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POLICY RECOMMENDATIONS FOR A SUSTAINABLE COPPER SUPPLY CHAIN:

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A CHINESE PERSPECTIVE

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Photo: Chuquicamata, world's largest copper mine.

POLICY RECOMMENDATIONS FOR A SUSTAINABLE COPPER SUPPLY CHAIN: A CHINESE PERSPECTIVE

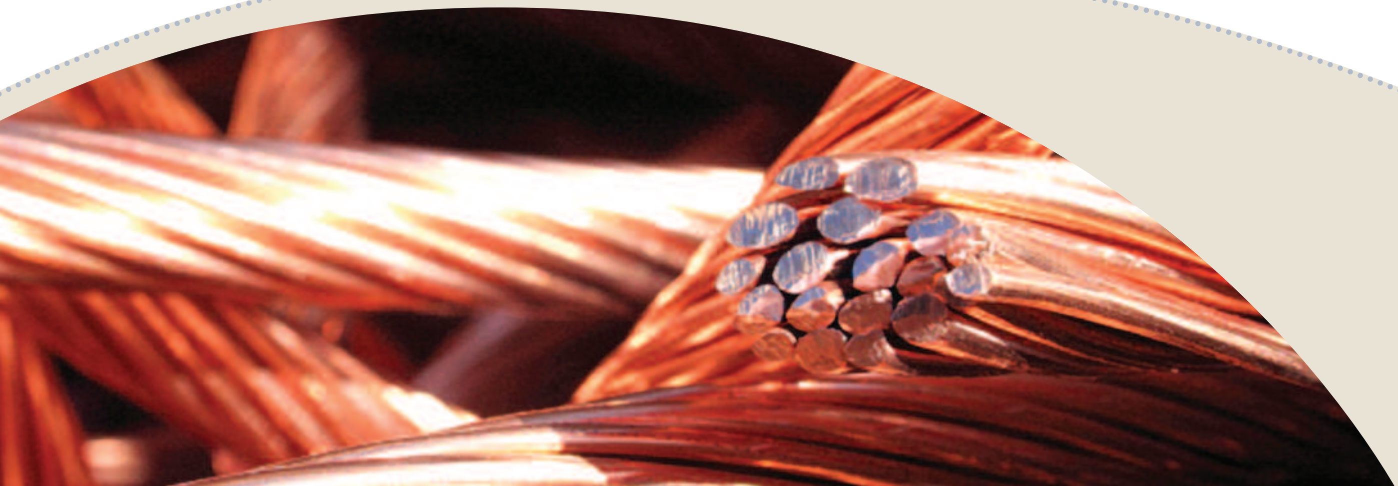
Rapid advances in technological and economic development across the planet over the past two decades have stimulated a widespread and rapidly expanding dependence on copper-based products such as electric motors, computers, mobile phones, household appliances and industrial machinery. The unprecedented growth in global copper consumption and production is placing growing pressures on both local ecosystems and finite copper stocks, giving rise to a growing need for global strategies for sustainable copper supply chain management. At the same time, recent growth in copper production and consumption has been dominated by supply and demand from China, now the world's most important producer and consumer of refined copper: this fact emphasizes the need to leverage Chinese leadership in building a global sustainability strategy for the sector.

The consumption of refined copper has tripled since 1970, reaching 18 Mt in 2008, and continues to grow at an average of 4 per cent per annum.[1] Refined copper consumption makes up about 65 per cent of total copper consumption, with the remainder being supplied by copper scrap. In 2008, copper scrap supply was estimated at approximately 8 Mt.[2] It is expected that copper consumption will more than double by 2035, reaching approximately 37 Mt (see Figure 1). Meanwhile, it is expected that China will account for 68 per cent of the global increase in copper consumption over this period.

