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Scrap Mining: An Overview of Metal Recycling in Canada

by Jay Fothergill[1], October 2004

In Canada, as elsewhere, mining exacts a severe and irreversible toll on the land. Many groups and individuals have documented the effect of mining practices on public health, water and air quality, fish and wildlife habitat, and community interests. If we hope to decrease our reliance on this activity while meeting our current and future metal needs, we must look at obtaining more of our raw materials from secondary sources — the only other terrestrial supply currently available. To that end, this report aims at assessing the current state of metals recycling in Canada to see what barriers exist to increasing this practice and in what areas gains are being made.

While virgin materials will remain the primary source of minerals and metals for a growing world demand, recycled materials are an increasingly vital component in the materials supply chain. Recycled materials account for between 30 and 60 percent of the total world consumption of metals and are a major component in the availability of minerals and metals for future generations as minerals and metals are not "consumed" in the way some other nonrenewable resources are. Although it may be years before they are recycled, most minerals and metals remain available for new uses.

Benefits of Recycling

The properties of metals provide a unique advantage for their reuse. Unlike other recycled materials, such as plastic and paper, metals are eminently and repeatedly recyclable without degradation of their properties. Metal from secondary sources is just as good as metal from primary sources.

Metals recycling, practiced since ancient times, embodies the spirit of sustainable development. That is, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs," as defined by the World Commission on Environment and Development (the Brundtland Commission). Recycling extends the efficient use of minerals and metals, reduces pressures on landfills and incinerators, and results in major energy savings relative to primary production.

This savings stems from two common processes in primary metal reduction. First, the comminution (particle size reduction) of minerals, often hard rock minerals, is usually necessary for subsequent physical and chemical treatment. About 60% of the total energy used in the production of most metals is consumed when crushing and grinding the ores. Second, primary production is premised on reducing metals from their chemically stable oxide or sulfide mineral form, an inherently energy intensive practice. Thermochemical reduction (e.g. iron ore in the blast furnace) is less demanding

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than electrolytic reduction but still requires higher temperatures than secondary smelting. Electrolytic reduction, used for aluminum and zinc, is very energy intensive. To illustrate, energy savings realized when metals are produced from secondary sources versus primary sources are: zinc, 60%; steel, 74%; lead, 76%; copper, 85%; aluminum, 95%.

Additionally, the reduction in pollution realized from recycling can be immense. For aluminum, there is a 79% material conservation, a 95% reduction in emissions and a 97% reduction of effluents through recycling.[2] For steel, one sees a 90% virgin materials savings, an 86% emissions reduction, a 40% effluent reduction, a 76% water pollution reduction and a 97% mining waste reduction through recycling.[3] Of course, many of these benefits also translate into substantial economic savings for producers.

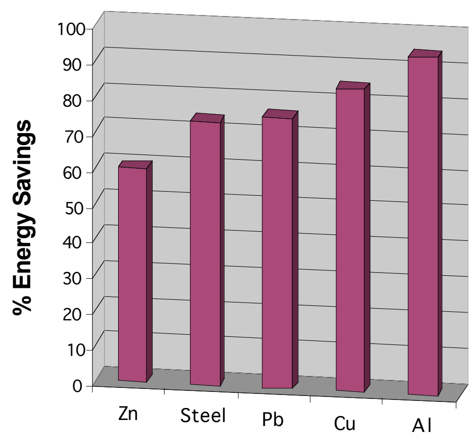

Figure 1: Energy savings from recycling

The Canadian metal recycling sector salvages an estimated 10 million tonnes of metal each year, valued at roughly $3 billion. Those in the industry say that recycling creates many more jobs than does landfilling and waste disposal.

When a recyclable metallic material makes up part of a stream emitted from an industrial facility, the material is referred to as "new scrap," signifying that it never comprises part of a final product. Recycling such new scrap within the same facility, or to another facility as a raw material, is a common example of waste minimization at source, widely accepted as the most efficient mode of pollution prevention. Reprocessing of "old scrap," material that has come to the end of its useful life, diverts this metal from disposal in landfill.

