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# SUPPLY CHAIN COSTS OF BIOMASS COFIRING

## THE SIGNIFICANCE OF SUPPLY CHAIN COSTS OF BIOMASS FOR COFIRING

Fuel supply chain management is a vital part of power plant operation to ensure security of supply, quality and consistency of the product and, not least, to control costs. Supply chains for combustion plant using biomass for cofiring may, like coal, range from local production to global markets. For larger-scale power stations, international supply chains are more common, especially in Europe where the demand for biomass has developed a considerable import trade from North America. The costs of such long-distance movement of materials are considerable. As the global demand for biomass increases over the next decade in both Europe and Asia, the pressures for reducing supply chain costs will also increase. For biomass to be a truly effective means of avoiding long-term greenhouse emissions, the sustainability and renewability of the resource must not be compromised by cost pressures. In this context, energy from biomass cofiring should be assessed in terms of the overall cost of '$CO_2$ saving' compared to other renewable technologies. Clearly the supply chain costs of the biomass fuel and the associated supply chain emissions will have an impact on this.

## BIOMASS AVAILABLE FOR COFIRING WITH COAL

There are several forms of biomass with a range of properties available for cofiring in existing coal fired power stations. Wood pellets derived from wood processing waste streams, forest residues and roundwood are the most widely used. Pellet production has steadily increased from ~7 Mt in 2006 to 26 Mt in 2015, mainly driven by growth in the EU as power stations aim to meet emissions reduction targets. The demand has been met by increased production in North America; the USA is the largest producer and exporter. Demand for wood pellets is expected to grow in Asia, particularly Japan, South Korea and potentially China.

Demand for pellets is sensitive to sustainability criteria and the resulting financial incentives given by end-user governments. The EU RED II may require pellet producing countries to be signatories to the Paris Accord. This may be a threat to the substantial trade with the USA and could affect the price of wood pellets in Europe significantly.

## WOOD PELLET PRODUCTION

For wood pellets to be part of an effective emissions reduction strategy they must be economically competitive with other renewable technologies and offer substantial emissions reduction. The cost of pellet production is dependent on the CAPEX and OPEX of a pellet plant and the cost of the feedstock, all of which are variable. Estimates of the production costs range from 40–200 US$/t whereas actual feedstock prices reported by pellet producers in the USA range from 55–155 US$/t (EIA,2017b). Delivered feedstock then accounts for 30–50% of the total pellet plant gate price.

As wood pellets are now a globally traded commodity there is data available on the cost, on both a FOB and CIF basis from producing nations. Both the FOB and CIF prices are starting to recover after a crash in the market in 2015-16 due to the change in sustainability criteria in the Netherlands and the resulting decrease in demand. This suggests the market is demand driven. Current prices (2017) for pellets are ~135 US$/t on an FOB basis and ~150 US$/t on a CIF-ARA basis.

The emissions associated with pellet production derive from the sourcing and transportation of feedstock and the process itself. Lifecycle analysis of the pellet production process shows the largest contributor to the overall emissions is the choice of utility fuel for the drying process. Using biomass to provide process heat results in estimated emissions of 30–120 kg $CO_2$/t pellets produced. If natural gas is used then the overall emissions increase to 138–248 kg $CO_2$/t pellets produced. Such emissions could lead to cofiring not meeting emission reduction targets.

## TRANSPORT OF WOOD PELLETS, ECONOMICS AND EMISSIONS

The majority of wood pellets used for electricity generation are sourced from the international market and transported long distances by truck, rail, ship and, in some cases, barges. This can have a significant impact on both the overall cost to the consumer and the GHG emissions produced. Transport costs can represent 25–40% of the delivered to consumer cost and between 26–60% of the total emissions.

Long distance shipping is currently the most cost effective and lowest emissions form of bulk transportation. Current prices for pellet transportation are 15–30 US$/t from North America. However, shipping costs have historically been volatile and could affect viability of projects using imported biomass.

Biomass utilisation must compete with other renewable lower carbon technologies and any potential reduction in cost and emissions would be of benefit. An option to reduce the cost and emission penalty from transport is to minimise the need, either through increased pellet production in large consumer areas (EU), or the deployment of cofiring in large producer areas (USA and Canada). It would be even better to use pellets derived from genuine waste streams in the country of production.

## POWER STATION MODIFICATIONS

Use of biomass in existing coal fired power plant requires modifications to the infrastructure and operation. These may include dedicated reception areas, covered storage areas, covered conveying systems and modifications to the existing milling and combustion infrastructure. At low cofiring levels, <10%, biomass may be co-milled and combusted in existing infrastructure. At higher cofiring ratios, new plant or more extensive modifications may be required to mills, combustion air system, burners and emission control systems. While costs for converting an existing plant to cofire biomass are case specific, the conversion may cost 250,000–700,000 US$/MW. Conversion to dedicated biomass may cost 314,000-485,000 US$/MW while new-build dedicated biomass is estimated at 2.6–3.8 million US$/MW.

## LEVELISED COSTS OF ELECTRICITY GENERATION

Levelised cost of electricity (LCOE) calculations are a means to compare the effective cost of generating electricity from different technologies. LCOE has been calculated using a published model for power generating technologies using figures for CAPEX, O&M costs and fuel costs, also taken from published examples. The analysis showed that, as expected, biomass cofiring adds cost to LCOE compared to coal.

The cost of reducing emissions of $CO_2$ derived from substituting biomass for coal in cofiring have also been evaluated. This analysis indicates that the average cost of $CO_2$ savings (82–126 US$/t$CO_2$) are similar for biomass, wind and solar. However, the range of costs calculated for solar and wind extend much lower than the lowest cost of cofiring implying that these technologies are more likely to be a cheap means of cutting net $CO_2$ emissions in future. Using the LCOE methodology, the cost of cutting $CO_2$ emissions using wood pellets in cofiring is determined to be in the range 57–199 US$/t$CO_2$.

The IEA Clean Coal Centre is a technology collaboration programme of the International Energy Agency (IEA). The objective of the IEA Clean Coal Centre is to provide definitive and impartial information on how coal can continue to be part of a sustainable energy mix worldwide.

Each executive summary is based on a detailed study which is available separately from www.iea-coal.org. This is a summary of the report: Supply chain costs of biomass cofiring by Ben Dooley and Patrick E Mason, CCC/286, ISBN 978-92-9029-609-6, 86 pp, April 2018.