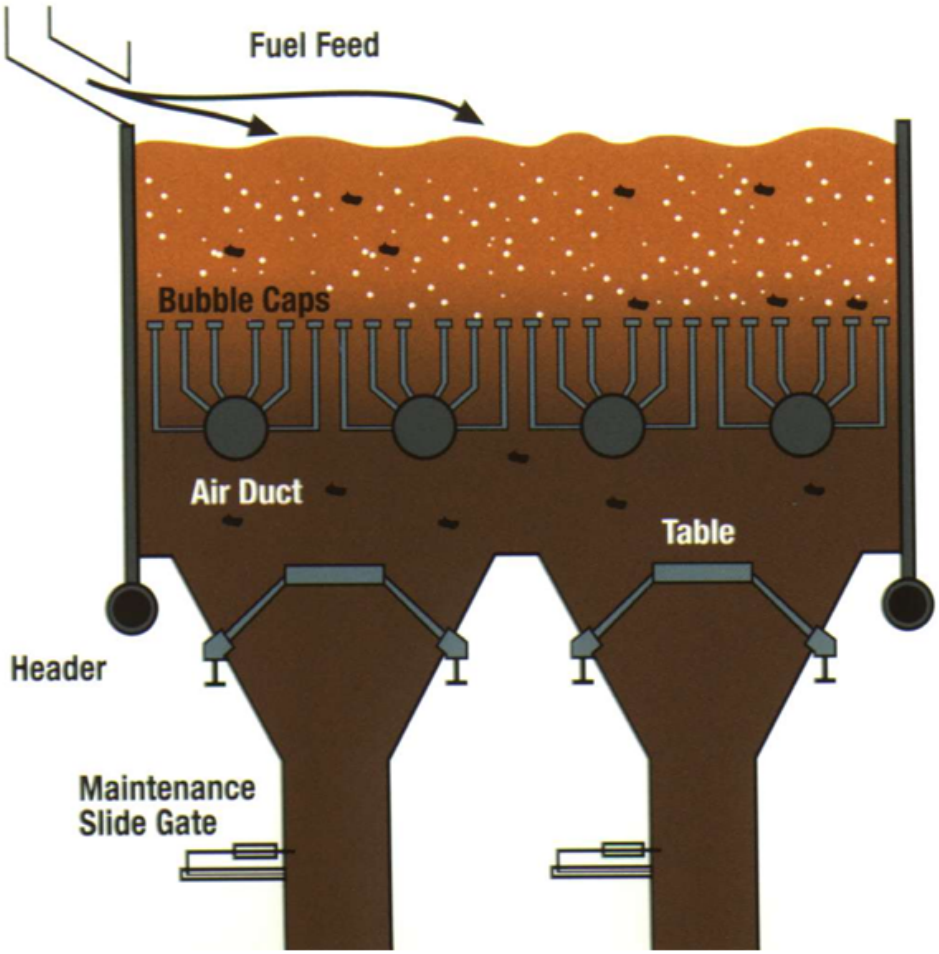
- The spreader firing principle is the most widely accepted, proven method.
- Sized fuel is metered to a series of distribution devices which spread it uniformly over the grate surface
- Fine particles of fuel are rapidly burned in suspension assisted by carefully designed overfire air turbulence systems
- Coarser, heavier fuel particles are spread evenly on the grate forming a thin, fast-burning fuel bed
- The combination of suspension and the fast-burning bed makes it extremely responsive to load demand.
- Bagasse is high fines hence common technology





