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**HYDROGEN STEELMAKING - CHALLENGES LIE AHEAD**

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# Not an absolute beginner

Considering that decarbonisation is one of the most crucial issues for the global steel industry these days, it is very interesting to scrutinise Aço Verde Brasil (AVB)'s 600kt/yr long steel charcoal integrated mill, located in the city of Açailândia (Maranhão State). By **Germano Mendes de Paula\***

AVB is a subsidiary of Ferroeste, one of the largest Brazilian independent pig iron producers ('guseiros', in Portuguese). It entered into the steel value chain in 1978 when the Nascimento family acquired Siderúrgica Ferroeste, a pig iron producer, located in the city of Divinópolis (Minas Gerais State). In 1986, FIESA, another pig iron producer, situated in the city of João Neiva (Espírito Santo State) started-up. In 1993, FIESA purchased Companhia Brasileira de Ferro (CBF), installed in the city of Viana (Espírito Santo State) from Gerdau, consolidating its position as one of the largest guseiros.

A less well-known aspect of Ferroeste's trajectory is that it had also acted as a long steel producer. In fact, in 1989, Laminação de Ferro S.A. (Lafersa), established in 1954 and located in Contagem (Minas Gerais State), was acquired by Ferroeste, having assumed the name of its new owner. However, this plant was gradually decommissioned, mainly because of environmental hurdles, as it was located within Belo Horizonte's metropolitan area, the capital of Minas Gerais State. In 1992, the steel shop (130kt/yr) was closed. It shut down the blast furnace (90kt/yr) at the end of 1993 and the rolling mill (90kt/yr) in 1996. AVB, therefore, corresponds to Ferroeste's re-entry into the Brazilian long steel industry.

## AVB'S project

AVB is, thus, the second project that Ferroeste was involved in to rejoin the league of long steel producers. Ferroeste

	2015	2016	2017	2018	2019	2020
Pig iron	182	216	240	266	336	298
Crude steel	2	157	144	279	338	321
Billet for sale		157	143	217	97	29
Rolled steel				62	236	274
Drawn products						9

Table 1. AVB's production, 2015-2020 (kt). Source AVB

	2015	2016	2017	2018	2019	2020
Net sales (\$M)	66	73	93	162	175	173
Net profit to net sales (%)	-19,4	4,6	-11,2	10,0	8,9	11,1

Table 2. AVB's final financial performance, 2015-2020 (kt). Source AVB

established Gusa Nordeste in Açailândia in 1989 and began its operations in 1993 with a 60kt/yr pig iron capacity. In 2005, the combined blast furnace installed capacity achieved 360kt/yr. In 2009, Ferroeste decided to verticalise, by building a steel shop and rolling mill in Açailândia.

AVB's project originally consisted of two phases, the first of which was scheduled for completion in 2012. It included the addition of a 600kt/yr BOF in 2011, as well as a 220kt/yr increase of blast furnace capacity and a new 600kt/yr long steel rolling mill producing rebar and wire rod. The second would comprise an additional 220kt/yr blast furnace capacity, and the duplication of steel shop and rolling mill, to be completed in 2014. Ultimately, AVB would reach 800kt/yr of pig iron and

1.2Mt/yr of crude steel and long steel capacity.

Due to unsatisfactory Brazilian macroeconomic and domestic steel market conditions, the AVB project experienced many delays. The steel shop was commissioned in December 2015. The first blast furnace started-up in May 2018, the rolling mill in June 2018 and the second blast furnace in May 2021. Besides the equipment originally planned, AVB also acquired, for an undisclosed sum, a 120kt/yr wire drawing mill from ArcelorMittal in 2018, as one of the conditions imposed by Brazil's antitrust regulation agency CADE to approve the merger between the latter with Votorantim Siderurgia.

**Table 1** shows AVB's operational performance along the period 2015-2020.

	2018	2019	2020
t CO <sub>2</sub> /t pig iron	-0,01	-0,01	-0,02
t CO <sub>2</sub> /t crude steel	0,10	0,06	-0,04

Table 3. AVB's CO<sub>2</sub> specific emissions, 2018-2020. Source AVB

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Last year, the company produced 298kt of pig iron, 321kt of crude steel, 29kt of billets for sale and 274kt of rolled long steel products, implying that it was operating at around half of its nominal capacity. It also fabricated 9kt of drawn products, remembering that this line began in 2019. However, this year, due to the bullish domestic steel market in Brazil and the commissioning of a new blast furnace, it will improve its outputs by roughly 25%. The company has not unveiled when it will engage in constructing Phase 2.

**Table 2** pays attention to AVB's financial performance. Net sales jumped from \$66 million in 2015 to \$173 million in 2020. Meanwhile, the profitability changed from -19.4% in 2015 to 4.6% in 2016 and to -11.2% in 2017, but recovered to around a 10% plateau in the years 2018-2020. Currently, AVB generates 2,300 direct jobs, which is having a substantial and positive social impact, in particular when it is taken into consideration that Maranhão State is among the poorest in the country.

### Decarbonisation

As mentioned previously, AVB is a charcoal integrated mill, which is a fairly peculiar steel technological route for the global steel industry. However, the fully and partially charcoal integrated mills are responsible for some 10% of Brazilian crude steel output. Moreover, in 2020, 24.6% of the country's pig iron production was based on charcoal.

In February 2021, AVB claimed to be the first carbon neutral steel producer in the world. As verified in **Table 3**, the company certified that its emissions were equivalent to  $-0.02t\ CO_2/t$  of pig iron and  $-0.04t\ CO_2/crude\ steel$  in 2020. This outcome was underpinned by the fact that AVB has 50k hectares of planted eucalyptus for sustainable charcoal and captive pig iron production. In addition, the company adopted a series of actions and implemented several technologies such as: a) purchase of 100% renewable electricity; b) reuse of process gases (blast furnace and BOF) to mitigate the use of fossil fuels; c) reuse/sale of 100% of blast furnace slag in

its own cement plant, that was started-up in 2011 in Açailândia too; d) reuse of 100% of the BOF slag as raw material for blast furnace (limestone) and BOF (lime); e) use of 100% blast furnace gas in the rolling mill's reheat furnace.

It should be stressed that production of charcoal-based pig iron and, consequently, crude steel, has typically raised many doubts about the  $CO_2eq$  emissions generated during the reforestation and wood carbonization process itself. The boundaries of  $CO_2$  emissions (involving scopes 1, 2 and 3) are subject to some controversies too. However, even though many studies indicate a possible carbon negative condition, AVB has followed worldsteel's methodology that considers charcoal a net zero emission raw material. Thus, AVB, a newcomer to the Brazilian long steel industry, has been involved in the steel value chain for many decades, it is definitely not a beginner. More importantly, it is in a good position to take advantage of the decarbonisation trend. ■

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