**Integrating Renewable Energy in the Iron and Steel Industry: Challenges, Opportunities, and Enabling Approaches**

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### Introduction

- Increase in mineral demand and declining mineral ore grades is expected to increase the energy demands and greenhouse gas (GHG) footprint by mining activities (Norgate et al. 2010; and Lezak et al., 2019).
- This paper focuses on iron and steel industry because it is the widely produced and consumed mineral in the world (see Figure 1).

### Energy and GHG Intensity

- High volume of global production of iron and steel, and the nature of steel making process make iron and steel production, one of the highest consumer of energy and producer GHG emissions within industries.

### Renewable Use Trend by Miners

- Prior to 2000, the use of renewables in mining operations was nearly non-existent.
- Recent years have seen an uptick in renewable energy adoption by mining companies, with a notable spike in commissioned projects in 2019.

### Challenges of Using Renewable Energy

- Technical challenges:
  - Feed stock demand
  - High temperature process heat demand

- Other challenges:
  - Conflicting business models
  - Lack of technology proof of concept
  - Lack of renewable energy awareness and expertise
  - Challenge for green supply chain certifications
  - Land constraints
  - Supply chain

- Variability of wind and solar
- Mining/plant design and investment structure

### Renewable Integration Opportunities

- From Table 3, high temperature processes like forging and using fuels fossil. These activities will hard to replace with renewable sources under current technologies (see Table 4).

### Enabling Approaches

- Research and development
  - Clean Hydrogen
  - Increase temperature produced by other renewables
- Alignment of business model and incentives
- Capacity building
- Addressing supply chain certification challenge
- Pooling resources
- Policy and regulations

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**References**

4. BNEF. 2019. Miners Turn to Clean Energy: Costs and Key Strategies. Source. Data from IRENA, 2015; University of Australia, 2019; and Environmental Protection Agency. Note: Low temperature (<150°C), medium temperature (150°C – 400°C), and high temperature (>400°C). *High temperature level production using solar and wind is not yet commercially available.
*Hydrogen energy refers to clean hydrogen generated from renewable electricity and water which is still unconventional at the moment.


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**Figure 2. Global Renewables Project by Mining Companies**

Source: Data obtained from Katta et al., 2020 as compile from several sources such as Natural Resources Canada, US Department of Energy and other studies. Notes: 1 KWh is equivalent to 3412.14 Btu.