Bubbling Fluidised Bed

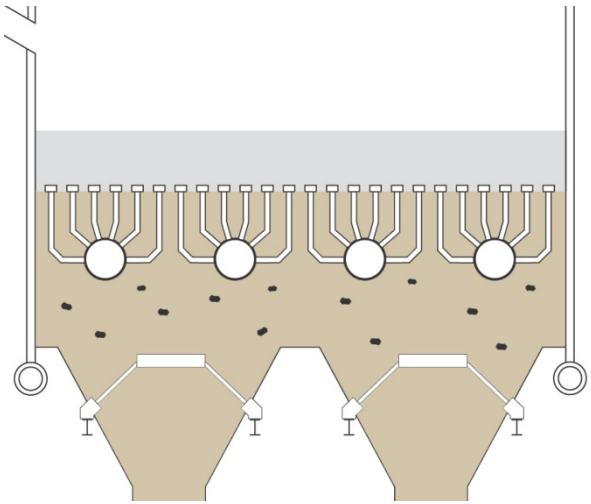
- BFB boilers are typically used when firing biomass
- The fuel is spread into the furnace over the bed
- The bed is made up of sand with a series of high-pressure nozzles below which fluidises the bed
- The fluidised sand bed mixes with the fuel to complete its combustion
- Since the sand bed mixes with the fuel, higher moistures upto 65% can be fired
- There are limitations however when the fuel becomes dryer and calorific values increase – Option e.g. CFB.



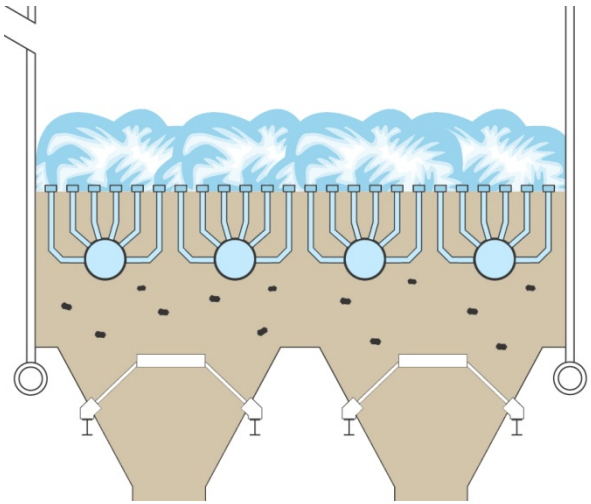
Bubbling Fluidised Bed

- Fuel delivered through air swept spouts immediately above the bed
- Air introduced through round air ducts and distributed through bubble caps.
- Water cooled membrane walls
- Widely spaced bubble caps allow removal of tramp material.
- Tramp material removed via open bottom hoppers.
- Tables ensure even flow from bed.

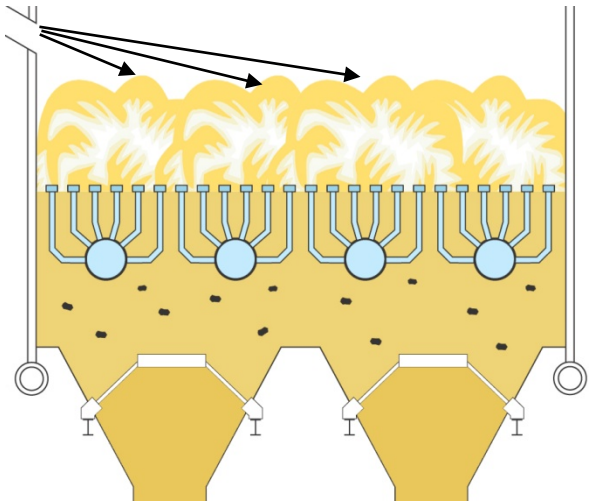
Not Operating
Bed Height ≈ 20”



Fluidised Bed With Air
Bed Height ≈ 32”



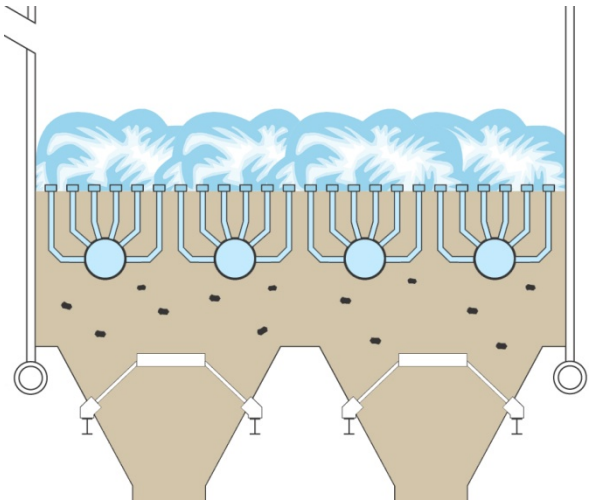
Heat Bed and add Fuel –
Normal Operation



