The Inherent Recycled Content of Today's Steel

This paper provides an overview of the methods used to produce steel in North America today, and describes steel's inherent recycled content. Contemporary technologies produce steel in two ways, both of which require old steel to make new.

The basic oxygen furnace (BOF) process uses 25 to 35 percent old steel to make new. It produces products--such as automotive fenders, encasements of refrigerators, and packaging like soup cans, five-gallon pails, and 55-gallon drums--whose major required characteristic is drawability.

The electric arc furnace (EAF) process uses virtually 100 percent old steel to make new. It produces products--such as structural beams, steel plates, and reinforcement bars--whose major required characteristic is strength.

Many are surprised to learn that steel is the world's, as well as North America's, most recycled material, and in the United States alone, nearly 70 million tons of steel were recycled in 2000. This is done for economic as well as environmental reasons. It is always cheaper to recycle steel than to mine virgin ore and move it through the process of making new steel. However, it should also be clearly understood that many steel applications are durables, and even though two out of every three pounds of new steel are produced from old steel, the fact that cars, appliances, and bridges last a long time makes it necessary to continue to mine virgin ore to supplement the production of new steel. Economic expansion, domestically and internationally, creates additional demand that cannot be fully met by available scrap supplies.

Unlike other competing industries, recycled content in the steel industry is second nature. The North American steel industry has been recycling steel scrap for over 150 years through the 1,800 scrap processors and some 8,000 auto dismantlers. Many of them have been in the business since the turn of this last century.

The pre-consumer, post-industrial, post-consumer, and total recycled content of steel products in the United States can be determined for the calendar year 2000 using information from the American Iron and Steel Institute (AISI), the Institute of Scrap Recycling Industries (ISRI), and the U.S. Geological Survey. Additionally, a study prepared for the AISI by William T. Hogan, S.A., and Frank T. Koelble of Fordham University is used to establish pre- and post-consumer fractions of purchased scrap.

Individual company statistics are not applicable or instructive because of the open loop recycling capability that the steel and iron industries enjoy, with available scrap typically going to the closest melting furnace. This open loop recycling allows, for example, an old car to be melted down to produce a new soup can, and then, as the new soup can is recycled, it is melted down to produce a new car, appliance, or perhaps a structural beam used to repair some portion of the Golden Gate Bridge.

Basic Oxygen Furnace

The basic oxygen furnace (BOF) facilities consumed a total of 18,848,000 tons of ferrous scrap in the production of 59,485,000 tons of liquid steel during 2000. Based on U.S. Geological Survey statistics, 4,353,000 of these ferrous scrap tons had been generated as unsalable steel product within the confines of these steelmaking sites. In the steel industry, these tons are classified as "home scrap," but are a mix of pre-consumer scrap and post-industrial scrap. Estimates by the Steel Recycling Institute identify about 80% of this home scrap as post-industrial scrap, equating to 3,482,400 tons (4,353,000 x 80%). Additionally, these operations reported that they consumed 165,000 tons of obsolete scrap (buildings and warehouses dismantled on-site at the mill) during this time frame. This volume is classified as post-consumer scrap.

For more information, please contact the Steel Recycling Institute at 1-800-876-7274, or visit us online at www.recycle-steel.org.

As a result of the above, based on the total scrap consumed, outside purchases of scrap equate to 14,330,000 tons [18,848,000 - (4,353,000 + 165,000)]. According to the Fordham University study, the post-consumer fraction of the purchased ferrous scrap would be 83.4 percent, while 16.6 percent of these purchases would be pre-consumer. This equates to 2,378,800 tons of pre-consumer scrap (14,330,000 x 16.6%). This "prompt scrap" is mainly scrap generated by manufacturing processes for products made with steel. It is also considered post-industrial scrap.

Therefore, the **total recycled content** to produce the 59,485,000 tons of liquid steel in the BOF is:

18,848,000 / 59,485,000 = 31.7%
(Total Tons Ferrous Scrap / Total Tons Liquid Steel)

Also, the **post-consumer recycled content** is:

(14,330,000 - 2,378,800) + 165,000 = 12,116,200
and
12,116,200 / 59,485,000 = 20.4%
(Post-Consumer Scrap / Total Tons Liquid Steel)

Finally, the **post-industrial recycled content** is:

(3,482,400 + 2,378,800) / 59,485,000 =
5,861,200 / 59,485,000 = 9.6%
(Post-Industrial Scrap / Total Tons Liquid Steel)

Electric Arc Furnace

The electric arc furnace (EAF) facilities consumed a total of 47,724,000 tons of ferrous scrap in the production of 49,997,000 tons of liquid steel during 2000. Based on U.S. Geological Survey adjusted statistics, 12,401,000 of these ferrous scrap tons had been generated as unsalable steel product within the confines of these steelmaking sites. Again, in the steel industry, these tons are classified as "home scrap," but are a mix of pre-consumer scrap and post-industrial scrap. Estimates by the Steel Recycling Institute identify about 80% of this home scrap as post-industrial scrap, equating to 9,920,800 tons (12,401,000 x 80%). Additionally, these operations reported that they consumed 49,000 tons of obsolete scrap (buildings and warehouses dismantled on-site at the mill) during this time frame. This volume is classified as post-consumer scrap.

