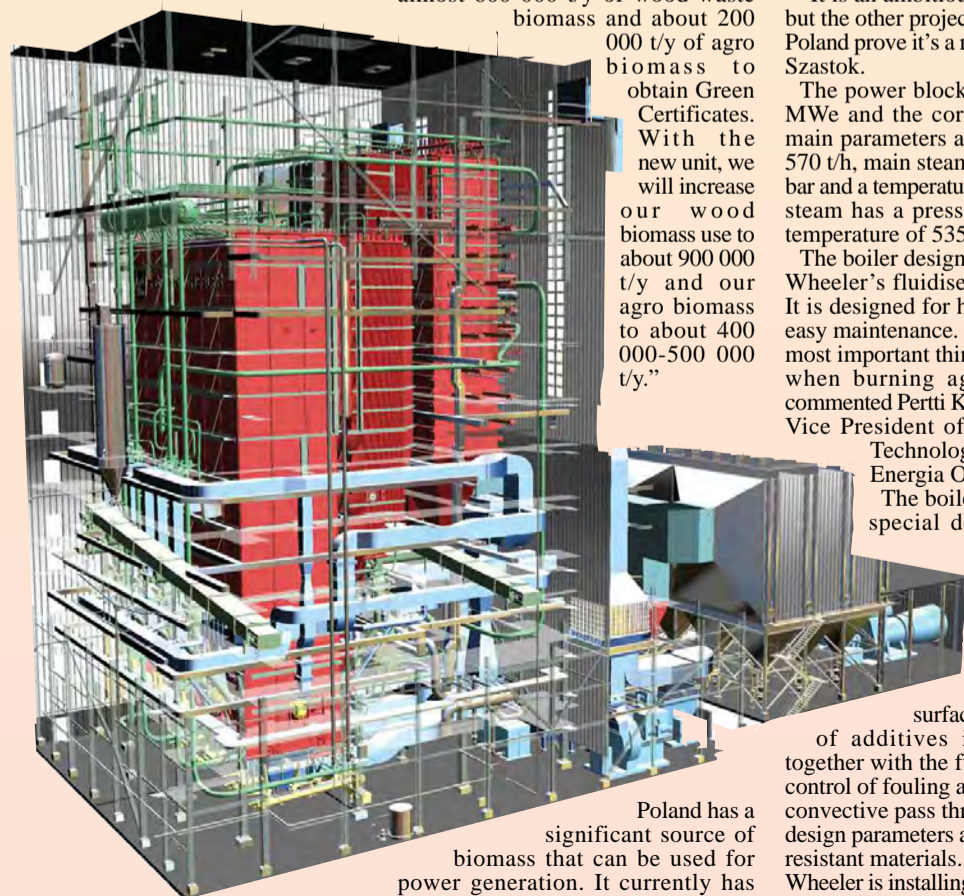


# Going big on biomass

EU directives promoting the use of renewables is seeing an increase in the size of biomass fired power plants. The end of 2012 will see the start-up of what will be the world's largest project running on 100 per cent biomass in Poland. **Junior Isles**

Cutaway of a CFB boiler. The boiler has the ability to combust the fuel completely and control emissions without back-end cleanup



Increasing the use of biomass for power generation is part of Europe's goal to reach a target of 20 per cent of renewables in the power generation mix by 2020. As each member country sets out its own method of reaching the renewables goal, Poland has taken an aggressive approach in providing incentives to spur the growth of biomass fired power projects.

The Polish government's strategy is to promote the use of biomass locally produced from agricultural waste (agro biomass). According to a law introduced at the end of 2008, in order to obtain green certificates for all the electricity produced in a power unit, the share of agro biomass in 100 per cent biomass fired boilers must increase from 20 per cent in 2012 to 60 per cent in 2017.

The new rule applies to all generators but the Polish policy rewards early movers (plants that will start operation by the end of 2012) by exempting them from the climb in the required agro share. In this particular case the limit of the share of agro biomass will stay at 20 per cent even beyond 2012 and the operators will still be eligible to obtain the green certificates which currently trade at about €60.

Accordingly, generators are moving quickly to set up biomass based power projects before the 2012 deadline. Notably, March this year saw GDF Suez award a contract to Foster Wheeler to build what is being claimed as the world's largest circulating fluidised bed (CFB) to be fired on 100 per cent biomass at the Polaniec power station.

