

WHAT IS YOUR CARBON FOOTPRINT?

Greenhouse Gas Emissions from World Copper Mines

Minecost.com and Metalytics have combined forces to produce the world's **only** mine by mine carbon emissions data, analysis and emissions curves for the western world copper mining industry.

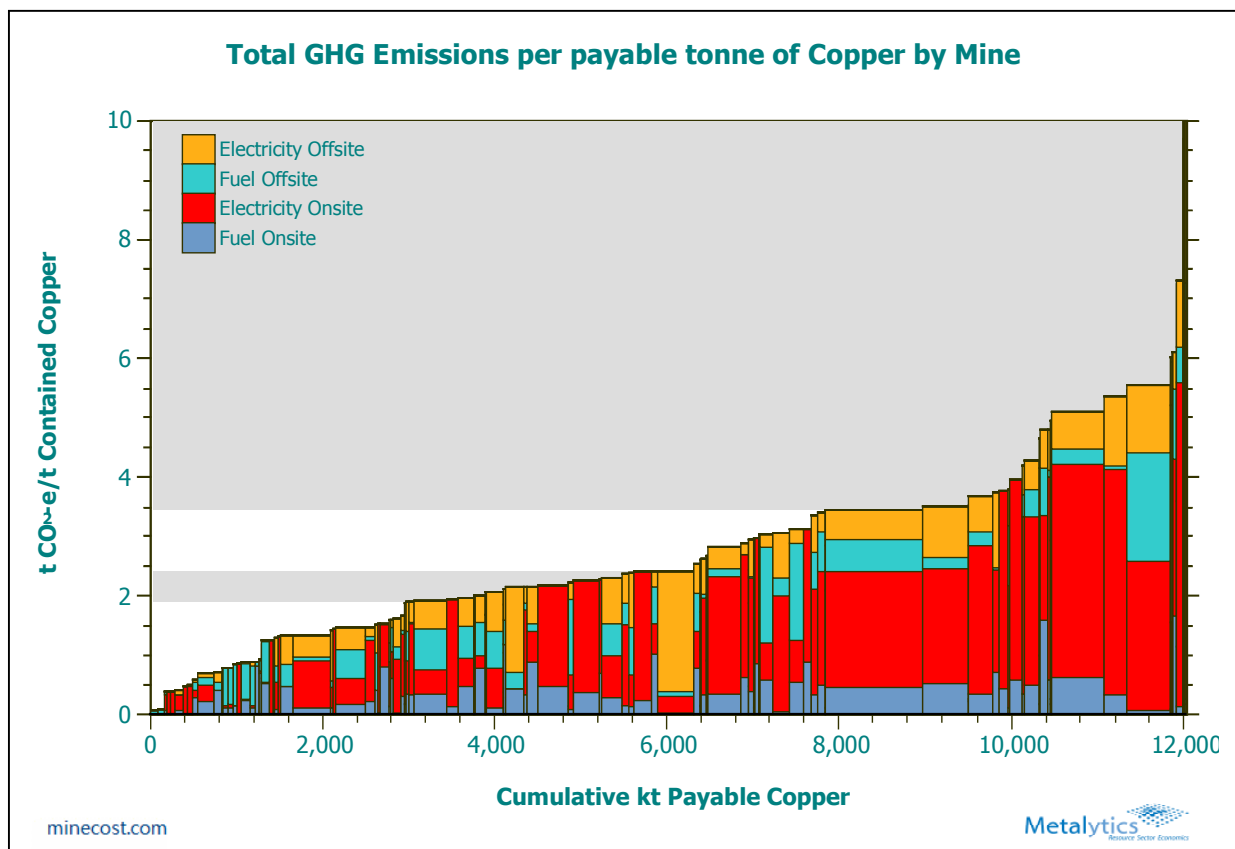
Mining is a significant emitter of greenhouse gases and is the focus of increasing attention from green groups and regulators. Miners need to know their own carbon emissions and how they compare with the rest of the industry. Miners and mining companies need to know where they fit in the emissions curve.

Are you in the bottom quartile?

This timely analysis, ***unavailable elsewhere***, combines the ten-year mine modelling experience of minecost.com with the energy economics and greenhouse expertise of Frontier Economics and its mineral economics associate Metalytics Pty Limited.