China has already played a major role in expanding global access to copper-based products through its efficient and low-cost manufacturing base. Although China accounts for only 6 per cent of global production of copper ore concentrates, it is the single largest producer of refined copper products (21 per cent of global production) and copper semis (50 per cent of global production). Moreover, while Chinese refined copper production has been steadily growing at an average of 15 per cent per annum over the past decade, it has not matched the country's consumption of refined copper. Between 2002 and 2008, China's total copper usage (refined and scrap) doubled from 3.7 Mt to 7 Mt, accounting for just under a third of global copper usage.[3]

Notably, China has rapidly been increasing its use of scrap copper as a source of copper for meeting its consumption needs. Growing from around 100,000 tons in 1980 to over 3 Mt per annum in 2008,[4] China currently supplies over 40 per cent of its copper needs through copper scrap—a scrap contribution that is notably higher than the current global average.

The remaining 60 per cent of Chinese copper supply comes from virgin sources in the form of copper concentrate or refined copper. China itself is the fourth largest supplier of copper concentrate which is almost entirely destined for Chinese refining and consumption, Chile is by far the single largest foreign



supplier of both copper concentrate and refined copper to China, accounting for over half of total non-scrap copper supply to China. The majority of imports from other countries are in the form of copper concentrates, with Peru, Australia, Mongolia and Kazakhstan leading the way (see Figure 2). These source countries for Chinese copper represent key targets for managing the sustainability of the Chinese global copper supply chain.

FIGURE 1: PROJECTED GLOBAL CONSUMPTION OF REFINED COPPER[5]

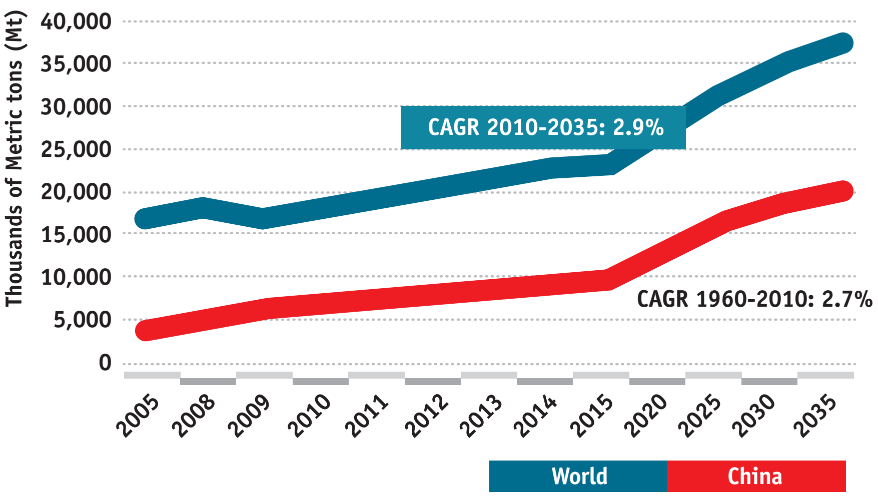
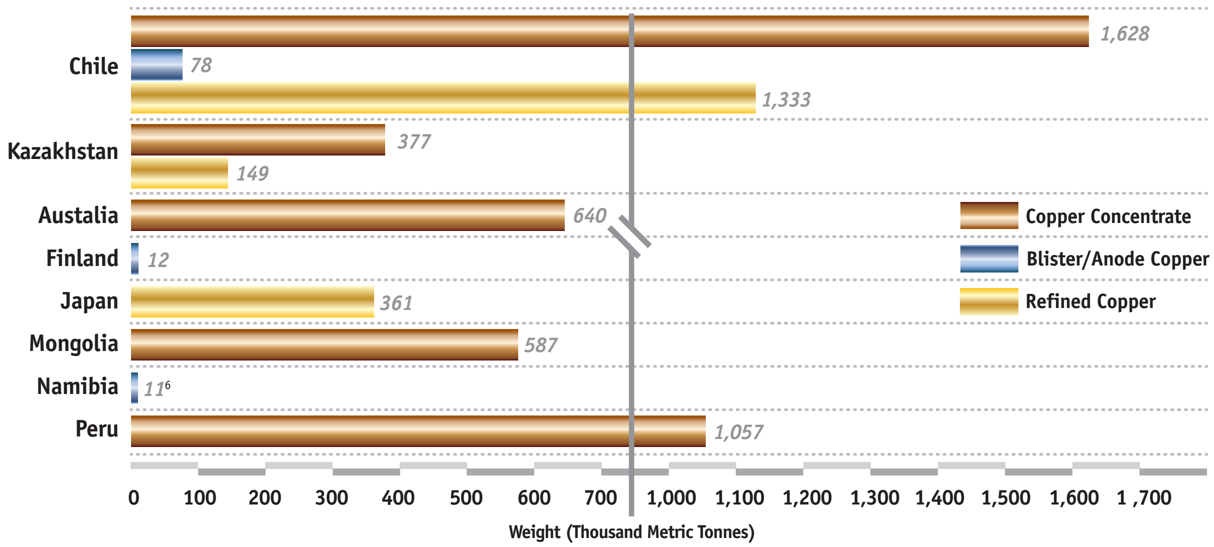