The increasing cost of landfilling, and the decreasing grade and increasing complexity of mineral reserves, will continue to tip the scales in favour of increased recycling.

Mining vs. Recycling

With no shortage of metal scrap in our country, why is it that our reliance on mining continues? A 1999 study by the Institute for Fiscal Studies (U.K.) concluded that our tax system "significantly

[2] U.S. Environmental Protection Agency.
[3] U.S. Institute of Scrap Recycling Industries.

favours the use of virgin materials rather than recycled materials in the case of metal and glass products".[4] This is exemplified by corporate income and mining tax incentives at the exploration and extraction stages of production, as well as by provincial sales taxes on capital and on business inputs, which are borne more heavily by scrap firms than by resource and manufacturing firms. Another report, prepared in 1995 for the Canadian Council of Ministers of Environment (CCME), found taxation by the federal and provincial governments demonstrated a bias against recycling[5]. The authors estimated that, for Ontario, recycled materials should be taxed at a rate 4.5% lower than at present in order to be taxed at the same rate as virgin minerals. Furthermore, to achieve optimal waste management the taxation rate for recycled materials would have to be 13 percentage points less than virgin materials.

Many organizations, including the federal Department of Natural Resources (NRCan), have recognized that Canada provides an especially favourable climate for mining. In 1994, NRCan released a study showing that Canada's taxation of the mining industry ranks in the low-to-middle range on an international scale, particularly when such factors as allowable accelerated capital cost allowances, tax deferrals, tax credits and tax holidays are taken into account. The authors concluded that the removal of corporate tax breaks, combined with the use of market-oriented mechanisms such as assessing taxes on the amount of waste material generated and water and energy used, could lead to a more efficient use of resources. MiningWatch Canada and the Pembina Institute have documented the value of public subsidies, both federal and provincial, to the metals mining sector in Canada (see their "Looking Beneath the Surface" report at www.miningwatch.ca/publications).

This raises an important question about policy priorities in our country. How much public money should go to support metals mining and how much to metals recycling? Canadian mining companies still receive large public subsidies and they spend huge amounts on exploration worldwide, estimated at $837 million for 2002 (based on larger companies accounting for 80% of exploration economic activity).[6] A small fraction of this spending would go a long way to establishing a greatly enhanced infrastructure for the recovery and processing of secondary metal products.

Recycling Industry Operation

Canada's metals recycling sector is mature and extensive and includes brokers, peddlers, collectors, processors and consumers. Figure 2 depicts the structure of this industry, represented by a triangle in which a large number of small and medium-sized enterprises form the base, these companies more frequently being involved with the collection and segregation of scrap. A smaller number of more sophisticated firms, including the capital intensive primary and secondary smelters, occupy the apex.[7]

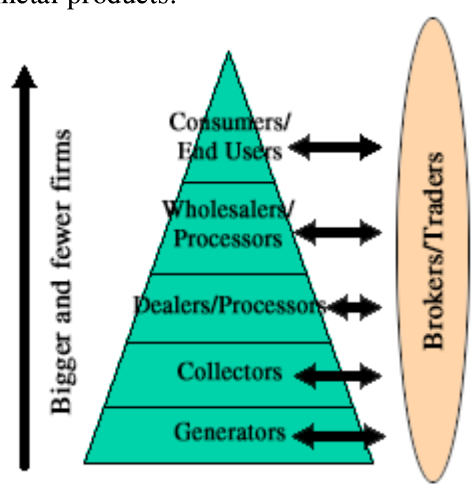

Figure 2: Metals Recycling Industry Structure

[4] K. Scharf, "Tax Incentives for Extraction and Recycling of Basic Materials in Canada", Fiscal Studies, 20(4), pp 451-477, 1999.
[5] EMCBC publication, "Protecting the Future through Action Today", http://www.miningwatch.org/emcbc/publications/mineral_efficiency.htm (30/08/2004).
[6] NRCan publication "Canadian Exploration Activity Around the World" http://www.nrcan.gc.ca/mms/pdf/explor/2003/3.03-e.pdf (30/07/2004).
[7] NRCan web site. http://www.recycle.nrcan.gc.ca/structure_e.htm (30/07/2004).