Frontier is one of the leading energy market and regulatory economic consultants in Western Europe, Australia and the Pacific with special expertise in the quantitative and qualitative aspects of environmental policies. ***Metalytics*** is associated with Frontier as a specialist in high-level services in resource sector economics.

Minecost.com maintains detailed engineering-based spreadsheet models of the over 90% of the world's base metals mines. All minecost models are peer-reviewed by analysts and through strategic alliances with CHR Metals, Bloomsbury Mineral Economics, GFMS and Metalytics.



The threat of global warming, and its increasingly prominent position in the public consciousness, demand that every major industry takes stock of its contribution to the rising atmospheric concentration of greenhouse gases (GHGs). For the primary copper industry, an initial step must be to examine the pattern and range of GHG emissions at every step in the production chain. Only then can participants assess the economic consequences, for themselves and their competitors, of the penalties on emissions that will be imposed by governments and or regulators, and proceed to devise cost-effective plans to avoid or mitigate the impact of such penalties.

Reputable copper producing companies have moved in sympathy with the times to issue sustainability information the GHG emissions from their major facilities, but in the absence of any standardized reporting format, it is difficult to make useful comparisons between even the best-reported producers on a like-with-like basis. ***Greenhouse Gas Emissions from World Copper Mines*** is designed to do just that, based on modelling of the usage of fuels, energy and explosives in the production process. It covers "cradle-to-gate" emissions of greenhouse gases resulting from the production of primary copper, from a mining perspective.

Greenhouse gas emissions are associated with the consumption of energy at every step in the copper production chain, from exploration through mining to the production of refined metal, and also with the use of explosives in mining. Producers of primary copper employ diverse technologies to mine, mill, smelt and refine several different types of ore, with every orebody having its own special character. Along the production chain, the various modes of transport of ores and intermediate products can also contribute to GHG emissions.

Many mines produce copper in association with other saleable metals such as nickel, cobalt, molybdenum, silver and gold, raising the issue of how to allocate GHG emissions among these co-products, similar to the question of allocating production costs. The report compares results obtained by allocating emissions from common processes to the metal products either according to their metal weights or their economic values.

Depending largely upon location, mines, smelters, refineries and electrowinning plants consume energy in different proportions from the major primary sources – hydroelectricity, nuclear electricity, natural gas, petroleum products and coal – each with its own GHG impact. The report, of course, identifies the specific electricity supplier and the source of generated power for each mine.

All of these factors mean that each unit of production (mine, smelter, hydro- or pyro-metallurgical plant etc.) has its unique GHG footprint, changing over time with movements in such factors as mine ore-to-waste ratios and head grades, pit depths, haulage distances, the energy efficiency of the mining fleet, process technical developments and changes in energy sourcing – not to mention the relative proportions and values of co-product metals recovered from the ore.

To calculate the total GHG emissions associated with a unit of copper production from an individual mine, we include not only the emissions associated with the mining operation, but also trace through the transport and downstream processes that transform mine output into refined copper. Thus our focus is twofold: firstly on the emissions directly generated onsite, and secondly on the total emissions associated with copper production.

Both copper in concentrate and SXEW copper cathode production is covered by the report. Nevertheless, the copper mining industry is still predominantly concerned with producing copper concentrates, often for sale to third party smelters and refiners. Some mines regularly feed a particular smelter (either in-house or third party); others sell virtually on the open market, and their pattern of deliveries to a variety of customers defies tracking via public-domain information.

Our approach to estimating the GHG emissions from metallurgical treatment is therefore a twofold one: for those mines identified with a particular smelting and refining route, we have added plant-specific emissions data to the emissions from mining, ore dressing and concentration activities, while for other mines we have simply attached emissions estimates representative of the mix of smelters and refineries that we believe to be relevant.

Greenhouse Gas Emissions from World Copper Mines

This 250 page report details the specific carbon dioxide emissions for 128 copper mines operated or owned by 55 mining companies in 20 countries around the world, covering over 90% of western world copper production including Russia. This is the **first time** that such information has become available.

The GHG estimates are based on minecost model estimates of direct onsite fuel, power and explosives consumption for each mine, plus the indirect emissions associated with the identified electricity suppliers to each mine. For mine complexes that include a smelter we include emissions estimates for metallurgical processing. All estimates are audited against published sustainability statements wherever possible.