RCR Energy Systems

BFB - Startup

Fluidized Bed With Air
Bed Height ≈ 32”

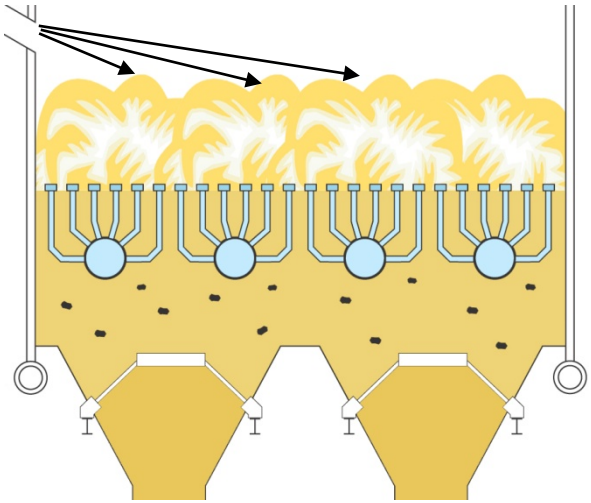




RCR Energy Systems

BFB - Normal Operation

Heat Bed and add Fuel – Normal Operation





RCR Energy Systems

BFB - Lower furnace



RCR Energy Systems

Open bottom allows for on line removal of tramp material

Man-made

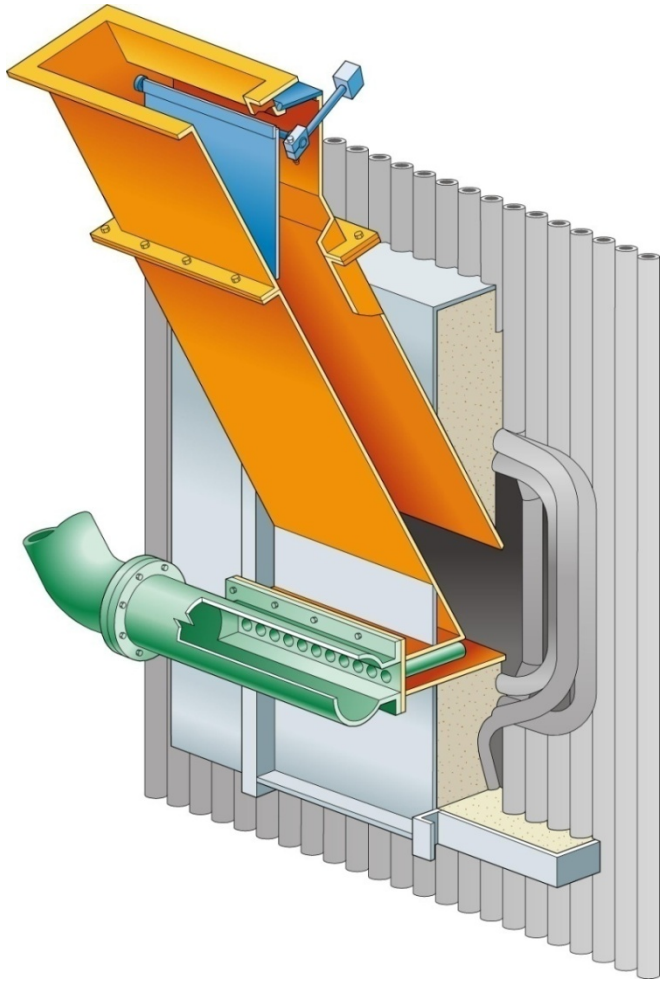


Naturally occurring



RCR Energy Systems

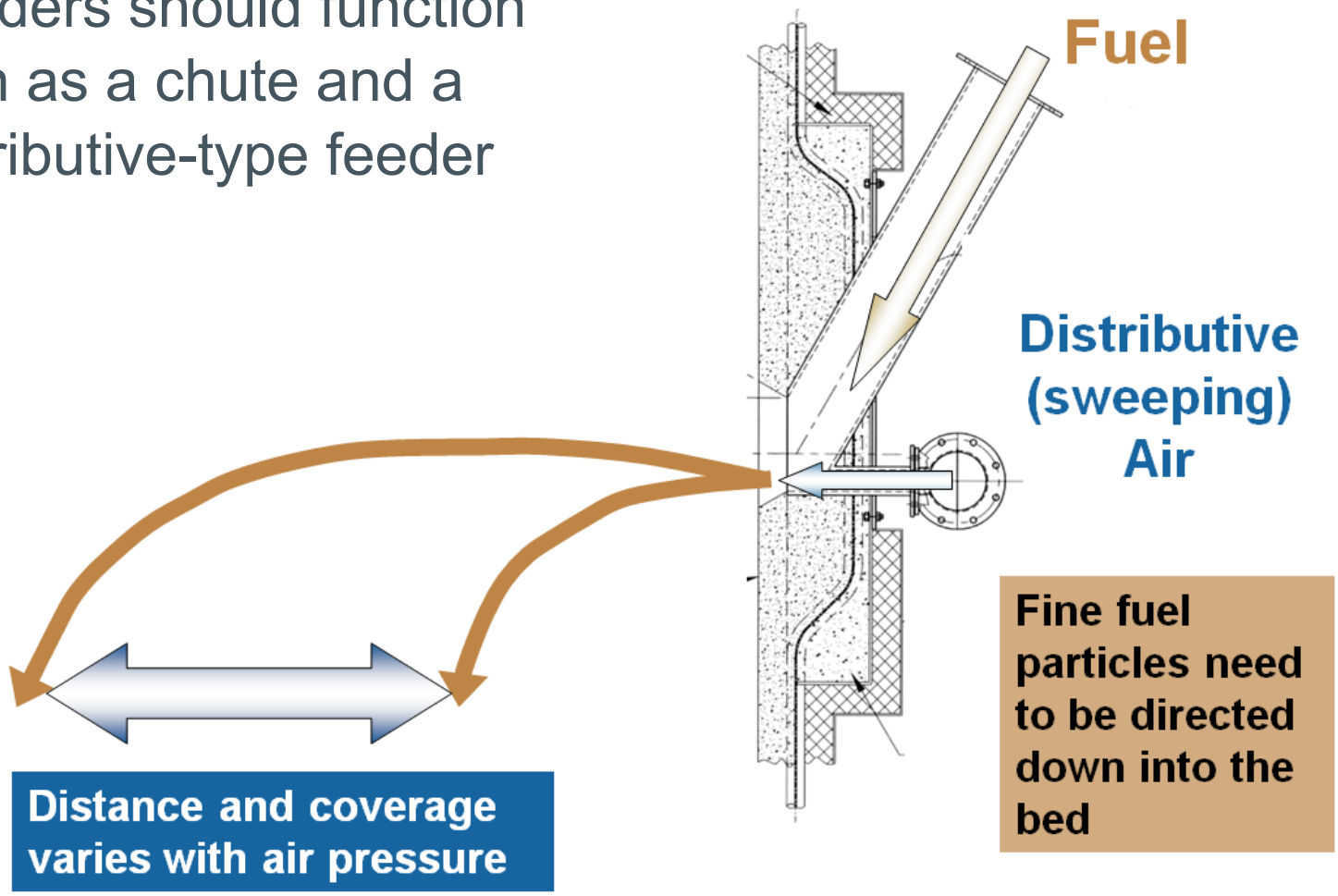
BFB - Feeder Spreader





RCR Energy Systems

- Feeders should function both as a chute and a distributive-type feeder