According to a 1993 report prepared for NRCan, our industry is similar to that of the United States, Europe and Japan. For that report, it was found that "a total of 344 firms were identified across Canada that are involved in the collection, sorting, recycling, and reprocessing of metal-bearing scrap, by-products and waste," which is taken to include all metals recycling services. The current estimate by NRCan, however, is that 2800 firms are involved in the recycling of metals. Therefore, even if some services in this sector were not included in the 1993 assessment, a major increase in the number of enterprises operating in the industry has been seen in the past decade. It is worth mentioning that the report made recommendations regarding regulatory and policy initiatives that could improve the operation of the metals recycling industry and these included:

- evaluate the merits of requiring manufacturers to take back their expired products in achieving waste diversion targets and, ultimately, redesign for recycling;
- evaluate the merits of enacting policies that mandate or indicate preference to products which have recycled content and for which a recycling infrastructure exists;
- resolve the legal definition of waste versus by-product as soon as possible.

The recycling sector is very segmented, with secondary smelters targeting easy to process scrap to maintain profit margins, i.e. copper and brass, used aluminum beverage cans, stainless steel scrap, etc. Scrap that is difficult to process and requires several processing steps still ends up at primary smelters. Primary smelters are well equipped to recycle complex metallic composite materials, such as electronic waste, and the refining facilities enable the extraction of all the values including precious metals.

Barriers to Resource Recovery

One major impediment to tracking down the scrap metal in Canada, and to determining recycling rates, is that "currently, flows of recycled or recyclable materials in Canada are generally poorly characterized," according to NRCan's web site. While Statistics Canada and NRCan both collect some specific information, "neither [department] collects comprehensive information on the demand for all recycled/recyclable materials. Likewise, neither department collects a significant amount of information on the supply of recycled/recyclable materials". The collection of this information is improving, however, in part because the federal government has identified improving and enhancing recycling activities as a priority in its Minerals and Metals Policy, and partially under our commitments to provide recycling data for official OECD environmental statistics. It is certain that other international organizations will also increase requests for such information in the future. For example, the United Nations Commission for Sustainable Development is currently establishing a set of indicators that will require recycling statistics. Another project seeking to identify the material flows of certain metals in all continents, and around the world, is underway at Yale University and will be discussed later in this report.

The barriers to improving our rates of recycling in Canada are in part geographic. Our huge landmass and low population density mean increased costs for material recovery as compared to Europe, for example, where a more extensive transportation infrastructure is in place. Recyclable materials generally amass in urban centres, where most waste is created, but the smelters are generally located close to mine sites, in rural areas, thus necessitating transport over great distances. These costs of recovery and transport mean that a theoretical maximum rate of recycling would be reached where such costs outweigh the energy, and other, savings from recycling. This was found in a study conducted in France and, as a result, both minimum and maximum rates of recycling were proposed.

Despite this, we are far from such a theoretical maximum rate and the benefits to be gained are more than monetary.

It is the mining industry position that "the pace of growth in global economy and demand for resources suggests that raw materials will remain the primary source of mineral and metal commodities".[8] In a response to the Government of Canada's 2002 strategy on innovation and economic growth, the Mining Association of Canada cites that metal producers already use a great deal of secondary materials in their operations, but they agree that metals recycling has not achieved its full potential. Current regulations limit recycling because many recyclable materials are caught in regulations that have been designed for hazardous wastes, they say, inhibiting their use as recycling feed.