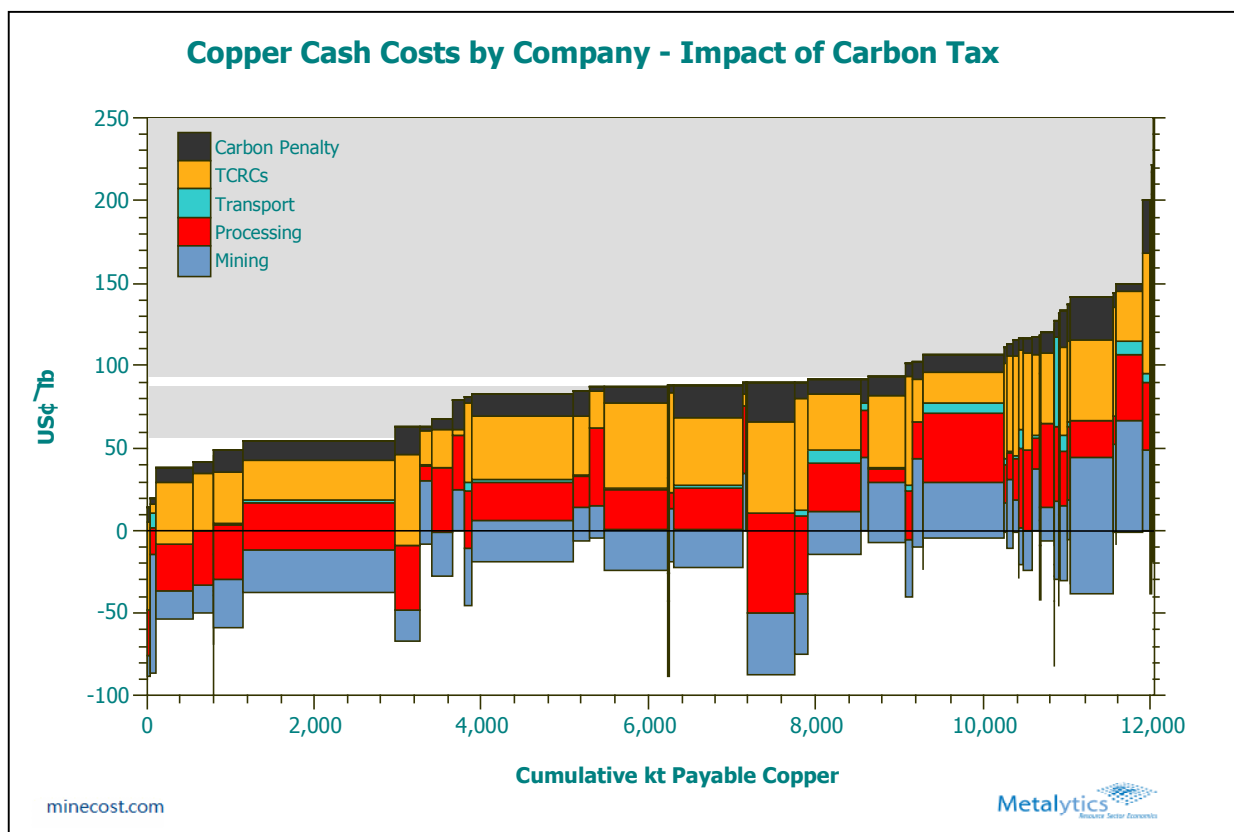
Fuel and power consumption and carbon emissions data are tabulated and shown in the form of emissions curves that rank mines by their GHG emissions consistent with each producer's sustainability reporting requirements. This allows each producer to be meaningfully compared with its competitors.

For regulatory agency purposes and for global comparisons we also estimate emissions data for concentrate shipping and metallurgical processing to show all direct and indirect carbon emissions associated with the production of finished metal from each producer. The carbon emissions data is then used to measure the impact of **carbon penalties** on the cash operating cost of each producer.

Data tables and emissions curves and the carbon tax implications are shown for all mines, producer companies and producer countries. Complete sets of tables and curves are shown for the base year 2007 and forecasts for 2012. The results are presented in 64 tables and 60 charts for mines, companies and countries showing:

- site energy consumption per tonne of ore treated;
- site GHG emissions per tonne of ore treated;
- copper's share of site GHG per tonne of ore treated and per tonne of contained copper produced;
- total GHG emissions (on- and off-site) per payable tonne of refined copper;
- unit cash cost of copper (with carbon penalties at various levels).

