

Profiles

Fuels for biomass cofiring

‘Cofiring is often the cheapest form of renewable energy production’

There is considerable current interest in the use of biomass for power generation. This is due to several reasons, the principal one being that, if the biomass is grown in a regenerative manner, its combustion will not produce any net CO₂ emissions. Many countries have initiated incentives in recent years to encourage the utilisation of biomass for electricity production. However, there are some disadvantages of the use of biomass which relate to its supply, transportation and composition but these can be reduced if the biomass is cofired with coal.

Cofiring does not involve the high capital costs of building a new biomass plant but the significantly lower retrofitting costs at an existing plant.

‘SO₂ emissions decrease during biomass cofiring’

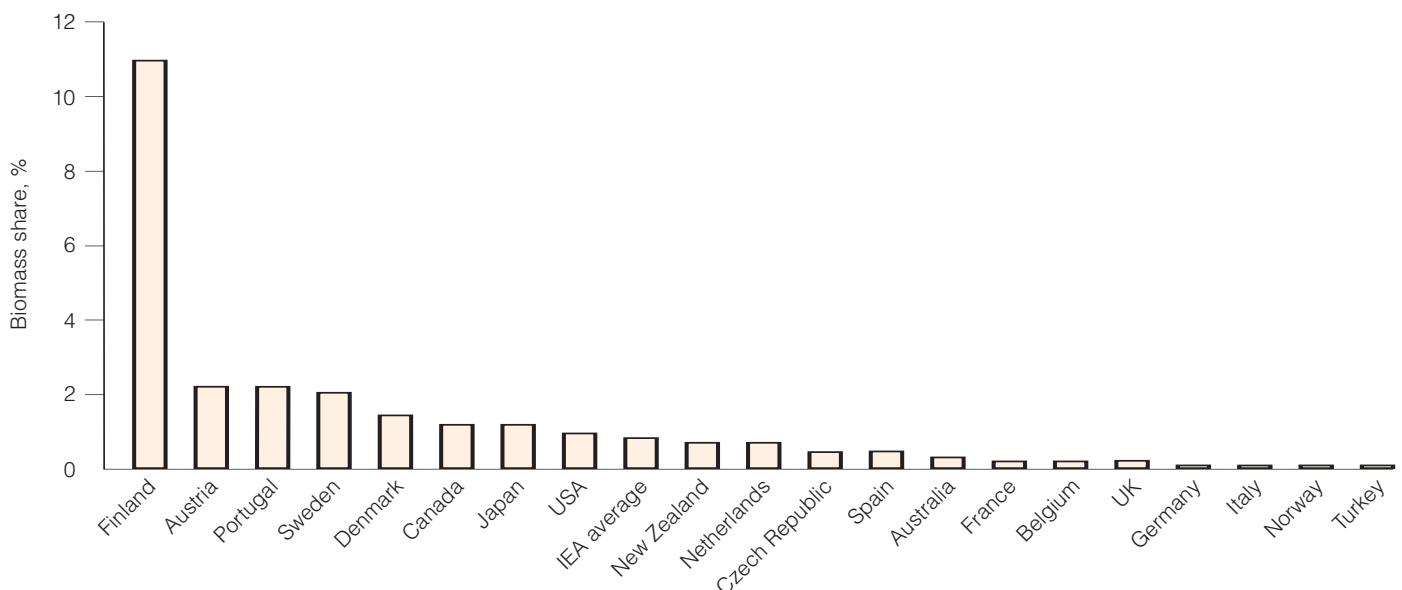
Retrofitting boilers can fire biomass when biomass supplies are plentiful but switch back to coal when biomass supplies are low. Cofiring increases the efficiency of the energy conversion by firing the fuel in a larger plant compared to a smaller plant firing biomass alone. Biomass conversion efficiencies when cofired range from 30% to 38% which is very much higher than in a dedicated biomass plant. The other advantages of the use of biomass include the fact that it diversifies the power plant’s fuel portfolio. In addition to reducing net CO₂ emissions, cofiring enables the coal-fired plant to reduce SO₂ emissions as biofuels generally contain less sulphur than coal. Biofuels also tend to contain less nitrogen which

‘Biomass can be regarded as carbon neutral’

leads to lower NO_x emissions. The operating costs of cofiring could be higher due to the higher costs of biomass compared with coal. In spite of this, cofiring is often the cheapest form of renewable energy production.

