An EU-funded project has demonstrated that biofuel produced from wood and agricultural waste can be used to recycle scrap steel – replacing fossil fuels. The research aims to help Europe’s steel recycling industry cut greenhouse gases, lower costs and become more competitive.

Scrap metal from vehicles, buildings, industrial waste, cans and other sources go into Europe’s steel mills for recycling. What comes out some 1650°C later is fresh rolled or flat steel for reuse in thousands of products sold in Europe and worldwide.

Recycling steel is much more environmentally friendly than smelting virgin ore. Producing one tonne of steel from scrap uses 75% less energy, while CO2 emissions fall by 231 tonnes, compared to smelting virgin ore, according to an EU study [2]. Recycled steel also reduces the EU’s dependence on imported ore or steel.

But steelmakers still need to reduce their CO2 footprint even further to meet EU targets for lowering greenhouse gas emissions. In response, the EU-funded project GreenEAF demonstrated that it is possible to replace a portion of the natural gas and coal used for recycling steel with biofuel – in particular, charcoal produced from agricultural and forestry waste.

The project focused on electric arc furnaces, a type of smelter. Some 50% of Europe’s steel mills use electric arc furnaces. Around 40% of the energy used by electric arc furnaces is from natural gas and coal, the rest from electricity.

The project also showed that agricultural and forestry waste for conversion to biofuel could be economically collected in the region where an electric arc furnace is located.

Biofuel produced this way would help a steel plant reduce its greenhouse gas emissions and potentially cut costs, says project coordinator Loris Bianco of Ferriere Nord, a steelmaker in Italy. Biofuel is considered ‘carbon neutral’ and does not add to a steelmaker’s greenhouse gas emissions under EU rules.

“Moreover it can be considered an economical option considering increasing prices of oil and coal,”
adds Bianco.

**From theory to test**

As a demonstration, the project collected agriculture, forest and wood industry waste in the area around three electric arc furnaces. The furnaces are operated by the project’s partners – steelmakers in Italy, Germany and Austria.

The partners used a carbonisation process called ‘pyrolysis’ to produce a type of charcoal called ‘char’ and biogas. This process uses heat in the absence of oxygen to break down organic materials, leaving behind a carbon-rich solid or char. The process also releases biogas.

Pilot tests allowed the partners to adjust the process so it could efficiently produce the type of char needed for electric arc furnaces. About 15 tonnes were produced for pilot trials and for use during the production of recycled steel at the three furnaces.

“Coal substitution by charcoal is feasible – the steel, slag and furnace operating parameters are not modified significantly,” Bianco says about the results. “The tests showed that the GreenEAF process can be applied at all electric arc furnaces.”

The project also found there was enough agricultural and forestry waste in each of the regions where the tests were conducted (Friuli in Italy, Styria in Austria, North Rhine-Westphalia in Germany) to supply a medium-sized electric arc furnace plant producing about one million tonnes of steel a year.

“The strict regional link for the collection of scrap and for the collection and preparation of biomass represents a plus in sustainable electric arc furnace production in terms of reducing materials, energy and CO2 emissions – while creating local jobs,” says Bianco.

The biogas produced during the carbonisation process was not tested due to difficulties with storing it close to a steel plant. Instead, the project simulated its use in an electric arc furnace using a computer model. The simulation showed that the biogas could take the place of natural gas in a furnace’s burner.

“This option, together with the use of char would increase the economic value of biofuel produced from forest and wood waste,” Bianco adds.

**Market uptake**

Bianco notes there is not yet a market for biochar in the steel sector, so it is difficult to determine right now the potential cost savings for the industry. However, he expects the market will develop as steelmakers see the advantages of using biochar, especially if prices rise for coal, and for CO2 permits issued through the EU’s trading scheme for limiting greenhouse gas emissions (EU ETS [3]).

“This is an opportunity for the steel industry to become more efficient, more competitive,” says Bianco.

Negotiations are underway among some of the former GreenEAF partners to start a new project to further develop the process.

**Project:**
Green fuel for steel furnaces

**Project Acronym:**
GreenEAF

Links
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