“How can we get the most out of Life Cycle Assessment to address sustainability and meet our traditional business objectives?”
Key Messages

- Background leading up to study
- What is Life Cycle Assessment
- IMnI LCA Programme
- Results
- Operational savings (a key competitive advantage in today’s markets).

Project Players

IMnI’s Manganese Sustainability Programme
- Enhancing benefits for producers and users of manganese
- Centered around Life Cycle Assessment (LCA)
- Strong focus on communication and outreach

About Manganese
- An essential nutrient for human health
- A critical component of steels and stainless steels
- Produced mainly by mining and pyrometallurgical processing

The International Manganese Institute
- Association representing manganese producers
- Mission to promote economic, social and environmental responsibility within the industry

Hatch
- Engineering and Consulting services firm
- 10,000 professionals in Metals, Energy, and Infrastructure
- Projects in over 150 countries
Leading up to the LCA

**IMnI Sustainability Programme**

**Phase 1**
Understanding the Landscape
- Association Benchmarking
- GAP Analysis
- SWOT
- Regulatory Review

**Phase 2**
Developing a Strategy
- OHES Sustainability Workshop
- Member Questionnaire
- Ranking & Prioritization of Initiatives

**Phase 3 & 4**
Action Plan
- Board of Directors IMnI Sustainability Initiatives Workshop
- Develop & Implement the Sustainability Programme Action Plan

Member Ownership and Involvement through Process
Adapt to changing pressures and focus areas

What is Life Cycle Assessment (LCA)

- LCA is a standardized scientific method used to measure, assess and manage the environmental performance of a product system from cradle to grave:
  - Collection of raw material;
  - Phases of Production;
  - End of life.

- LCA can measure and track different quantities:
  - Energy consumption;
  - Water Consumption;
  - Resource Consumption;
  - Greenhouse Gases;
  - Waste Generation.

Value of Life Cycle Assessment (LCA)

- To understand the impacts of Manganese throughout the whole chain of alloy production
- Communicate with stakeholders and regulators proactively
- To identify interface points where Mn impacts the environment and to humans
- To provide the industry a benchmark for site specific improvement
- Share Best Practices among the industry
What are the primary drivers of price?

What are the primary drivers of cost?

Which of these are under your control?

System Boundary

Upstream production and transport of energy and raw materials:

- Extraction
- Hauling
- Ore processing and beneficiation
- Overburden, ore rejects & tailings
- Ferronickel production
- Transportation
- Furnace
- Tapping & casting
- Crushing
- Mn-Alloy

Direct primary processes (on-site) • Indirect/secondary processes (upstream)
System Boundary

Sustainability

Greenhouse gas

Energy

Fossil Fuel Energy Water

Smog

Water
Industry Associations
Ideal Champions of Sustainability

Traditional Roles
• Industry Representative, communicating and promoting industry issues to 3rd parties
• Industry Service Provider, providing market statistics, conducting research, etc. for members
• Industry Meeting Place, providing an avenue of communication within an industry

The Sustainability Potential of Industry Associations
• Product Stewardship, communication pathway to supplier and customer industries
• Research, measuring and reporting on environmental performance
• Industry Collaboration, facilitating sharing of best practices on sustainability issues.

IMnI Manganese Sustainability Programme
Objectives & Features

Programme Objectives
1. Achieve a shared understanding of sustainability in the industry
2. Improve the sustainability of the manganese industry through IMnI activities
3. Ensure that the industry follows responsible business practices

Programme Features
1. Use Life Cycle Assessment (LCA) as a basis for understanding and communicating environmental impacts
2. Raise public awareness of manganese
3. Promote industry improvement and operating cost performance
**Global Manganese Alloy LCA Project**

**A Comprehensive, Global Study**

- Cradle-to-gate, ISO14040/14044 compliant LCA
- 3rd party peer reviewed
- Three alloy systems studied
- 17 participating mines and smelters.
- 20% coverage of global ore production.
- 10% coverage of alloy production.

**Regional distribution of participating sites**

- Africa: 25%
- Europe: 11%
- USA: 6%
- Australia: 19%
- China: 19%
- India: 19%

**LCA Results**

**Process Water (L/kg Mn-Alloy)**

- Ore processing: 4 L
- Slag processing: 2 L
- Dust: 0.5 L
- Other: 0.1 L
- Total: 6.6 L

Two main purposes of water in Mn mine and smelter:
- Cooling water
- Process water

On average, 6.6 L of process water are required to produce 1 kg of manganese alloy.
LCA Results

Roughly half of the energy contained in the resources at extraction is lost before entering the primary manganese supply chain.