FIGURE 2: CHINESE COPPER CONCENTRATES, BLISTER/ANODE AND REFINED COPPER (MAJOR IMPORTING COUNTRIES)



Chinese demand for refined copper is being driven by its own growing industrial base. In 2009, the manufacture of industrial products and consumer goods, accounted for 46 per cent of Chinese refined copper demand—in part stimulated by China's role as the single most important producer of electronics and machinery products globally. However, copper consumption is also being stimulated by China's own economic development to supply infrastructure and construction demands at higher rates than in more developed copper-consuming countries (See Table 1).

China's growing presence in the global copper supply chain is generating demonstrable social and economic benefits both within and outside China. The Chinese Nonferrous Metals Industry Association (CNIA) estimates that more than one million people within China are directly employed in the copper extraction, refining and manufacturing processes.[7] Similarly, growing foreign direct investment in key supply countries such as Chile, Peru, Mongolia and Zambia is driving significant infrastructure development and providing an important platform for economic growth.[8]

Moreover, China's prominent role in global copper supply chains is itself a direct reflection of its unique capacity to turn raw materials into high-value manufactured products at a low cost. China's efficient and low cost production base provides the global community with increased access to a wide variety of copper-based products which in turn contribute to overall human well-being. The role of China within the global copper supply chain is therefore fundamentally—and undeniably—characterized by increased global social welfare.

At the same time, growing demand for electronics and other copper-dependent products also implies an intensification of the social and environmental challenges associated with the production and trade of copper products.[9] Because copper is a non-renewable resource, its consumption is systemically challenged by limited global reserves. Current copper reserves are estimated at 550 Mt and are expected to be exhausted by 2060 at current utilization rates. Therefore, re-use, reduction and enhanced extraction efficiency are all imperatives within the sector as a whole to ensure its long-term sustainability.

More immediately, growing copper consumption presents a number of environmental and social challenges resulting from expanding activities at the extraction, manufacturing and waste disposal stages of the supply chain.

TABLE 1: DISTRIBUTION OF COPPER CONSUMPTION AMONG MAJOR CONSUMING MARKETS (BY SECTOR)

	China	European Union	United States
Industrial Equipment	29%	23%	13%
Building & Construction	24%	40%	52%
Infrastructure	21%	10%	8%
Consumer Products	17%	15%	16%
Automotive	9%	12%	11%

EXTRACTION

The extraction stage of the copper supply chain is faced with the most significant environmental and social challenges:

Environmental impacts: A "cradle to gate"[10] lifecycle assessment commissioned by IISD attributes 70–75 per cent of environmental impacts to the extraction and primary ore-processing stages of the copper supply chain.[11] The main sources of environmental degradation at extraction are related to:

