Founded in 2016, Skarn Associates is a specialised UK-based mining sector information provider developing new subscription data products which address environmental, social and governance (ESG) issues. Skarn has developed a unique methodology for quantifying mining industry environmental impacts, including greenhouse gas (GHG) emissions and water consumption, on a forward-looking basis. Our products allow clients to independently evaluate mining company ESG performance.

Skarn’s senior team were previously key players in leading mining sector information businesses Wood Mackenzie, CRU, S&P Global and Thompson Reuters Refinitiv; we are specialists in commercialising mining sector technical and economic data.

Since the first products were launched in September 2020 the business has grown rapidly. Some of the largest global mining companies, including Anglo American, BHP, Glencore, Rio Tinto, Vale, First Quantum and Teck, plus major financial institutions including Barclays and Standard Chartered use our GHG Intensity Curves.

In November 2021 we will be launching our Gold Mines Water Benchmarking analysis, marking our entry into a new ESG subject area.

Skarn’s mission is to create high quality, independent, forward-looking mining sector ESG analysis. Skarn has developed unique methodologies and datasets, on an asset-by-asset basis.

Sophie Chung  
Director,  
Industry Analysis

Martin Haller  
Aluminium  
Consultant
OUR APPROACH TO ESG RESEARCH

Forecasting & reconciling ESG impacts
- Asset-by-asset, forward-looking ESG models, based on mine production schedule
- Requires thorough understanding of technical drivers; balancing energy inputs to emissions
- e.g. fuel inputs ↔ consumption rates/tonne ore ↔ fuel carbon intensity ↔ CO₂e

Data consistency
- Consistent approach to presenting corporate asset ownership
- Standardised metrics – e.g. production reporting basis – concentrate at mine gate vs refined metal at refinery
- Critical scrutiny of company reported data, CDP etc
- Intelligent, flexible and transparent treatment of system boundaries

Value-add research
- Carbon intensity and abatement curves; flexing functionality
- Benchmarking – energy, water, land/rehab costs, ecosystem impact, social indicators
- Capital and operating cost implications; connecting ESG to mine economics
- Longer term - Life Cycle Analysis, Scope 3 Emissions, implications for commodity markets
# ESG PRODUCT ROADMAP

## GHG INTENSITY CURVES

**Available now**
- Aluminium-alumina-bauxite
- Copper (Mines & Smelters)
- Gold
- Nickel
- Iron ore
- Metallurgical Coal
- Zinc (Mines & Smelters)
- Cobalt
- Lead
- Silver

## H₂O BENCHMARKING

**Launching Q4 2021**
- Unique asset-level approach to balancing water withdrawal, consumption and discharge.
- Groundbreaking application of intensity curves to water.
- Overlaying climate, water stress, watershed, hydrology and precipitation data.

## CORPORATE ANALYSIS

**Launching Q4 2021**
- Quarterly Review – company targets
- Data tool – ESG metrics including emissions, water, safety & others
- Reconciliation of reported vs. equity basis

## THEMATIC RESEARCH

**Regular Analytical Reports**
- Skarn Mining ESG Bulletin: a monthly round-up of mining-ESG news, plus feature articles
- Periodic whitepapers and thematic reports
- Monthly roundtable webinars

## Upcoming

**Upcoming**
- PGMs
- Forecast future years

**Upcoming**
- Gold Mines H₂O Benchmarking launch (November); Copper Mines - January

**Upcoming**
- Forecast ESG metrics for future years
SKARN’S E₀ & E₁ INTENSITY METRICS VS SCOPES 1-3

Source: GHG Protocol, Skarn Associates; E1 GHG Emission Metrics® is a registered trademark of Skarn Associates
SKARN’S PROPRIETARY METRICS: GHG EMISSIONS

Scope 1 & 2 emissions related to the boundary of asset in question: mine, smelter or refinery.
- Often referred to as: mine-, smelter- or refinery-gate GHG emissions.
- Includes onsite fossil fuel consumption, fugitive emissions, purchased electricity.

