Sustainable charcoal for "green steel" production: the case of Brazil

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Charcoal is one of the main sources of energy used in the production of pig iron for steel in Brazil. The country has the second largest forest area in the world with unique characteristics, as in addition to being one of the main holders of forest resources, it is also the only region with an extensive area of tropical forests. As a result, the nation has developed a complex productive structure in the forest-based sector, including plantations, mainly with the Pinus and Eucalyptus genera, dedicated to serving different sectors of the national economy.

From an economic point of view, government and relevant stakeholders estimates that in 2020 the forestry sector was responsible for 1.2% of the national Gross Domestic Product (GDP), equivalent to a total gross revenue of US$ 22.9 billion, and for 4.8% of the total exports of the country, equivalent to US$ 8.9 billion, with the pulp and paper sector responsible for US$ 7.7 billion, the sector of wood panels, laminated, sawn and plywood floors for US$ 1.5 billion and the charcoal pig iron sector for US$ 1.0 billion.

The history of steel industry in the state of Minas Gerais has always been linked to its mineral and forest abundance. Brazil is the world leader in charcoal production and the state of Minas Gerais has the largest area of dedicated forests for charcoal production, in addition to being the main producer and consumer of this raw material in the country.

According to data from non-governmental entities in the sector, Minas Gerais state stands out as the main forestry and steel centre in the country, concentrating around 28% of the eucalyptus plantations in its territory, more than 40% of the national production of pig iron and responsible for 79% of the production of pig iron using charcoal as a reducing agent.

Data shows that replacing or producing part of the traditional coke ironmaking by renewable energy source can avoid the use of approximately 0.45t of carbon per ton of pig iron from fossil source which represents 1.65t of CO_2 emission after total combustion.

In this context, in order to encourage the development and demonstration of sustainable technologies and processes for the production of biomass-based charcoal and provide the reduction of greenhouse gas emissions in the national steel sector the “oven-furnace system” was developed, using 100% national technology, where the gases from the carbonization process are directed to a combustion chamber (furnace), generating thermal energy. The energy derived from burning can be used for various purposes, including drying the wood. In addition, the Project “Sustainable Steel”, of the United Nations Development Program (UNDP), aims to transfer this technology to small and medium charcoal producers in Minas Gerais state through a partnership with the Federal University of Viçosa.

It is worth mentioning that all the initiatives indicated above are aligned with the Sustainable Development Goals (SDG), effectively contributing to SDG 7 – Affordable and Clean Energy; SDG 8 – Decent work and economic growth; SDG 9 – Industry, Innovation and Infrastructure; SDG 12 – Responsible Consumption and Production; and SDG 13 – Climate Action.

This study analyses the variables forest production, consumption and production of charcoal, emissions of greenhouse gases (GHG) in the production and use of charcoal by the steel sector in Minas Gerais state and, to this end, it describes a detailed history of the variables mentioned above. In methodological terms, the research follows a qualitative and exploratory approach through bibliographic research and survey of official data, presents some of the solutions developed by Brazilian researchers for sustainable charcoal production and makes recommendations to institutional bodies about the data management of forest resources.