WHAT IS YOUR CARBON FOOTPRINT?

Greenhouse Gas Emissions from World Copper Mines

Note: This product is no longer available. To see current models, charts and data supporting this research, go to http://www.minecost.com/carbon.htm

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.

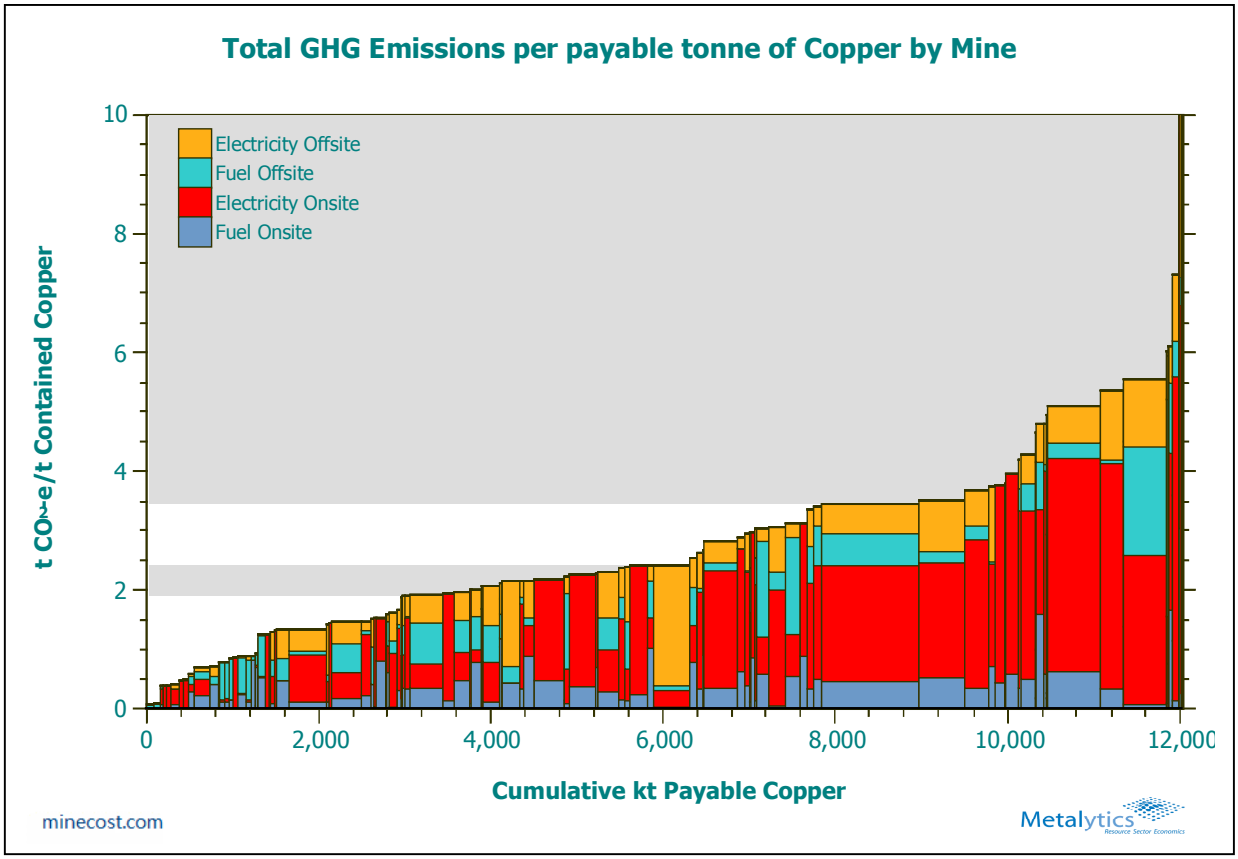
Minecost.com maintains detailed engineering-based spreadsheet models of the over 90% of the world's base metals mines. All minecost models are peer-reviewed by analysts and through strategic alliances with CHR Metals, Bloomsbury Mineral Economics, GFMS and Metalytics.