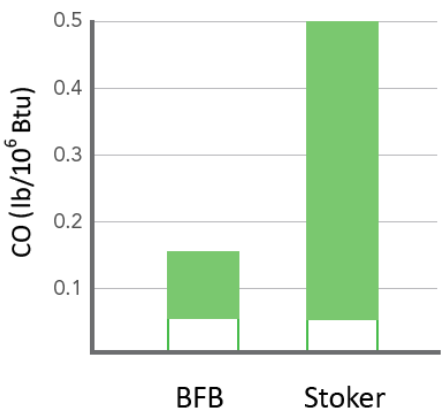


RCR Energy Systems

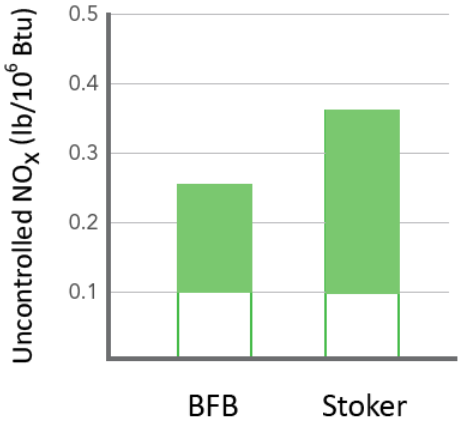
LOWER EMISSIONS

- Low temp sub-stoichiometric combustion, hence the generation of Nitrogen Oxide (NOx) is inherently low.
- BFB inherently produces low Carbon Monoxide (CO) and Volatile Organic Compound (VOC) emissions.
- Reduced Sulphur Dioxide (SO2) where required through in-bed capture with bed material and alkali fuel. Limestone can reduce further.
- Improved carbon burnout allows for better particulate emission control.