Commenting on the business case for the new plant, Robert Zadora Vice president of the Board GDF Suez Energia Polska S.A. noted: "You have to evaluate the best investment when considering the technology, the costs and the Law. According to our current assumptions, building a power plant using 100 per cent biomass before the 2012 deadline presented the best but very challenging case today. Currently we are burning almost 600 000 t/y of wood waste biomass and about 200 000 t/y of agro biomass to obtain Green Certificates. With the new unit, we will increase our wood biomass use to about 900 000 t/y and our agro biomass to about 400 000-500 000 t/y."

Poland has a significant source of biomass that can be used for power generation. It currently has

about 35 million t/y of wood waste available for power production and about 12-14 million t/y of agro biomass. The ability to use this waste product as a fuel source is good for the economy and generators.

Robert Giglio, Marketing Director for Foster Wheeler's Global Power Group said: "The good quality biomass is typically from long growth, wood stock but this is of limited supply in Poland. Instead of using the good quality wood, which can be used to make furniture and paper etc, the Polish government is promoting the use of agro biomass, which is more difficult to burn. They therefore get the 'green' value of biomass while limiting the use of high quality wood."

Foster Wheeler says it has seen a strong interest in CFB boiler technology in Poland. "This is due to its flexibility to burn a wide range of biomass including the more difficult-to-burn agro type biomass. At the same time, CFBs achieve thermal cycle efficiencies similar to coal fired boilers," explained Grzegorz Szastok, Commercial Director, Foster Wheeler Polska.

The Polaniec boiler is specially designed to burn, on a large power plant scale, wood chips in combination with 20 per cent of agricultural derived fuel such as straw pellets or crushed briquettes, sunflower pellets, fruit husk pellets, and crushed palm kernel shells.

Under its contract, Foster Wheeler will provide a 190 MWe CFB boiler island and a biomass handling plant. The plant will be built on a brownfield site next to the existing units at the Polaniec power station. The contract also includes the civil works, foundations and piping from the boiler to the existing turbine.

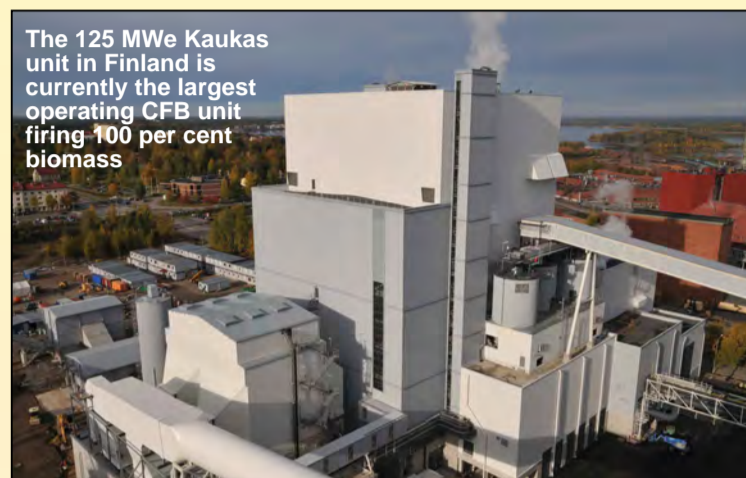
Engineering of the project began in March and is now in full swing. Civil works will start in the middle of this year and the boiler will be delivered throughout 2011. Commissioning is expected to begin in the middle of 2012, ready for commercial operation before the end of 2012.

"It is an ambitious project schedule but the other projects we have done in Poland prove it's a realistic one," noted Szastok.

The power block will produce 190 MWe and the corresponding boiler main parameters are a steam flow of 570 t/h, main steam pressure of 127.2 bar and a temperature of 535°C. Reheat steam has a pressure of 20 bar and temperature of 535°C.

The boiler design is based on Foster Wheeler's fluidised bed technology. It is designed for high reliability and easy maintenance. "These are the two most important things to the operator, when burning agricultural fuel," commented Pertti Kinnunen, Executive Vice President of Engineering and Technology, Foster Wheeler Energia Oy Group.

The boiler has a number of special design features. It allows control of bed material agglomeration and fouling in the furnace through moderate thermal loading of heat surfaces, and the feeding of additives into the furnace together with the fuel. It also permits control of fouling and corrosion in the convective pass through conservative design parameters and using corrosion resistant materials. In addition, Foster Wheeler is installing online diagnostics



The 125 MWe Kaukas unit in Finland is currently the largest operating CFB unit firing 100 per cent biomass

to monitor fouling and corrosion in the boiler during operation.