> ***Land degradation:*** current stocks of copper ore have an average of less than 1 per cent purity. As a result, more than 100 tons of material must be extracted to produce one ton of copper giving rise to very large extraction impact on the land surface.[12] Many copper mines are open pit and lead to the removal of all forms of vegetation over the area of the mine.[13] Other sources of land degradation relate to the roads, tailings dams and mine facilities that typically accompany a mining site. Land degradation can significantly disrupt existing ecosystems and contribute to greenhouse gas emissions.[14]
>
> ***Toxic chemical release:*** copper mining generates massive amounts of waste rock that, when exposed to air and water, can lead to acid rock drainage, a process whereby the natural elements present in the rock react to produce an acidic or neutral runoff with dissolved metals that—if left unmanaged—can flow into water streams.[15] Tailings dams are built to contain the tailings indefinitely but need to be managed over time and—particularly in certain environments—can be vulnerable to leakage. This can represent a serious threat to local waterways and water tables and the ecosystems dependent upon them.

Social impacts: Mine workers are exposed to a variety of occupational health and safety hazards related to the use of heavy machinery and other practices associated with ore extraction. Communities will often experience higher noise and dust levels as a result of nearby mining operations. Copper is both a finite resource and a public good: its extraction from a given locality comes at a social cost to that community which may not be covered by market prices or actual employment conditions.

REFINING

The refining process is predominantly defined by its environmental impacts:

Environmental impacts: The refining process generates between 20 and 25 per cent of the copper supply chain's environmental impact. The main environmental impacts from the refining process arise from:

> ***Air pollution:*** The copper refining process, particularly smelting operations, leads to the generation of significant quantities of potentially toxic airborne particles and gases. These constituents include sulphur dioxide, carbon dioxide and nitrogen dioxide (Non-ferrous metals account for about 8 per cent of global sulphur dioxide production). In addition, they may include toxic concentrations of numerous metals such as arsenic, nickel, lead, cobalt, mercury, etc.
>
> ***Energy consumption:*** The copper refining process can involve the heating of copper concentrate to high levels which require significant amounts of electricity. As copper demand and production grow, the per ton greenhouse gas emissions are expected to rise due to a higher reliance on coal power sources. In Chile, for example, China's most important source of refined copper, a 50 per cent increase in refined copper production by 2020 is expected to result in a doubling of greenhouse gas emissions (to 36 Mt by 2020).[16]

CONSUMPTION

The use phase of copper is generally associated with a range of social and environmental benefits.

Environmental impacts: As a conductor of electricity, the consumption of copper is often linked to the consumption of electricity, which can have negative environmental impacts. However, relative to other industrial materials, copper is a highly efficient conductor of electricity and therefore can be used to improve the efficiency of industrial machinery and appliances. Some of the applications that copper can be used in as a replacement for less energy efficient substitutes include electric motors, power cables, transformers and solar panels.

Social impacts: Copper is used for a variety of industrial and consumer applications. About 65 per cent of copper is used in electrical applications with the majority of that being applied to electrical cables and lines. 50 per cent of copper consumption is for the construction sector, making it the most important single use of copper.[17] Industrial and business applications represent the second and third most important uses for copper at 22 per cent and 10 per cent respectively. The multiple uses of copper lead to significant gains in social welfare and human well-being.

DISPOSAL

Copper is 100 per cent recyclable and can be reused indefinitely. The disposal stage of the copper supply chain therefore has significant potential for reducing the overall environmental impact of the copper supply chain.

Environmental impacts: By recycling copper scrap, the environmental impacts of copper production can be reduced by up to 75 per cent. At present, recycling currently accounts for approximately one third of global copper production; however, those rates are increasing and represent an important opportunity for improving the overall environmental footprint of the sector. Imperfections in recycling processes, and the co-use of copper with other materials in electronics products, can generate the release of toxic materials into the environment.