The Canadian Association of Recycling Industries (CARI) sees it the same way. Government regulations rely on a system based on chemical characteristics (e.g. leachability, radioactivity, etc.) to determine whether a waste stream will be classified as hazardous or not. But if a waste material is headed for reprocessing and will never end up in a landfill, what is the importance of its leaching behaviour? While such characterization is valuable, we should instead be using a system based on risk assessment, suggests CARI president, Leonard Shaw, in which the risks are identified and managed appropriately. Lead, for example, is used in many everyday settings, such as hospitals, where specific procedures are outlined to obviate its potential hazards accordingly. The same system should be used when recovering waste lead, in his opinion, to avoid the material being saddled with the catch-all title "hazardous waste" wherein the costs of handling and shipping increase three-fold.

One impediment to the transport of recyclable materials commonly cited by the recycling industry is the Basel Convention. The agreement came into force in 1992 and was signed by 108 countries in an attempt to curb the transport of hazardous waste to developing countries and Eastern Europe, as began to happen in the late 1980s when environmental laws were being strengthened in industrialized nations.[9] The convention defines recycling as a "disposal" activity and recyclable materials as "wastes". It is a continuing concern for Canadian and other government representatives that the Convention does not adequately distinguish between recyclable materials, destined for recovery operations, and hazardous wastes, destined for final disposal.[10] For example, used lead-acid batteries are considered hazardous waste under the convention and, as a result, material from such batteries can only make its way from an industrialized country to a developing country if a special agreement between the two is in place. Critics say that this deprives poorer nations of this cheap source of lead, forcing them to import the metal as lead concentrate if the rules are followed.

Despite the inefficiencies this may cause, the Basel Action Network (BAN), an organization devoted to researching the toxics trade, is unapologetic about this non-distinction and "considers the reference to waste-recycling to be a crucial one as it is well known that virtually all actual or intended hazardous waste exports from rich to poor countries is now justified under the name of "recycling"[11]. The recycling, however, is either a complete sham or involves some of the world's most polluting industries such as shipbreaking and mercury and lead waste recycling, they state. Recycling facilities in poorer countries, such as India, are often inadequately equipped to protect human health from

[8] Mining Association of Canada, "Resource Recovery, Recycling and Mining Innovation", Briefing Note, Sept. 2002. http://www.mining.ca/english/publications/recycling.pdf (30/07/2004).
[9] http://www.basel.int (23/07/2004).
[10] http://www.nrcan.gc.ca/mms/cmy/content/1997/07.pdf (30/07/2004).
[11] BAN April 2001 press release. http://www.ban.org/ban_news/ban_applauds.html (30/07/2004).

harmful substances released in the process. Additionally, much of what is shipped as recyclable waste, such as plastics and computer waste, is unrecyclable and simply gets dumped in the receiving country.

Under the convention, Canada may only trade hazardous waste with other signatories to the convention or countries with which Canada has a bilateral/multilateral agreement. Other international and interprovincial agreements on the movement of hazardous materials are now being modeled on the Basel Convention, which worries those in the recycling industry who fear the same inefficiencies will be perpetuated.

Another problem with recovering secondary metals is the inability to separate them efficiently from other materials in a product. Separation technologies employ physical and magnetic separation techniques.

Re-thinking for Recycling

Leonard Shaw of CARI also calls for government to play a stronger role, first, in promoting more intelligent product design for resource recovery and, second, enhancing product stewardship through such tools as extended producer responsibility. When the entire life cycle of a product is considered, smarter instruments can be used to reduce obstacles to recycling. For example, European and Japanese automakers have had a ban on mercury-containing switches for years, but their American counterparts have only recently begun to phase them out and they continue to use mercury in braking and entertainment systems, despite the well-known toxicity of the metal. It is the auto scrapping industry that has to deal with such hazardous materials at the end of a car's life. Instead of legislating design requirements for easier disassembly and recycling, or mandatory product take-back by manufacturers at end-of-life, we generally rely on market forces to get scrap metal back into production and close the loop. Inevitably, products that are more expensive to process go by the wayside and are landfilled because it is uneconomical to do otherwise.