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.

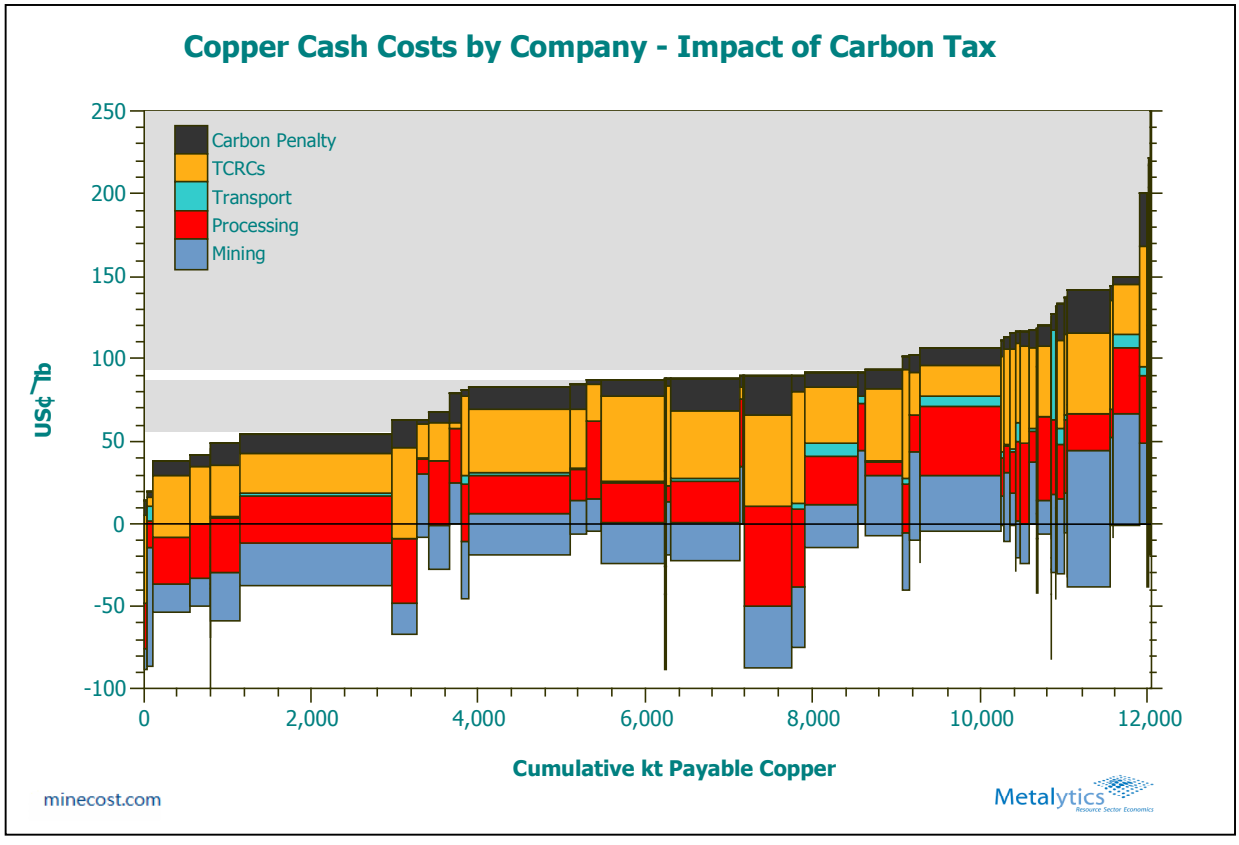
Fuel and power consumption and carbon emissions data are tabulated and shown in the form of emissions curves that rank mines by their GHG emissions consistent with each producer's sustainability reporting requirements. This allows each producer to be meaningfully compared with its competitors.

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 2006, estimates for 2007 and forecasts for 2012. The results are presented in 64 tables and 60 charts for mines, companies and countries showing:

- onsite energy consumption per tonne of ore treated;
- onsite 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 2006 and 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
Pyhasälmi, 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

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