CO Comparison

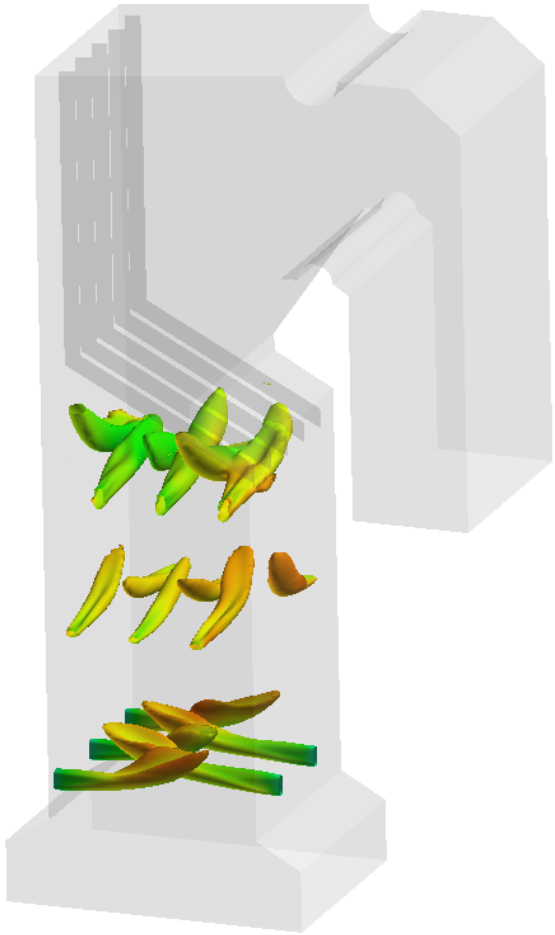


NO_X Comparison



RCR Energy Systems

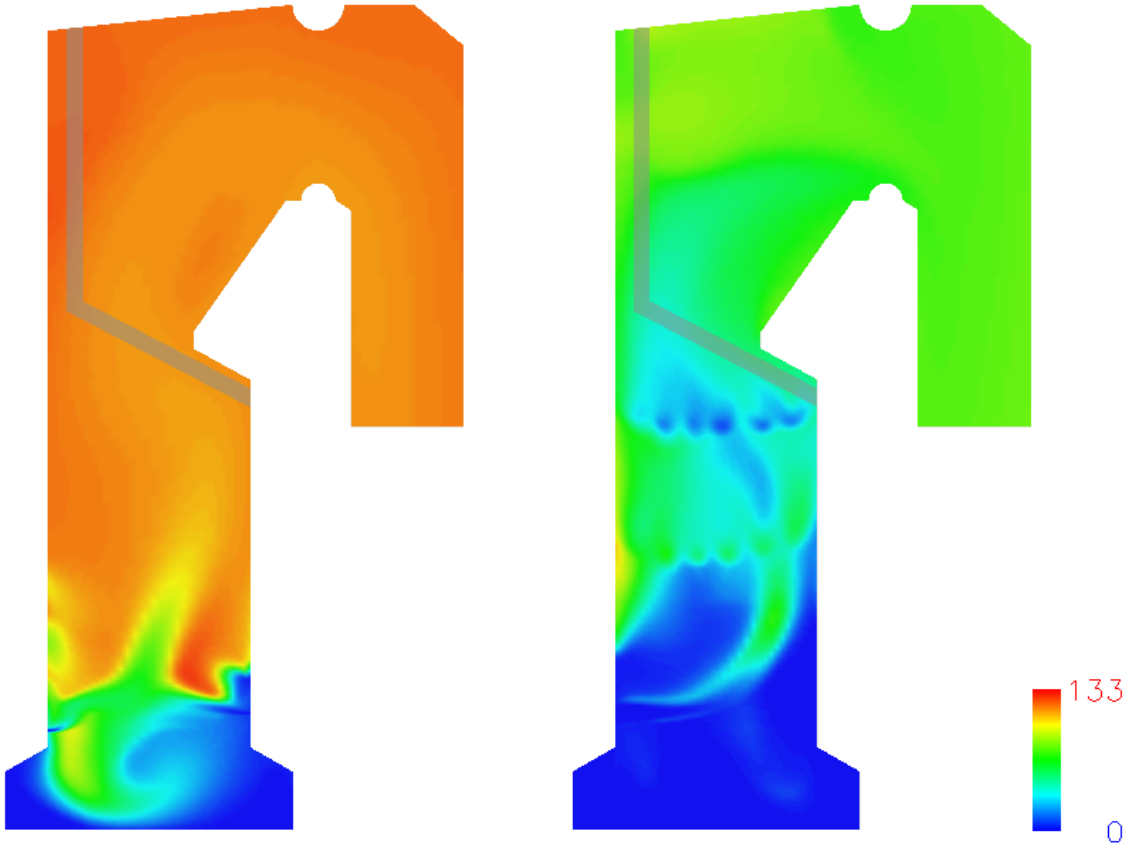
BFB - PrecisionJet™ Three Level Air System



- **Fully Interlaced Over-fire Air**
- **Velocity Dampers**
- **Multi-level for NOx control**

RCR Energy Systems

BFB - NO (ppm)

