

CSPA/CCRA Steel Industry GHG Reduction R&D Overview

Background

As an industry with fixed-process emissions of greenhouse gases, the steel industry will need to research, develop and implement major technology changes in the future to drastically reduce its emissions. Significant innovation and technology breakthroughs will be essential for the industry to achieve its aspirational goal of net zero carbon emissions by 2050. The Canadian Steel Producers Association (CSPA) and the Canadian Carbonization Research Association (CCRA) have developed a R&D action plan following a stepwise transition approach.

(2020-2025) Near future R&D and implementation: Implementation of technologies to reduce GHG emissions of ironmaking and steelmaking using existing production facilities.

(2020-2050) Long term R&D: Potential reduction of fixed-process emissions. Pursuit of net-zero carbon emission steelmaking technology.

This is a living document that will be updated as required.

References:

[CSPA Canada's Steel Industry: A Sustainable Choice](#)
[ArcelorMittal Climate Action Report 1 May 2019](#)
[IEA Iron and Steel Technology Roadmap](#)

Goal Statement

- To achieve significant reduction in GHG emissions in ironmaking and steelmaking processes with existing production facilities
- To research and develop non-fossil carbon based iron and steelmaking processes to replace existing fossil carbon based technology to achieve net-zero carbon emissions in steel production
- To improve the productivity and global competitiveness of the Canadian steel sector during this transition

Specific Objectives

Near future R&D and Implementation

- To substitute fossil carbon reductants by renewable biocarbon in blast furnace ironmaking and EAF steelmaking
- To substitute combustion of fossil fuel by alternate low carbon fuel for heating
- To explore potential of electrification in steel production
- To improve management and utilization of waste heat
- To explore potential of carbon capture, utilization and storage in steel production

Long Term R&D

- To advance alternate ironmaking technologies, including H2 DRI and electrolytic ironmaking
- To advance steelmaking technologies in order to utilize the alternative iron sources
- To develop technologies for production, storage and delivery of gaseous reducing agents to support DRI processes
- To develop technologies for non-emitting and renewable electricity generation to support alternate ironmaking technologies in the steel industry
- To apply CCUS in iron and steelmaking processes for establishing circular carbon pathway and long term carbon sequestration

Near Term Goal: Reduce GHG in Existing Processes

(1) Alternate Reductant (CCRA current program)

- Raw biomass supply
- Suitable biocarbon production
- Utilization of solid biocarbon in iron and steel production
 - Cokemaking
 - Blast furnace Ironmaking
 - EAF steelmaking
 - Iron ore pellet production

(2) Alternate Heating

- H2 Substitution and Renewable Natural Gas (RNG)
 - Raw feedstock supply
 - Production technology
 - Utilization in iron and steel production
 - New materials
- Others (e.g. conductive and electromagnetic induction heating)
 - Production technology
 - Utilization in iron and steel production

(3) Process Electrification

- Electricity utilization in iron and steel production
 - Opportunity
 - Technology development
- Renewable and non-emitting electricity
 - Production and storage technology development
 - Integration with iron and steel production process

(4) Waste Heat Recovery and Utilization

- Waste heat recovery technology
 - Development of enabling technologies for recovery of process waste heat
- Heat Management
 - Recovering of heat from unit operation
 - Integration of recovered heat from unit operations within the process
 - Integration between processes

(5) Carbon Capture, Utilization and Storage

- Development of carbon capture technology, for example:
 - Absorption and adsorption
 - Calcium looping
 - Algae
 - Microbial fermentation
 - Other technology
- Application of carbon capture in iron and steel production
 - Process modification to facilitate carbon capture
- Utilization of captured carbon
 - Utilization in iron and steel production
 - Conversion into marketable products
- Long term storage of captured carbon
 - Existing storage technology selection
 - Storage technology development

(6) Other

- Material efficiency (e.g. co-products, required steel grade development)
- Development of tools:
 - LCA models
 - Business case assessment

Long Term Goal: Sector Net Zero Emissions

(1) Alternate Reduction

- H2-DRI
 - Iron ore pellet production
 - Technology development
- Electrolytic ironmaking
 - Mineral processing for feedstock preparation
 - Technology development
- Flash metallization
 - Process feed preparation
 - Technology development

(2) Gaseous Reducing Agent and Renewable Heating Fuel Supply

- H2 production
 - Natural gas cracking with carbon capture
 - Water electrolysis with renewable and non-emitting electricity
- Bio-H2 and Renewable Natural Gas (RNG) production
 - Raw feedstock supply
 - Production technology

(3) Non-Emitting and Renewable Electricity

- Production and storage technology development
- Utilization of electricity in DRI and EAF processes

(4) Carbon Capture and Utilization

- Application of carbon capture in DRI and EAF processes
 - Process modification to facilitate carbon capture
- Utilization of captured carbon
 - Utilization in DRI and EAF processes
 - Conversion into marketable products

(5) Others

- Material efficiency (e.g. co-products, required steel grade development)
- Development of tools:
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 - Business case assessment