As a result of the above, based on the total scrap consumed, outside purchases of scrap equate to 35,274,000 tons [47,724,000 - (12,401,000 + 49,000)]. According to the Fordham University study, the post-consumer fraction of the purchased ferrous scrap would be 83.4 percent, while 16.6 percent of these purchases would be pre-consumer. This equates to 5,855,400 tons of pre-consumer scrap (35,274,000 x 16.6%). This "prompt scrap" is mainly scrap generated by manufacturing processes for products made with steel. It is also considered post-industrial scrap.

Therefore, the **total recycled content** to produce the 49,997,000 tons of liquid steel in the EAF is:

47,724,000 / 49,997,000 = 95.5%
(Total Tons Ferrous Scrap / Total Tons Liquid Steel)

Also, the **post-consumer recycled content** is:

(35,274,000 - 5,855,400) + 49,000 = 29,467,600
and
29,467,600 / 49,997,000 = 58.9%
(Post-Consumer Scrap / Total Tons Liquid Steel)

Finally, the **post-industrial recycled content** is:

(9,920,800 + 5,855,400) / 49,997,000 =
15,776,200 / 49,997,000 = 31.2%
(Post-Industrial Scrap / Total Tons Liquid Steel)

The above discussion and calculations demonstrate conclusively the inherent recycled content of today's steel in North America. To buy steel is to "Buy Recycled."

Understanding the recycled content of BOF and EAF steels, one should not attempt to select one steel producer over another on the basis of a simplistic comparison of relative scrap usage or recycled content. Rather than providing an enhanced environmental benefit, such a selection could prove more costly in terms of total life cycle assessment energy consumption or other variables. Steel does not rely on “recycled content” purchasing to incorporate or drive scrap use. It already happens because of the economics. Recycled content for steel is a function of the steelmaking process itself. After its useful product life, regardless of its BOF or EAF origin, steel is recycled back into another steel product. Thus steel with almost 100 percent recycled content cannot be described as environmentally superior to steel with 30 percent recycled content. This is not contradictory because they are both complementary parts of the total interlocking infrastructure of steelmaking, product manufacture, scrap generation and recycling. The recycled content of EAF relies on the embodied energy savings of the steel created in the BOF. Steel is truly the most recycled material.

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TO: Architects, Engineers, Designers, And Specifiers

RE: LEED Documentation of Recycled Content for Steel Building Material Products

LEED™ is Leadership in Energy & Environmental Design. LEED Green Building Rating System(tm), as promulgated by the U.S. Green Building Council, is to improve environmental and economic performance of commercial buildings using established or advanced industry principles, practices, materials, and standards. LEED Green Building Reference Guide(tm) serves as the supporting document.

The intent of **Materials Credit 4: Recycled Content** is to increase demand for building products that have incorporated recycled content, thus reducing the impacts from extraction of new material. Steel positively contributes to attaining the two available points, because of "The Inherent Recycled Content of Today's Steel", as explained in more detail in the companion fact sheet of the same name. Although LEED does not provide a credit for recyclability of recycled content products, steel is fully recyclable at the end of its useful life.

Credit 4.1 (1 point) "Specify a minimum of **25%** of building materials that contain in aggregate, a minimum of weighted average of **20%** post-consumer recycled content material, OR, a minimum weighted average of **40%** post-industrial recycled content material."

Credit 4.2 (1 point) "Specify an additional 25% (**50%** total) of building materials that contain in aggregate, a minimum weighted average of **20%** post-consumer recycled content material, OR, a minimum weighted average of **40%** post-industrial recycled content material."

The **Recycled Content** percentage for the overall project is documented with a spreadsheet that lists all building materials with their dollar values, and then, on the basis of dollar value, calculates the percentage of recycled content building materials compared to all materials.

Recycled Content $ = (Material Cost)(%Post Consumer/20% + %Post Industrial/40%)

Steel building materials of all kinds are applicable, including light gauge steel framing (loadbearing and non-loadbearing), structural steel (wide flange, beam, channel, angle iron), rebar, doors and sashes, windows, roofing, fixtures, ductwork, piping, hardware (hinges, handles, braces, screws, nails), storm drains, and manhole covers. Representative products from the Basic Oxygen Furnace and Electric Arc Furnace are calculated below for $10,000, with data from the companion fact sheet, "The Inherent Recycled Content of Today's Steel".

Basic Oxygen Furnace Typical Product: Light Gauge Steel Framing

R/C $ = ($10,000)(20.4% / 20% + 9.6% / 40%) = ($10,000)(1.02 + 0.24) = $12,600

Electric Arc Furnace Typical Product: Structural Wide Flange

R/C $ = ($10,000)(58.9% / 20% + 31.2% / 40%) = ($10,000)(2.95 + 0.78) = $37,300

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