All emissions to produce LME metal or first saleable product:
- Supply chain emissions outside the boundary of asset.
- Typically Scope 3 emissions.
- Emissions from transportation & distribution of intermediate product and any mining or processing along the supply chain not included in E0.

Other emissions
- Capitalised project development, e.g. waste stripping
- Carbon credits/offsets.

Offsite emissions not directly related to production.
- Elements of Scope 3 not included in E0, E1 and E2.
- Corporate G&A not associated with day-to-day operations.

E1 GHG Emission Metrics® is a registered trademark of Skarn Associates
UNIQUE ASSET LEVEL ANALYSIS

Skarn’s GHG Intensity Curves quantify emissions along the supply chain at the asset, company and country level.

Iron Ore
$E_1$ GHG Intensity (kgCO2e/t)

Copper
$E_1$ GHG Intensity (tCO2e/t Cu eq.)

Nickel
$E_1$ GHG Intensity (tCO2e/t Ni eq.)

Aluminium
$E_1$ GHG Intensity (tCO2e/t Al)

Cumulative Iron Ore (dry) (million tonnes)

Cumulative Copper Production (000 tonnes)

Cumulative Nickel Production (000 tonnes)

Cumulative Primary Aluminium Production (kt)

Emissions to first-saleable product:
- Mining activities (Scope 1 & 2*)
- Ore processing (Scope 1 & 2*)
- Fugitive emissions (Scope 1 & 2*)
- Transport (Scope 3*)
- Downstream processing (Scope 3*)

Emissions by:
- Asset
- Company
- Country

Commodity coverage:
- Aluminium, Alumina, Bauxite
- Copper – mines, smelters & refineries
- Gold
- Nickel
- Iron Ore
- Metallurgical coal
- Zinc – mines & smelters
- Silver
- Lead
- Cobalt

*As defined by the GHG Protocol Corporate Accounting and Reporting Standard
NICKEL E1 GHG INTENSITY CURVE BY COUNTRY
ALUMINUM E1 GHG INTENSITY CURVE BY COUNTRY
GOLD E1 GHG INTENSITY CURVE BY COUNTRY
CROSS-COMMODITY COVERAGE

Annual CO₂e Emissions by commodity, to first saleable product (E₁)

CO₂e Emissions (Mt)

- **Primary Aluminium**: 178 [Mine, refinery & freight]
- **Copper**: 124
- **Nickel**: 120
- **Met Coal (Seaborne)**: 108
- **Iron Ore (Seaborne)**: 77
- **Gold**: 81
- **Zinc**: 47

**Notes:** excludes secondary and recycled production. Numbers equate to annual refined mine supply.

Source: Skarn Associates

E1 GHG Emission Metrics® is a registered trademark of Skarn Associates
MAJOR COMPANIES — $E_1$ GHG EMISSIONS BY COMMODITY

Percentile position: $E_1$ CO$_2$e Emissions Intensity/Unit Production

<table>
<thead>
<tr>
<th>Company</th>
<th>E$_1$ CO$_2$e Emissions (Mt CO$_2$e)</th>
</tr>
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<tbody>
<tr>
<td>Agnico Eagle</td>
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<tr>
<td>Anglo American</td>
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<tr>
<td>ArcelorMittal</td>
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<td>Barrick Gold</td>
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<td>BHP Group</td>
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<td>Freeport</td>
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<td>Glencore</td>
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<td>Hudbay Minerals</td>
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<td>Kinross Gold</td>
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<td>Kirkland Lake</td>
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<td>Newmont</td>
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<td>Rio Tinto</td>
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<td>Sherritt</td>
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<td>Teck</td>
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<td>Vale</td>
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</tbody>
</table>

Notes: based on equity ownership.
Includes international assets (i.e. not restricted to Canada)
Emissions are for stated commodities only, i.e. exclude oil & gas, thermal coal etc.
Anglo American excludes Kumba, which is reported separately.

Source: Skarn Associates
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