Getting the right fuel mix into the boiler is crucial. Accordingly, there will be a fuel quality management system at the fuel yard to ensure the proper fuel mixture and quality. Screening to remove stones and other unwanted materials will be carried out in this area. Sampling and analysis of the fuel will help increase plant reliability and reduce maintenance costs.

GdF Suez will produce the wood chips in the chipping process at the fuel yard. Agro bio fuels will come already pelletised from external suppliers within a 100 km radius of the plant. The various agro fuels will be kept in separate silos and further mixed with wood chips according to certain parameters such as moisture, ash, alkali content etc.

The wood chips/agro biomass mixture feeding the boiler has a lower heating value of 9.7 - 12.1 MJ/kg, a moisture content of 30-45 per cent, ash content of less than 2.5 per cent and bulk density of 300-400 mg/m<sup>3</sup>.

The different biofuels have a similar chemical analysis, with the exception of ash quality. The alkalis are basically sodium and potassium, which at high temperatures can form a melting slag that can cause fouling on the heat transfer surfaces and bed agglomeration problems in the furnace.

Kinnunen commented: "This can have an impact on reliability and maintenance of the unit. Therefore the presence of alkalis, which are mainly present in the agro fuel, is taken into account in the design of the unit."

The main emissions to be controlled in the boiler are NO<sub>x</sub>, SO<sub>x</sub>, CO and dust. Other than an electrostatic precipitator for dust removal, the plant needs no other emission control equipment between the boiler and stack.

"The natural features of CFB combustion ensure low emissions. The CFB uses limestone to control SO<sub>x</sub> and a low combustion temperature to ensure low NO<sub>x</sub> emissions. The CFB also has the capability for ammonia injection to further reduce NO<sub>x</sub> if needed," said Kinnunen.

He added: "The emissions from this plant will be well below those required by the EU Large Combustion Plants Directive."

Under dry conditions at 6 per cent O<sub>2</sub>, NO<sub>x</sub> will be less than 150 mg/Nm<sup>3</sup>, SO<sub>2</sub> less than 200 mg/Nm<sup>3</sup>, CO under 50 mg/Nm<sup>3</sup> and dust less than 30 mg/Nm<sup>3</sup>.

Foster Wheeler says that the ability to control emissions without back-end cleanup and combust the fuel completely, are a major advantage of

CFB combustion.

Giglio said: "There are a number of technologies that can burn biomass but the CFB in our opinion is the most advanced. They can go to higher steam conditions and handle these fuels better. It also has the advantage that it can be scaled up beyond the other technologies."

According to Foster Wheeler, its 125 MWe Kaukas unit in Finland, which just started this year, is currently the largest operating biomass unit today firing 100 per cent biomass. This is followed by the company's Igelsta unit in Sweden at 85 MWe, which went on-line in 2009. At 190 MWe, Polaniec will be larger than both of these.

Foster Wheeler believes there is really no technical design limit to the size of a CFB biomass unit. Other boiler technologies such as bubbling fluidised beds (BFB), or grate boilers are limited by their inability to maintain even fuel mixing and combustion as the units grow beyond the 50-75 MWe size range.

"In a CFB, the fuel is fluidised to a point so that the entire bed is lifted and circulated to the top of the furnace, collected by solid separators and returned back to the furnace. This ensures the best mixing for clean and efficient combustion of the fuel," explained Giglio.

"For a CFB biomass plant, our experience has been that the size of the plant is almost always limited by the local supply of biomass. Biomass plants are most economical when their fuel is sourced from within a 50 km radius to the plant," he added.

However, for some projects with more aggressive incentive programmes, like Drax in the UK, importing fuel pellets from overseas has become more economically viable and plant sizes for these projects are under consideration for up to 300 MWe.

As generators and industrial installations look to reduce CO<sub>2</sub> emissions through the increased use of biomass, Foster Wheeler is continuing its focus on expanding its fuel experience into the more difficult to burn agricultural biomass while at the same time improving plant efficiencies by increasing steam temperature and pressure.

Kinnunen concluded: "Our goal is to optimise and advance CFB technology and offer units for utility scale combustion of clean wood at 570/570°C steam temperatures with at least 30 per cent agro biomass in the combustion. We are also looking at utility scale combustion at 605/605°C steam temperatures for coal with a high portion of agro biomass in co-combustion."