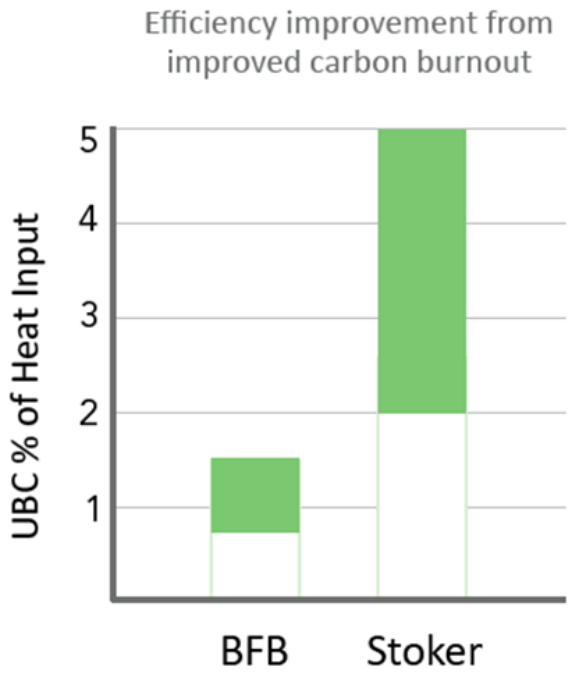


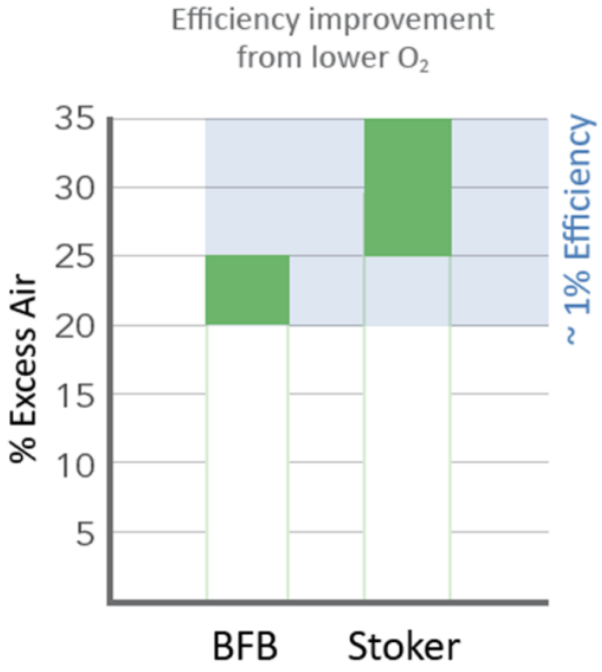
Base case **Three-level system**

RCR Energy Systems

IMPROVED EFFICIENCY

- Improved combustion reduces the remaining carbon from incomplete combustion.
- Improved combustion reduced the excess air requirements.





RCR Energy Systems

OPERATING BENEFITS

- Rapid response to fast changes in fuel and steam demand
- Fuel flexibility.
- Imported Contaminated Fuels
- High Moisture fuels & sludge.
- Multiple fuel feed.
- No moving or wear parts.
- Reduced Operating costs.
- Not Viewed as “old technology” to regulators –therefore easier to permit

Citrovita Agro Industrial, Brazil

- Babcock & Wilcox BFB Stirling Boiler - 113MWth
- 130tph (287kpph) / 55 Barg (792psi) / 415°C (779°F)
- Fuel - Sugar Cane Bagasse & Orange Peels