The programs that are in place, says Shaw, are all geared to the supply side of the materials equation, focusing on recovery and reprocessing. He believes attention needs to be given to the demand side so that recycled material has a dependable market. Green procurement programs that set guidelines for minimum recycled content in various products is one example. The federal government has proposals for a green procurement policy in their sustainable development strategy and should be leading by example in this regard. Ecolabelling that shows the recycled content (along with recyclability) of a product is another example.

Federal Programs

Federally, Natural Resources Canada oversees most of the work on industrial recycling, while Environment Canada coordinates more of the programs that affect consumers. As part of Canada's commitments under the Kyoto Protocol to reduce greenhouse gas (GHG) emissions, new initiatives are underway to increase metals recycling because of the energy offsets to be realized, as discussed above.

The Enhanced Recycling program is a 5-year, $3.4 million initiative specifically focused on steel, aluminum and magnesium, because of their high rate of GHG generation in production.[12] For example, a tonne of aluminum produces four tonnes of GHGs and a tonne of steel produces 0.8 tonnes of GHGs.[13] Accordingly, small increases in their rates of recycling would yield substantial benefits. The government is working with industry and other stakeholders to find ways to increase the recycling of aluminum by 100,000 tonnes per year (tpy) and of steel by 200,000 tpy to yield total GHG reductions of 700,000 tpy of CO_2 equivalent. Industry is helping to fund some of the projects, perhaps realizing that an investment in a government-led initiative now could produce significant savings down the road. The Enhanced Recycling initiative comprises over 30 programs now on the books, which should be appearing on the NRCan web site in the future.

Michael Clapham, of the Minerals and Metals Policy division of NRCan, coordinates the Enhanced Recycling initiative, one program within which is the National Resource Recovery Strategy (NRRS), started as part of the 2000 Action Plan on Climate Change. The goal of the NRRS is to take stock of existing reserves of recoverable material and to improve diversion rates from landfill. Part of this strategy aims at reclassifying streams as recyclable material, if they are going to recovery, instead of as waste material, headed for final disposal. Meetings were held across Canada with industry, local government, non-governmental organizations and the public to identify the most efficient and cost-effective projects to increase recycling of commodities and many of the projects are underway. One project highlighted by Mr. Clapham involves the shipment of waste diesel fuel drums from Iqaluit to Churchill, Manitoba, where they are then taken by rail to recycling facilities further south. Large quantities of scrap metal in northern communities such as this are a major environmental challenge facing the government.

Provincial Role

The provinces oversee blue box programs for the recovery of recyclable household wastes, aluminum and steel (often coated) being the only collected metals and representing the higher value items in the box. Ontario's new system includes a funding plan in which industries producing the recyclable materials pay for half the net costs of running the municipal programs. Many provinces have a similar shared responsibility system in place already. British Columbia and Québec report the highest recovery rates in the country, while Nova Scotia's extensive program has seen its rates make significant increases. Legislation in Ontario has created Waste Diversion Ontario, a non-governmental body with representatives from the major recyclable materials sectors. Its aim is to achieve 60% recycling rates for all blue box materials by 2008. Currently, aluminum packaging is recycled at a rate of 60-65%, which is well below recycling leaders, such as Switzerland (91%), but ahead of the UK (42%).

The provinces also oversee take-back programs for specific material streams, though this has been limited to batteries and beverage cans for metal products. Alberta has implemented the first provincial waste electronic and electrical equipment recycling program, which, for now, is limited to computers and fluorescent bulbs.

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[12] Action Plan on Climate Change 2000 annual report.

[13] R. Sage, "Implications of Canada's GHG Programs for Metals and Recycling Industries", CANMET-CARI-European Commission Environmentally Clean Technologies for Sustainable Production and Consumption Workshop Proceedings, NRCan, 2003.