Social impacts: The main social impacts associated with the disposal stage are related to worker exposure to heavy metals and organic compounds due to the recycling of e-waste. China faces special challenges and opportunities for maximizing the positive social impacts in the disposal phase due to its exceptionally active informal recycling industry.[18]

RECOMMENDATIONS AND OPPORTUNITIES

As the world's most important importer of copper ore, and the single most important producer of refined copper and key copper-based products, China fulfills a unique role in the global copper supply chain. China has already made rapid advances in reducing the environmental impacts of its primary production, resulting in average impacts that are less than the world average and less than most of the countries exporting primary copper to China. Notwithstanding its leadership in creating sustainable primary production, there are important opportunities to carry its learning and technological capacity to the rest of its supply chain.

On the one hand, Chinese buyers and manufacturers, have the capacity to establish benchmarks for production from their supply base. On the other hand, with its growing refining, smelting and manufacturing capacity, China bears a growing responsibility to ensure that its processing and manufacturing activities are applied in accordance with the core principles of sustainable development. Finally, China's importance in copper recycling presents some of the most important gains for improving the sustainability impacts of the copper supply chain. With this in mind, the Global Copper Markets project has identified the following opportunities for action by the Chinese Government:

Strengthen existing domestic environmental regulations with complementary industrial policy:

Among the most important environmental impacts of the global copper sector are those resulting from industrial processes related to copper extraction and refining. The effectiveness of environmental regulations and objectives can be significantly enhanced through the rapid deployment of more efficient and cleaner technologies. China's rapid growth represents a unique opportunity to invest in cleaner technologies. Key opportunities for focusing industrial policy and technologies exist in such areas as: comprehensive utilization of mine tailings, mine reclamation, wastewater recycling in extraction process; reduction of gas and dust emissions, reduction of energy consumption; promotion of advanced dismantling and sorting technologies and treatment of dioxin pollution in the recycling process. China should direct positive participation from industrial enterprises in pollution control and environmental protection through industrial policy and fiscal incentives.

Bilateral sustainable economic development partnerships:

One of the key obstacles to the implementation of sustainable practices at production is due to the absence of robust governance of the extraction process. As China increases its reliance on developing country supplies from countries like Zambia and Mongolia, ensuring sustainable practice will require targeted investments in monitoring, enforcement and implementation. Based on its strong commercial relationships with these and other key developing country suppliers, China has an opportunity to play a proactive role in helping build governance in key host countries for Chinese mining activity through economic development partnerships designed to promote sustainable production in the copper sector.

China corporate social responsibility (CSR) policy for copper companies operating in host countries:

As a complement to direct investments in building governance capacity in key source countries, the Chinese government can also leverage market forces to support and reinforce the objectives of improved governance at the extraction phase by specifying relevant requirements for both state-owned and privately-owned Chinese enterprises operating overseas on copper mining projects (building on the State-owned enterprises operating in China on Corporate Social Responsibility Reporting and Protection of Labour Rights as well as the draft "Guidelines on Corporate Social Responsibility Compliance by Foreign Invested Enterprises").

Legalization and monitoring of import of copper containing e-waste:

The social and environmental challenges associated with e-waste treatment in China need to be balanced with the clear need for secondary copper and the social and environmental benefits of recycling. The current ban on e-waste imports forces potentially safe recycling of e-waste underground and exposes workers and communities to unnecessary safety and environmental hazards. There is therefore a growing need to legalize and standardize the customs clearance procedures for waste metal imports. Nationwide port, inspection site and equipment standards should also be developed for monitoring and managing waste metal imports at all ports. By establishing rules for the safe trade and handling of such products and complementing these with the legalization of e-waste imports, the Chinese government could play a significant role in improving the global environmental impact of copper supply chain.

