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Electric Smelting Technology Implementation Road Map

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ABSTRACT

The Iron & Steelmaking industry is grappling with a transition from carbon intensive blast furnace production to new process routes with substantially lower emissions. It is it imperative to that the industry to makes careful investments without risking production or quality.

This paper outlines a low-risk transition road map to commercial green iron and steel production, via electric smelting furnace (ESF) process routes. While ESF equipment is proven from decades of ferrous and non-ferrous commercial installations, risk management is required for the new scale of production envisioned for iron and steelmaking. Topics will include key technology requirements, technology readiness level (TRL), project de-risking and technology development to ensure project success.

Keywords: CRISP, Decarbonization, DRI Melter, Electric Smelting Furnace, Green Steel, Low Nitrogen, Low Carbon Steelmaking, Reducing Electric Furnace, Sustainable Steelmaking

INTRODUCTION

The steelmaking industry has been responding to global pressures to reduce CO_2 emissions. Steel is an essential commodity that drives the development of global infrastructure; however, the industry is also one of the highest CO_2 emitters. Direct and indirect emissions account for about 7% and 10%, respectively, of the global totals [1] [2]. Given the size and importance of this industry, decarbonization is critical to meet global climate change goals, with a requirement to decrease its average CO_2 intensity by 60% from 1.4 to 0.6 t-CO_2/t-crude-steel to meet the 2050 Sustainable Development Scenario (SDS) of limiting the rise in global temperature to 1.5°C [2].

Today, the steel industry primarily consists of two process routes: the direct reduced iron (DRI) and/or scrap to electric arc furnace (EAF), and the blast furnace (BF) to basic oxygen furnace (BOF) integrated route. The BF-BOF route is currently the most widely used with a global production share of 71% [1], but also generates the highest emissions per tonne of production. EAFs have become increasingly popular in part due to the wide availability of scrap. Although EAFs can be operated solely on scrap, higher quality products require the use of virgin iron units from sources such as DRI or pig iron [3].

Although Global DRI production is increasing significantly [4], with many steelmakers planning to switch to DRI-EAF flowsheets, the demand for high quality DRI is also increasing substantially and availability of the DR-grade pellets required for efficient EAF operation is limited.

DRI-EAF steelmaking is expected to have a significant place in the future of steelmaking. However, the current trend towards DRI-EAF presents several notable challenges which will limit the ability to increase global steel production using this method:

- Limited availability of DR-grade pellets. Currently only ~10% of iron ore exports are DR-grade pellets or pellet feed concentrate [5]. Using BF-grade pellets and lump ore in the DRI-EAF process leads to higher gangue DRI and significant impact to EAF efficiency due to slag volume, yield losses, higher fines, etc.
- Although the availability of DR-grade pellets is expected to increase with demand, the cost is expected to increase substantially, and yield losses from beneficiating BF-grade concentrates to DR-grade can be very significant, up to 30% in some cases. [6]