Industry Initiatives

The lengthy history of metals recycling demonstrates that domestic and international trade in recyclable metals and metals-bearing recyclable materials generally operates on a commercial basis. There is a great amount of money being made from our vast supply of scrap metal in Canada, but the limitations of the market are well known.

The recycling of e-waste or waste electronic and electrical equipment (WEEE) is an emerging area of activity for metals recycling because of the incredible glut of this material. Aluminum, **antimony, arsenic**, barium, beryllium, **cadmium**, **chromium**, **cobalt**, copper, gallium, gold, iron, **lead**, manganese, **mercury**, palladium, platinum, **selenium**, silver, and zinc are all used, with eight of these metals (in bold) considered to be hazardous. Along with the plastics inevitably contained in shredded WEEE, the material can be a toxic mix when smelted. For this reason, WEEE is classified as a hazardous material. Industry takes issue with such classifications when the material is one that can be used as a raw material for recycling. In a presentation to the Mines Ministers Conference in 2002, Noranda stated that "government regulations must reflect government policy". Furthermore, "current proposals for interprovincial regulations and amendments to the *Export and Import of Hazardous Waste Regulations* fail to address real barriers to increased recycling in Canada."[14]

Still, Noranda began "mining" metals from waste electronics because of the comparatively lower levels of arsenic, mercury and sulphur common to ore, and the precious metals to be recovered. By 1999, they were North America's largest recycler of this material, receiving more than 50,000 tpy of electronic scrap. Noranda's findings indicated that the concentration of some metals in average computer and other electronic scrap may be more than twice that found in ores. Recycled material provides on average about 15% of the feed for Noranda's smelters in Canada.

Inco has also realized the value of secondary metal materials and has opened one of the only Ni-Cd and Ni-MH battery recycling facilities in North America. The plant, Inmetco, processes thousands of tons of nickel-, chromium-, iron-, molybdenum- and cadmium-bearing wastes each year. About 90% of the manufacturers of rechargeable batteries contribute to the voluntary *Recyclable Battery Recycling Corporation* for their recovery. Recycling options for conventional, disposable batteries, such as alkaline, zinc carbon and mercuric oxide, are still in their infancy. Mercury was banned from batteries in 1996.

Major Metals at a Glance

Steel

Steel is by far the most common metal in the world, its production exceeding by a factor of 20 that of aluminum, the second most common metal. The recycling rate for steel is 50-65%.[15] In the last decades, the decline of integrated plants, which primarily use virgin iron ore for the production of new steel and iron, and the rise of mini-mills, which use steel scrap as their primary input, shows that an incredible quantity of secondary ferrous products exist that is proving to be an economical raw material for new steel production.

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[14] Noranda/Falconbridge, "Creating A Sustainable and Viable Metals Recycling Industry in Canada" Brief, Presentation to the 59th Annual Mines Ministers Conference, Winnipeg, Manitoba, 2002.
[15] Lower figure from NRCan, higher figure from Dofasco.

Stainless steel has a higher value than normal carbon steels and is recycled at a higher rate, its recovery aided by its simple recognition thanks to the stability of this alloy. Nickel is the major alloying element in stainless steel and, accordingly, this is the primary usage of nickel.

Cars are recycled at a high rate according to the Ontario Automotive Recyclers Association.[16] With 76% of an average car's content being recycled (i.e. parts resale and materials recycling), the Association claims that no other complex mass-produced article has achieved such a high rate of recycling. However, North America still lags behind many European countries and Japan with respect to proactive recycling initiatives for automobiles. They use a combination of dumping taxes, waste disposal fees on sale, minimum recycling rates, and take-back laws to increase the rate of recovery of all materials in cars. Such measures lead to improved design for the disassembly of vehicles at their end of life.

White metal, used in household appliances, is also recovered to a large degree, according to NRCan's Michael Clapham. The regulated collection of CFCs from refrigerators, however, has meant increased costs for their recycling, which are often shouldered by the recycler. Because of the complications, some scrap yards will no longer accept refrigeration units. This is one example of a hazardous substance reducing the recycling rate of a product.