RECOMMENDATIONS FOR THE INTERNATIONAL COMMUNITY

China does not, however, face these responsibilities alone. Chinese copper consumption is driven largely by global demand for Chinese copper-based products—products which are typically designed and consumed across Western Europe, North America and Japan. As buyers, developers and end-users of copper-based products manufactured in China, these countries bear a corresponding capacity and responsibility to promote and secure best practices for sustainable development along the global copper supply chain. This responsibility needs to be backed by firm commitments, action and investment. The Global Copper Markets project has identified the following opportunities for action by the international community:

Establishment of an international information platform for the copper sector:

> *The global copper supply chain is defined by a wide variety of processes and actors. The effective management of the copper supply chain requires access to timely and accurate information on production capacities, standards and policies. The International Copper Study Group (ICSG) provides a logical focal point for such activities. The work of the ICSG could be significantly strengthened to serve sustainable development by gathering information not only core economic and policy parameters but also on core environmental indicators such as, among other things, carbon dioxide, sulphur dioxide and tailings emissions.*

Establishment of an international copper material flow strategy:

> *Ensuring the sustainability of the copper supply chain over the longer term will require clear and intentional management of global copper supply and demand. Building on the International Copper Association's "Copper Stewardship Initiative" and the ICSG's mandate for promoting transparency and cooperation in the global copper sector, the international community should act towards the establishment of a "Global Material Flow Strategy" for the copper sector setting out targets and priorities for recycling rates, mine management, refinery modernization and mine reclamation.*

Establishment of an international standard for the sustainable treatment of e-waste:

> *More efficient copper recycling will form a pillar of the long term sustainability of the global copper supply chain. One of the major challenges in recycling copper under current conditions relates to the growth of informal recycling practices and the corresponding social and environmental dangers this poses. The international community could play a significant stimulus of the sustainable recycling of copper from electrical products by developing an international e-waste treatment standard in accordance with the spirit and principles of the Basel Convention.*

Establishment of a global private sector e-waste partnership:

Building on and working with existing multi-stakeholder e-waste partnerships, such as the Mobile Phone Partnership Initiative, The Global Knowledge Partnerships in E-waste Recycling, The Global Computer Refurbishment and Recycling Partnership; and the Solving the E-waste Problem: A Synthetic Approach Initiative, the Chinese government, in collaboration with the United Nations Environment Program, could facilitate a global multi-stakeholder, supply chain-based approach to monitoring and managing trade in e-Waste.

Mandate eco-design for copper recyclability:

Access to copper embedded within products will depend in part on intentional design to allow efficient recovery. The establishment of international guidelines for eco-design related specifically to enabling, inter alia, efficient copper extraction could help support the transition to a more complete recovery process in the copper supply chain.

Capacity building for safe and sustainable copper extraction practices in developing countries:

The greatest environmental impacts of the global copper supply chain are found within developing country suppliers. Chile, Mongolia and Kazakhstan represent major suppliers of primary copper resources to China and the rest of the world and generate higher than average environmental impacts through the copper extraction process. China and the global community have a role to play in facilitating the adoption of cleaner technologies and ensuring that mine waste and reclamation are properly managed. A global fund aimed at promoting and supporting best practices in copper extraction could play an important role in bringing developing country supply up to international accepted standards.

International cooperation on technologies for energy efficiency and emissions reduction throughout global copper supply chain:

Energy efficiency and emissions reductions at the extraction, refining and consumption stages of the supply chain represent key targets for building the sustainability of the global copper supply chain. Energy demand and energy-related environmental impacts are spread across the global copper supply chain. The international character of the energy challenge within the copper sector necessitates a global approach to building energy efficiency throughout the chain. A global action plan and consortium aimed at promoting the development and use of energy efficient technologies at the extraction, refining and equipment design phases of the supply chain could reduce the global impact of the supply chain significantly. Prioritization should be placed on phasing out high-energy consuming technologies such as reverberatory furnaces.

FIGURE 3: DISTRIBUTION OF ENVIRONMENTAL IMPACTS (BY PRODUCTION LOCATION)

THE ENVIRONMENTAL IMPACTS OF CHINESE PRODUCED CATHODES IS, ON AVERAGE, LESS THAN CATHODE PRODUCED IN ALL OTHER REGIONS. ENVIRONMENTAL IMPACTS IN ECO-INDICATOR 99 POINTS PER KG CU-CATHODE PRODUCED.