Biomass properties

Biomass fuel properties differ significantly from those of coal and there is a greater variation in these compared with typical coals. The issues regarding the delivery, storage and preparation of biomass are different from those for coal. Biomass has a much lower bulk density, is generally moist, strongly hydrophilic and is non-friable. The heating values and particle densities of biomass are generally about



Biomass share in electricity production, 2001

half that of coal and bulk densities about one fifth of coal. Hence the overall fuel density of biomass is about one-tenth that of coal. The long term storage of wood in chip form, for example, can cause difficulties if the moisture content exceeds 20% as biological activity can lead to heating of the storage pile. Problems may also arise as most mills utilising pulverising coal depend on the brittle fracture of the coal particles whereas biomass does not mill by this mechanism. If the biomass does not mill satisfactorily, the biomass/coal cofiring ratio may be limited.

Slagging, fouling and corrosion

The extent of slagging and fouling can be affected by cofiring as biomass can contain a higher proportion of alkaline species compared with coal though the total ash content must also be considered. The major proportion of inorganic materials in biomass is in the form of salts or bound in organic matter, whereas in coal they are bound in silicates which are more stable. The effects on deposition when cofiring biomass with coal are that the rate and extent of slag formation increases. Most types of biomass are high fouling fuels and cofiring biomass with coal in almost all cases increases the likelihood of fouling. In many cases the appropriate response to problems of slagging and fouling during cofiring, is to reduce the cofiring ratio. Experience in Europe suggests that slagging and fouling are unlikely to be a problem for cofiring ratios less than 10%. Biomass cofiring can increase both the high and low temperature corrosion rates in utility boilers. Increased high temperature corrosion can occur due to changes in ash chemistry of the ash materials deposited on boiler surfaces. Moreover some types of biomass contain relatively high chlorine levels which results in high HCl concentrations in the boiler flue gas which can also result in low temperature corrosion in the back end.

SO_x, NO_x and CO₂

SO₂ emissions invariably decrease during biomass cofiring, often in proportion to amount of biomass used, as most types of biomass contain far less sulphur than coal. NO_x emissions when cofiring biomass are more difficult to predict and may increase, decrease or remain the same as when

firing coal depending on the particular type of biomass, firing conditions and operating conditions. The emissions of CO₂ arising from biomass can be regarded as being carbon neutral if the biomass is grown in a managed forest.

Cofiring experience

Biomass cofiring has been successfully demonstrated in over 150 installations worldwide for most combinations of fuels and boiler types. About a hundred of these have been in Europe. In the United States there have been over 40 commercial demonstrations and the remainder have been mainly in Australia. A broad combination of fuels, such as residues, energy crops, herbaceous and woody biomasses have been cofired in PCC, stoker and cyclone boilers. The proportion of biomass has ranged from 1% to 20%. The experience of biomass cofiring in PCC boilers has demonstrated that, cofiring woody biomass resulted in a modest decrease in boiler efficiency but no loss of boiler capacity. There was, however, a considerable reduction of SO₂, NO_x and mercury emissions. Though herbaceous biomass have been cofired in several plant worldwide, their higher inorganic matter content results in higher chance of slagging and fouling. Cofiring herbaceous fuels tends to be more difficult and costly than other fuels but it is possible to cofire there fuels if there is a regulatory incentive to do so.

Each issue of *Profiles* is based on a detailed study undertaken by IEA Clean Coal Centre, the full report of which is available separately. This particular issue of *Profiles* is based on the report:

Fuels for biomass cofiring

Rohan Fernando
CCC/102, ISBN 92-9029-418-3,
37 pp, October 2005,
£255*/£85†/£42.50‡

- * non-member countries
- † member countries
- ‡ educational establishments within member countries

IEA Clean Coal Centre is a collaborative project of member countries of the International Energy Agency (IEA) to provide information about and analysis of coal technology, supply and use.

IEA Clean Coal Centre has contracting parties and sponsors from: Australia, Austria, Brazil, Canada, China, Denmark, the European Union, Germany, India, Italy, Japan, Republic of Korea, the Netherlands, New Zealand, South Africa, Sweden, the UK and the USA.



Gemini House
10-18 Putney Hill
London SW15 6AA
United Kingdom

Tel: +44 (0)20 8780 2111

Fax: +44 (0)20 8780 1746

e-mail: mail@iea-coal.org.uk

> Internet: www.iea-coal.org.uk