RCR Energy Systems

	Mill Sugarcane Bagasse	Diffuser Sugarcane Bagasse	Orange Bagasse (Peel)
Dry Basis			
% Volatile Matter	82.64	80.21	77.72
% Ash	1.98	4.86	8.09
% Fixed Carbon	15.34	14.89	14.10
% Sulfur	0.04	0.04	0.09
Total	100.00	100.00	100.00
Total moisture (as received)	50.00	55.00	60.00
Sieve Analysis	**Cumulative Results (% Passing)**		
1” Sq	100.00	91.65	96.79
1/2” Sq	93.15	45.35	73.49
1/4” Sq	81.58	8.72	58.81
1/8” Sq	0.00	0.00	21.26
8 Mesh	0.00	0.00	6.79
16 Mesh	0.00	0.00	6.57
30 Mesh	0.00	0.00	0.00
Density, Kg/m^3	130	145	---

RCR Energy Systems

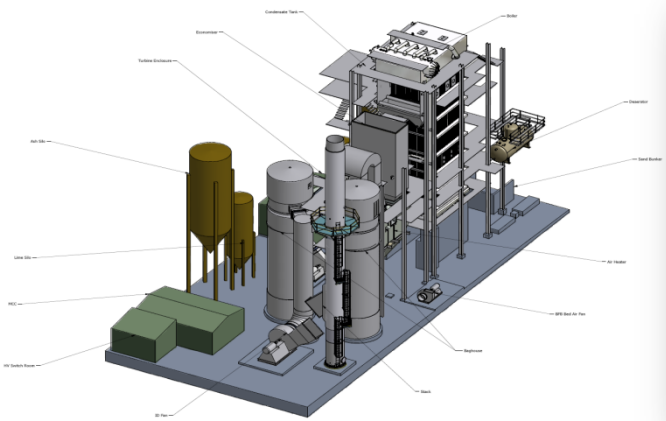
Babcock & Wilcox have over 60 Biomass-fired boilers in operation with 38 BFB boilers

Equates to Certainty of Outcome



babcock & wilcox power generation group







RCR Energy Systems