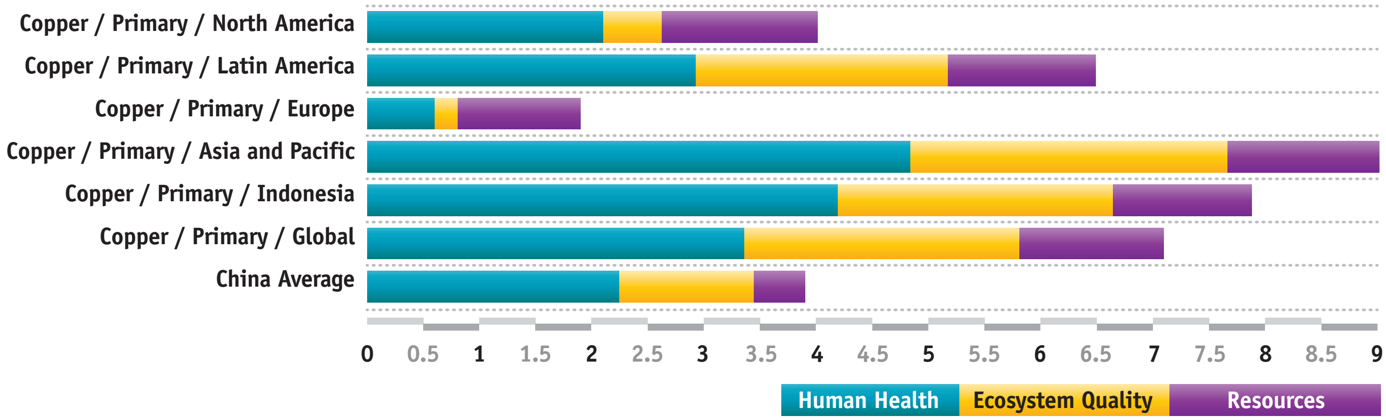
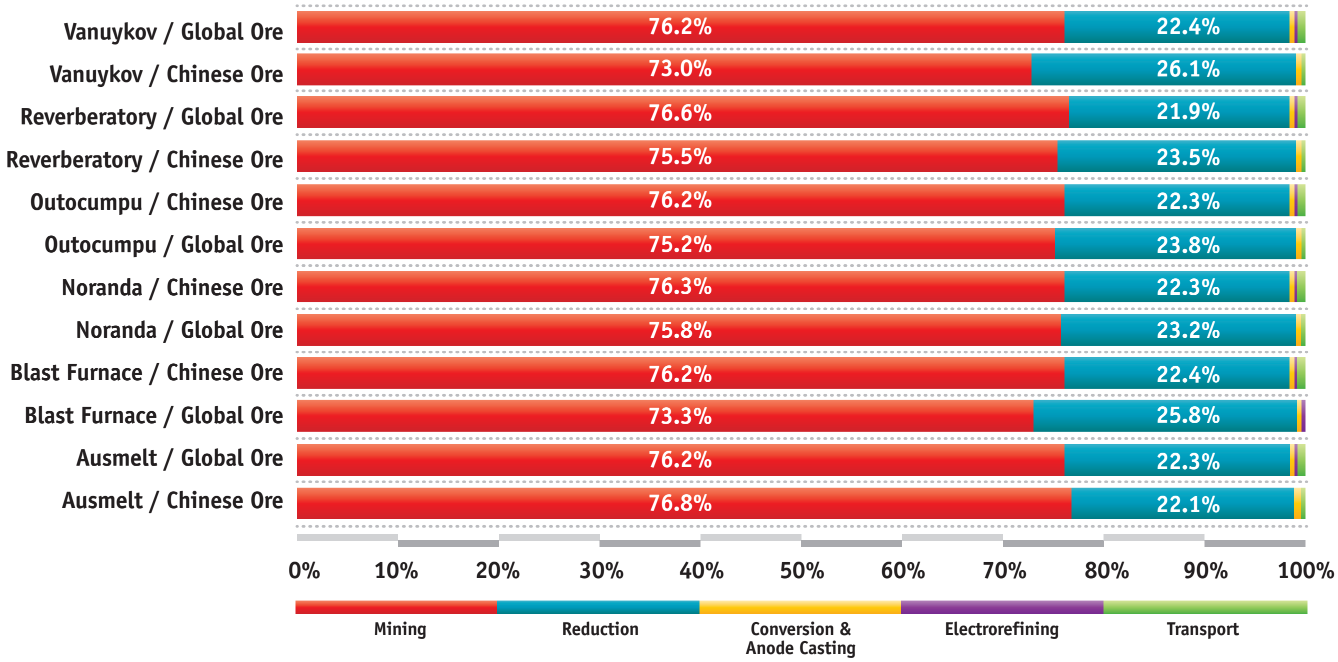