Electricity Production contributes to the majority of environmental impact. Direct emissions are within direct control.

GWP = Global Warming Potential
POCP = Smog Creation Potential
AP = Acidification Potential
PM = Particulate Matter
LCA Results

Close to 94% of the total mine rejects are from overburden
Only 14% of the slag is stockpiled

Mine Rejects (kg/kg Mn-Alloy)

- Overburden: 24.50 kg, 94%
- Tailings: 1.16 kg, 4%
- Ore rejects: 0.47 kg, 2%
- Total: 26.31 kg, 100%

Slag Recovery (kg/kg Mn-Alloy)

- Slag sold to construction: 0.53 kg
- Slag stockpiled: 0.14 kg
- Slag recovered in furnaces: 0.06 kg
- Total: 0.73 kg

GWP = Global Warming Potential
POCP = Smog Creation Potential
AP = Acidification Potential
PM = Particulate Matter
Global Manganese Alloy LCA Project
Communicating the Results

• LCA provides a massive resource for industry improvement and stakeholder engagement.
• How do we get the message out?

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Raising the Profile of Manganese
Summary LCA Reports

Strategy
• Providing LCA data tailored to general audiences
• Linking LCA data with general product and industry information

Benefits
• Education
• Raises industry profile
• Transparency
• Product stewardship
Global Manganese Alloy LCA Project

Communicating the Results

External Industry Communication
- Public access to full LCA report
- Synthesis of LCA results to target audiences
- Alignment with broader industry representation

Communication within Industry
- Process and environmental benchmarks
- Relationship to cost and operating performance
- Technological solutions

Raising the Profile of Manganese

Summary LCA Reports

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Benefits
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Process & Environmental Benchmarking

Strategy
• Unique LCA modeling approach allowed for simultaneous process-level benchmarking
• Participating sites received benchmark reports comparing their performance to global averages

Benefits
• Positive industry engagement
• Supporting environmental improvements
• Demonstrating capabilities of LCA

Operating Cost Reduction Opportunities

Strategy
• Use LCA to connect environmental benefits to cost reduction opportunities

Benefits
• Leverages strong economic drivers
• Demonstrating capabilities of LCA beyond sustainability practitioners
Operating Cost Reduction Opportunities (Examples)

**OPEX Savings from Manganese Recovery**
- Supply chain analysis shows cumulative effect of losses upstream
- Costs borne by upstream processes, transferred through ore costs

![Graph showing OPEX savings from manganese recovery](image)

**FeMn Slag Byproduct Applications**
- Potential source of Mn for SiMn producers
- Evaluate potential benefits on global production

**Byproduct Potential**
- 1.1 – 2.2 million t additional recovery potential (280-560 kt Mn)
- Potential market identified in Asia
- Potential revenue stream for FeMn producers, while improving global industry

![Graph showing FeMn slag utilization for SiMn production](image)

*Based on 2010 levels of globally averaged slag and alloy production.*
Linking to Technology Applications

Strategy
• Use LCA to link environmental and cost opportunities to technological solutions

Benefits
• Leads to direct performance improvement

Lessons Learned

From the LCA and across other industries like FeCr, what can we take away to improve the Mn industry.

Some ideas:
• CO gas recovery for displacing energy use
• Slag Atomization and recovery
• Zero Captial - Asset Optimizations
• Reduce Dust
Linking to Technology Applications (Examples)

Slag atomization for alternative slag processing and byproduct applications

- No Dust
- No Waste Water
- No Stock Piling
- No Noise Hazard
- No Explosions
- Heat recovery possible
- Valued product
- Reclaim metal in MRP
- Lower environmental footprint

Linking to Technology Applications (Examples)

CO gas recovery to offset fuel costs, heating or power requirements.

- Energy Recovery from Furnace Off-gas
  - Dependent on furnace technology (closed vs. open);
  - Cost savings and air emission reductions through avoided purchased power.
  - Potential to provide ~10% of furnace power requirements.
“How can we get the most out of Life Cycle Assessment to address sustainability and meet our traditional business objectives?”

For more information, please visit:
www.hatch.ca
www.manganese.org

Or contact:
OHES@manganese.org

Mohammed Ali
Regional Director - Environmental Services
Hatch, Ltd.
mali@hatch.ca
+1 (905) 491-7197