The printed report comes with an Excel-based **Dynamic Emissions Model** which generates the data tables and emissions curves displaying attributable GHG output for each mine, company and producer country. All offsite price and cost assumptions, including carbon taxes, may be changed by the user.



Mines included in the report for 2007

Sulphide Smelter-Route Producers

Alumbrera, Argentina
 Cadia, Australia
 Ernest Henry, Australia
 Golden Grove, Australia
 Kambalda, Australia
 Mt Garnet, Australia
 Mt Gordon, Australia
 Mt Isa Copper, Australia
 Nifty, Australia
 Northparkes, Australia
 Olympic Dam, Australia
 Peak, Australia
 Ridgeway, Australia
 Rosebery, Australia
 Telfer, Australia
 Sally Malay, Australia
 Tritton, Australia
 Phoenix, Botswana
 Fortaleza, Brazil
 Sossego, Brazil
 Brunswick, Canada
 Falconbridge Sudbury, Canada
 Flin Flon, Canada
 Gibraltar, Canada
 Highland Valley, Canada
 Huckleberry, Canada
 Inco Manitoba, Canada
 Into Ontario, Canada
 Kidd Creek, Canada
 Langlois, Canada
 La Ronde, Canada
 Montcalm, Canada
 Myra Falls, Canada
 Raglan, Canada
 Voiseys Bay, Canada
 Andina, Chile
 Candelaria, Chile
 Chuquicamata, Chile
 Collahuasi, Chile
 El Soldado, Chile
 El Teniente, Chile
 Escondida, Chile
 Los Bronces, Chile

Los Pelambres, Chile
 Mantos Blancos, Chile
 Salvador, Chile
 Pyhasalmi, Finland
 Spence, Chile
 Batu Hijau, Indonesia
 Grasberg, Indonesia
 Bismark, Mexico
 Cananea, Mexico
 Charcas, Mexico
 La Caridad, Mexico
 Sabinas, Mexico
 San Martin, Mexico
 St Barbara, Mexico
 Tizapa, Mexico
 Antamina, Peru
 Atacocha, Peru
 Cerro Verde, Peru
 Cuajone, Peru
 El Porvenir, Peru
 Huaron, Peru
 Quiruvilca, Peru
 Raura, Peru
 Tintaya, Peru
 Toquepala, Peru
 Ok Tedi, PNG
 KGHM Mines, Poland
 Neves Corvo, Portugal
 Norilsk, Russia
 Black Mountain, South Africa
 Nkomati, South Africa
 Palabora, South Africa
 Aguablanca, Spain
 Aitik, Sweden
 Boliden, Sweden
 Garpenberg, Sweden
 Cayeli, Turkey
 Bagdad, USA
 Bingham Canyon, USA
 Chino, USA
 Continental, USA
 Doe Run, USA
 Mission, USA

Ray, USA
 Robinson, USA
 Sierrita, USA
 Bwana/Lonshi, Zambia
 Kansanshi, Zambia
 Konkola, Zambia
 Mufulira, Zambia
 Nchanga, Zambia
 Nkana, Zambia

SX-EW Producers

Nifty, Australia
 Cerro Colorado, Chile
 Chuquicamata, Chile
 Collahuasi, Chile
 El Abra, Chile
 El Soldado, Chile
 El Teniente, Chile
 El Tesoro, Chile
 Escondida, Chile
 Lomas Bayas, Chile
 Los Bronces, Chile
 Mantos Blancos, Chile
 Mantoverde, Chile
 Quebrada Blanca, Chile
 Radomiro Tomic, Chile
 Salvador, Chile
 Zaldivar, Chile
 Cananea, Mexico
 La Caridad, Mexico
 Cerro Verde, Peru
 Tintaya, Peru
 Toquepala, Peru
 Bagdad, USA
 Chino, USA
 Miami, USA
 Morenci, USA
 Pinto Valley, USA
 Ray, USA
 Sierrita, USA
 Tyrone, USA
 Kansanshi, Zambia
 Mufulira, Zambia
 Nchanga, Zambia

To find out more about this report, please complete the order form and either mail it to:

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