FIGURE 4: DISTRIBUTION OF THE ENVIRONMENTAL IMPACTS ACROSS THE COPPER SUPPLY CHAIN (BY PROCESSING LOCATION AND PROCESSING METHOD).

GLOBAL REPRESENTS GLOBAL AVERAGE. CHINESE REPRESENTS CHINESE AVERAGE.



The environmental impacts of the copper supply chain are concentrated at the mining stage of production which account for more than 75 per cent of overall environmental impacts. Impacts of Chinese-based production are either lower or equal to those of comparative global processes.

ENDNOTES

[1] International Copper Study Group (2009). *The World Copper Factbook.*

[2] Jolly, J.L. (2010). *The U.S. Copper-base Scrap Industry and its By-products.* Copper Development Association Inc.

[3] International Copper Study Group (2009). *The World Copper Factbook.*

[4] International Copper Study Group (2009). *The World Copper Factbook.*

[5] CRU Strategies (2010).

[6] As data was unavailable for Namibia in 2009, this value is from 2008.

[7] See http://www.iisd.org/pdf/2011/sustainable_development_chinese_copper.pdf. CNIA notes the number is significantly larger if related sectors are included.

[8] In 2009 China invested an estimated $4.6 billion in the mining sector. See Wang E. (2009, May). China's investment in Africa for copper production. IWCC Joint Meeting, Seoul. Available at http://www.thebeijingaxis.com/upload_files/download/Presentations/China's%20Investment%20in%20Africa%20for%20Copper_May2009.pdf

[9] Increasing demand is also creating increasing pressures on trading relationships.

[10] The diversity of uses of copper prevented the performance of a full copper lifecycle analysis at the supply chain level. The IISD commissioned "cradle to gate" lifecycle analysis was performed by EMPA and covered the copper supply chain from extraction to processing into semis (plates, rods, pipes etc.).

[11] See http://www.iisd.org/pdf/2011/sustainable_development_chinese_copper.pdf

[12] von Gleich, A., Ayres, R.U., & Gössling-Reisemann, S. (2006). *Sustainable metals management: Securing our future-steps towards a closed-loop economy.* Dordrecht: Springer.

[13] Note that the degree of actual impact varies depending on the local conditions and climate—many copper mines are in desert regions where land degradation impacts are reduced.

[14] Sustainably managed mines will reduce the long-term impacts of land degradation by taking remedial action following mine closure.

[15] See the International Network for Acid Prevention at www.inap.com.au for more info.

[16] Gaete, P. (2009, Dec.). Copper sector stands to double carbon dioxide emissions by 2020. *Business News Americas.* Retrieved from http://www.bnamericas.com/news/mining/Copper_sector_stands_to_double_carbon_dioxide_emissions_by_2020_-_Cochilco

[17] UNEP (2010). *Metal stocks in society: Scientific synthesis.* International Panel for Sustainable Resource Management, Working Group on the Global Metal Flows.

[18] While the informal recycling sector can expose workers to dangerous chemicals, it also provides significant employment and environmental opportunities for China. See IISD (2008). *Sustainable electronics and electrical equipment for China and the world: A commodity chain sustainability analysis of key Chinese EEE product chains.*