Fact sheet

Biomass in steelmaking

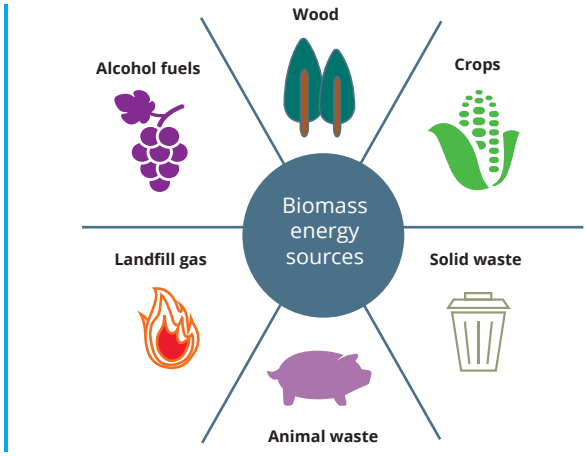
The transition to a low-carbon world requires a transformation in the way we manufacture iron and steel. There is no single solution to CO_2-free steelmaking, and a broad portfolio of technological options is required, to be deployed alone, or in combination as local circumstances permit. This series of fact sheets describes and explores the status of a number of key technologies and issues.

What is biomass?

Biomass is renewable organic material that comes from plants and animals, containing stored chemical energy from the sun. Plants produce biomass through photosynthesis. Biomass can be burned directly for heat, converted to renewable liquid and gaseous fuels through various processes[1], or used in industrial processes such as steelmaking.

Biomass sources for energy include:

- Wood and wood processing wastes - firewood, wood pellets and wood chips, lumber and furniture mill sawdust and waste, and black liquor from pulp and paper mills
- Agricultural crops and waste materials - corn, soybeans, sugarcane, switchgrass, woody plants algae, and crop and food processing residues
- Biogenic materials in municipal solid waste - paper, cotton and wool products, and food, yard and wood wastes
- Animal manure and human sewage
- Landfill gas
- Biofuels made from biogenic alcohol



Why consider biomass in steelmaking?

Under the right circumstances, biomass can be considered a carbon-free resource; therefore, it can be an attractive option to reduce emissions from iron and steel production.

IEA's bioenergy programme notes that "within the biospheric carbon cycle, bioenergy can be carbon neutral because the carbon that is released during combustion has previously been sequestered from the atmosphere and will be sequestered again as the plants regrow, i.e. if sustainably produced. However, the full supply chain must be considered, and all emissions associated with the production, processing, transport and use of bioenergy need to be included. Particularly harvesting, transport and processing generally involve fossil energy use. Nevertheless, analysis shows that the fossil energy used in the supply chain is generally a small fraction of the energy content of the bioenergy product, even for woody biomass transported over long distance, e.g. between North America and Europe."[2]

Biomass is already used to a significant degree in the power sector. For example, the former Drax coal-fired power plant in North Yorkshire, England, converted four of the power station's six generating units to use sustainable biomass instead of coal. This has transformed Drax, which supplies 5% of the country's electricity, into the UK's largest renewable power generator and the biggest decarbonisation project in Europe.

Biomass in iron and steelmaking

While some blast furnaces do currently operate entirely using biomass, the relative strength of charcoal compared to coke means that these are smaller furnaces. Charcoal is currently used commercially to substitute for a proportion of the coal used in blast furnaces, primarily in Brazil.[3]

Biochar can potentially be substituted for pulverised coal currently injected directly into blast furnaces. Work was undertaken to this end under the Australian CO_2 breakthrough programme, which focussed on substituting coal used in pulverised coal injection (PCI) in the blast furnace with sustainable biochar.[4] Some development continues to further optimise charcoal production to improve its product specifications for steel production.[5]

The Torero partnership project is testing the use of bio-coal (torrefied waste wood) to partially substitute coal in ArcelorMittal's plant in Ghent, Belgium; the largescale demonstration is expected to be operational by the end of 2020.

Opportunities and challenges

Potential approaches

Increasing demand for bioenergy feedstock is leading to conflicts, with differing demands on land use. Competition for arable lands required for food and fibre production is the major issue concerning biomass production. Soil disturbance, nutrient depletion and impaired water quality are also potential environmental effects from biomass feedstock production and utilisation of agricultural and forest residues for energy.[6]

The bioenergy industry has responded to these concerns by developing the Sustainable Biomass Verification Scheme, which can be used as a manual for accrediting the sustainability of biomass for energy.[7]

Supply chain developments

Robust supply chains exist to move the large amounts of raw materials (such as coal, iron ore, lime, scrap) required in modern steelmaking. Similar supply chains will need to be developed to harvest biomass at volume, convert and process it to char, and to deliver it reliably to steel manufacturing facilities. Transportation and processing will also generate greenhouse gas emissions. Taking an LCA approach to the assessment of emissions for the use of biomass is important in order to obtain a balanced view of the impact of biomass use on steel production.

The World Bioenergy Association has prepared a fact sheet[8] focussed on supply chain issues.

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[1] Based on Biomass explained - U.S. Energy Information Administration (EIA)
[2] Carbon neutrality | Bioenergy (ieabiocenergy.com)
[3] IEA Iron and Steel Roadmap, 2020
[4] Potential for the use of biomas in the iron and steel industry (researchgate.net)
[5] Replacing Coal used in Steelmaking with Biocarbon from Forest Industry Side Streams - VTT's Research Information Portal
[6] ScienceDirect
[7] Sustainability - Worldbioenergy
[8] Fact sheet - Biomass Supply Chains.pdf (worldbioenergy.org)