The construction and demolition sector uses steel, primarily, and is an area where recovery rates need substantial improvement.

Aluminum

The recycling rate for aluminum is about 30%. The capital investment required for a given output of recycled aluminum is only 10-15% of that required for the production from the bauxite raw material. About 14 kWh of electrical energy is required to produce one kilogram of primary aluminum by electrolysis, making it one of the most energy intensive metals. The energy requirements and greenhouse gas production provide a great incentive for increased aluminum recycling. It also means aluminum products have value – aluminum pop cans are the most valued item in our blue boxes and their value to aluminum producers helps subsidize the cost of recycling other lower value materials.

The transportation sector is the largest user of aluminum. Its usage in cars and light trucks has doubled in the last decade in the pursuit to produce lighter, more fuel efficient vehicles. The next largest aluminum users are packaging, construction materials and electrical products.

Copper

Over 40% of the current copper consumption in Canada is produced by recycling processes from secondary materials such as copper, brass, bronze, red brass scrap as well as copper bearing ashes, slimes and sludges.[17] Depending on the purity of the scrap the energy required to recycle is anywhere from 3-40% of the energy needed to produce copper from primary resources.[18] For Noranda, one of the largest copper recyclers in the world, recycled material makes up only 10% of its total refined

[16] http://www.oara.com (30/07/2004).
[17] G.V.K. Puvvada, R. Sridhar and V.I. Lakshmanan, "Recycling – An Essential Enterprise for Resource Conservation and Sustainable Development", Proceedings from Environmentally Clean Technologies for Sustainable Production and Consumption Workshop, Vancouver, NRCan, 2003.
[18] E. Gustovic, G. Fletcher, R. Kommel and U. Lembke, "Copper recovery from secondary materials in the shaft furnace with used automobile tire additions", Resource Conservation and Recycling, Vol. 10, No. 2/3, pp 93-98, 1987.

copper production. Being a higher value metal, many secondary smelters can exist that reprocess scrap copper to provide refined copper.

Most copper exists in the form of wiring and piping. The copper wiring in our telecommunications system is a huge reserve waiting to be mined, should trends continue towards increased use of optical fibres. One coordinated effort between NRCan and Public Works and Government Services Canada is aimed at the recovery of copper wiring and plumbing from government facilities.

The Stocks and Flows Project (STAF) at Yale University's School of Forestry and Environmental Studies has charted the anthropogenic flows of copper and zinc for the globe.[19] This work will be very helpful for tracking the movement of metals and will extend to many more metals in the future, should funding allow. The researchers found that the rate of use of copper has risen rapidly in recent decades and that copper's depletion time (reserves divided by annual use) is no more than 30-50 years. As much as 85% of the copper produced in the 20th century is still in use. The copper in production wastes currently approaches the quantity in post-consumer wastes, but the latter will dwarf the former over time as large in-use stocks reach the end of their lives. The greatest potentials for copper recycling are those with low magnitude flows but high copper concentrations – electronics, electrical equipment and vehicles. The researchers also found that about 53% of the copper that was discarded in various forms was recovered and reused or recycled, globally. About as much copper as was landfilled was lost in mine tailings, and nearly 30% of copper mining was merely to replace copper that was discarded.

Zinc

Zinc is the fourth most widely used metal in the world following iron, aluminum, and copper and, like aluminum, is very energy intensive, using 16.9 kWh of energy per kilogram for its production. Recycling captured 41% of the worldwide discard flow, as found by the Stocks and Flows Project.[20] Of the 7,800 kt of zinc contained in ore mined worldwide, 17% was lost in conversion to metal and another 17% was lost or recycled in fabrication and manufacturing leaving 6,970 kt to enter use. Since only a third as much left use in the form of discarded products, the stock of zinc in use throughout the global economy grew substantially. It is primarily used as a coating to produce galvanized steel, but also finds use alloyed with copper to produce brass and in castings and pharmaceuticals (mostly sunscreens). Zinc-containing electric arc furnace dust is considered a hazardous waste because of its high concentrations of lead and cadmium, and represents a major pollution problem for the steel industry. Research into how best to recover and reprocess this material, produced at a rate of 550,000 short tons per year in the U.S., is ongoing. As the zinc is valuable, dusts with lower zinc content are the real challenge.

