

The Current Status of Biomass Co-Firing at Coal-Fired Power Stations in Britain



**W R Livingston
Mitsui Babcock
May 2004**



Mitsui Babcock

Commercial Issues

- **Renewables Obligation Order, April 2002, provides significant financial incentives to the generators of electricity from renewable sources.**
- **The co-firing of biomass in existing coal-fired boilers is eligible, but under certain restrictions.**
- **There has been significant activity on biomass co-firing at most of the coal-fired stations in Britain.**



Commercial Issues

There are a number of key commercial issues, viz:

- The limited indigenous biofuel resources in Britain,
- The lack of a biofuel supply infrastructure, and
- The unwillingness of the generators to make major investments in biomass handling and firing equipment.



General Trends in the Approach to Biomass Co-Firing in Britain

- **The utilisation of imported dry biomass materials, principally solid residues from the olive oil and palm oil industries.**
- **The application of the pre-blending approach to biomass co-firing, i.e. the preparation of a biomass-coal blend at low blend ratio, and the handling and firing of the blended fuel through the existing coal handling and firing system.**



The Current Situation at the Large Central Coal-Fired Power Plants in Britain

Station	Capacity (MW _e)	Generator	Status	Biomass fuels
Aberthaw	1,455	Innogy	Trial	Wood
Cockenzie	1,200	Scottish Power	Trial	Wood
Cottam	2,000	EdF	Trial	Wood
Didcot	2,100	Innogy	Trial	Wood
Drax	4,000	Drax Power	Commercial	Various
Eggborough	1,960	British Energy	Trial	Various
Ferrybridge	2,035	AEP	Commercial	Various
Fiddlers Ferry	1,995	AEP	Commercial	Various
Ironbridge	970	Powergen	Trial	Wood
Kingsnorth	2,034	Powergen	Trial	Cereal residues
Longannet	2,400	Scottish Power	Commercial	Sewage sludge
Ratcliffe	2,010	Powergen	Trial	Various
Rugeley	1,000	International Power	Trial	Various
Tilbury	1,085	Innogy	Trial	Wood
West Burton	1,980	EdF	No activity	-



The Path to Commercial Operation on Biomass-Coal Co-Firing

- **The securing of the fuel supply, at least for the trial burn, and preferably for longer term operation.**
- **The preparation of the application for the Variation to the Authorisation under Section 11 of the EPA.**
- **Definition of the trial burn requirements and agreeing the Section 11 Variation for the trial.**
- **Performance and reportage of the trial burn.**
- **Final agreement on the Variation and proceeding to commercial operation.**



Biomass Co-Firing by the Pre-Blending Approach

- **The biomass-coal blend can be prepared off-site by the fuel supplier and delivered as normal.**
- **The biomass-coal blend can be prepared on-site by adding the biomass to the coal on the coal conveyors. There have been some problems with the generation of unacceptable levels of dust in the coal handling system.**
- **The maximum co-firing ratio depends on the biomass and the firing system, but is generally less than 10% on a heat input basis.**
- **The key issue is the behaviour of the blended fuel in the coal mills.**



The Milling of Biomass-Coal Blends

- Most mills designed to pulverise bituminous coals depend on brittle fracture of the coal particles.
- Most biomass materials do not mill by a brittle fracture mechanism.
- The biomass materials do not behave very well in the coal mills, and this generally limits the biomass:coal co-firing ratio.
- The utilisation of wet biomass materials will also have an impact on the heat balance in the mill.



The Milling of Biomass-Coal Blends

- The milling behaviour of the blend is dependent on the type of biomass and the mill type.
- There is a tendency for the biomass to accumulate within the mill, and this is important both during normal running, and when emptying the mill of fuel.
- This is generally one of the factors that will tend to limit the co-firing ratio.
- There will also be an impact on the quality of the mill product.



Mill Safety Issues with Biomass-Coal Blends

- Biomass materials release combustible volatiles at lower temperatures than do bituminous coals.
- There is a requirement therefore to modify the mill operating practice to take account of the behaviour of the biomass:coal blend.
- This is particularly an issue during start-ups, shutdowns, loss of coal incidents and mill trips/ restarts after trips.



The Technical Issues/Risks During a Biomass-Coal Co-Firing Trial

- **Both the technical and safety issues associated with milling the blended fuel are investigated and the appropriate actions demonstrated during the trial.**
- **The risks must be recognised and controlled.**
- **This is most conveniently done by starting with testwork on a single mill to establish the maximum sustainable co-firing ratio, and to demonstrate the response to the safety issues.**
- **The quality of the mill product is measured.**
- **The biomass:coal co-firing can then be rolled out to the other mills on the boiler.**



Impacts of Co-Firing on Boiler Operation and Performance

- The operating experience in Britain has been with biomass-coal blend ratios of less than 10 % on a heat input basis.
- Provided that the mill product quality is satisfactory, the combustion of the blends have been acceptable, even with wet biomass materials.
- Impacts on boiler performance have been relatively modest
- Environmental impacts of co-firing have also been negligible.



Conclusions 1

- **There have been significant advances in the co-firing of biomass in coal-fired boilers in Britain over the past two years.**
- **This activity has been in response to the introduction of the Renewables Obligation, which provides a higher price for the power generated from renewable sources.**
- **All of the large coal-fired boilers have held co-firing trials or have plans to hold trials.**
- **A number of power plants are co-firing biomass materials on a fully commercial basis.**



Conclusions 2

- The biomass materials involved include both dry imported materials such as the dry solid residues from olive oil and palm oil production.
- The co-firing has been carried out by pre-blending the biomass with the coal at low co-firing ratios and processing the blended fuel through the existing coal handling and firing system.
- There have been some problems with dust generation in the coal handling plant.
- The main constraint on the co-firing ratio has been the behaviour of the blended fuels in the coal mills.
- At low co-firing ratio, the impacts on the boiler operation and the emissions have been modest.