Lead

Lead is one of the most recycled and recyclable of all metals. The 1994 NRCan commodity review stated that "more than 90% of all the lead consumed in Canada can be economically recycled." Figures for 2002 show that about 47% of refined lead came from recycled scraps, wastes and residues.[21] Globally, battery recycling accounted for 60% of annual production.

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[19] http://research.yale.edu/stafproject/index.html (30/07/2004).

[20] R.B. Gordon, R.J. Lifset, M. Bertram, B. Reck, S. Spatari, and T.E. Graedel, "Where is All the Zinc Going?: The Stocks and Flows Project, Part 2", JOM, 56(1), pp 24-29, 2004.

[21] NRCan Mineral and Metal Commodity Reviews. http://www.nrcan.gc.ca/mms/cmy/content/2002/33.pdf (30/07/2004).

The reason for these high rates is that the majority of lead, about 70%, is used to produce lead-acid batteries; the average automotive lead-acid battery contains 10 kg of the metal. As well, the life of a battery is short, about 2 to 3 years. The surcharge on automotive batteries is one example of a provincially administered program, implemented nationwide, funded in whole or in part by industry and consumers. A $5 fee is levied on sales to fund the cost of the product's recycling at the end of its useful life and is cancelled if a used battery is returned. The supply of secondary lead is dependable and predictable thanks to such regulations.

Conclusion and Recommendations

The recycling of metal is primarily market-driven in Canada and this will continue to be the case for the foreseeable future, and the recycling sector is strong. This strength, however, is mostly a reflection of consistently increasing metals consumption and waste production. As long this is the case, and as long as scrap prices remain high, our recycling rates should see at least a marginal yearly improvement.

The government has seemingly played a rôle in the past where there is excessive waste production in a sector or region, where a human health risk is contemplated, or where international obligations demand action. With Canadians having the third greatest ecological footprint in the world[22], behind only the United States and the United Arab Emirates, and with our environmental record worsening with respect to other OECD countries[23], it is time for the government to do more in metals recycling.

First, Canada should be striving to improve its recycling infrastructure so that transport of recyclables is abetted. Cheap scrap collection is necessary for effective recycling and government regulations should work to expedite this collection. This is especially important for northern communities.

Second, the taxation system should be reviewed and overhauled to remove any systemic biases against recycling and to provide a level of taxation for recycled materials that is lower than for virgin materials.

Third, the life-cycle analysis of products should continue so that all material and energy flows to and from the environment are determined for our most polluting products and processes. To not do and act on the results of such analyses is simply negligent and short-sighted, especially in the case of hazardous substances. This work will help identify efficiencies to be achieved and barriers to downstream recycling of products.

Fourth, effective legislation or incentives need to be implemented to enhance producers' responsibility for their products. This could manifest itself in improved design for recycling, mandatory recycling rates, more take back programs (e.g. deposit and refund), and other instruments.

Fifth, mechanisms could be introduced to ensure stable markets for recycled metals, such as minimum recycled content in products. Government could institute firm green procurement principles so that they are purchasing products with an improved ecological footprint.

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[22] Federation of Canadian Municipalities (FCM), "Ecological Footprints of Canadian Municipalities and Regions", www.fcm.ca/english/communications/sept292004.html (29/09/2004).
[23] David R. Boyd, "Canada vs . the OECD: An Environmental Comparison", University of Victoria, 2001.
Also: Organisation for Economic Co-operation and Development (OECD), "OECD Review of Canada's Environmental Performance: Good Progress, Much to Be Done" on www.oecd.org (29/09/2004).