

Steel Takes LEED® with Recycled Content

steel beams and columns

Designers and builders have long recognized and lauded steel for its strength, durability, and functionality. Increasingly, however, architects and engineers are recognizing steel's important environmental attributes—especially its high recycled content and high recovery rate.

steel studs

For many years, there has been a strong economic motive to incorporate recycling into the process for making steel, but today's environmental concerns make recycling even more important. Recycling saves money while conserving energy and other resources, as well as reducing solid, liquid, and gaseous wastes.

steel roofing

steel decking

steel doors

Recycled content is a measure of how much recycled material is contained in a finished product. On the other hand, the efficiency with which a material is recycled is indicated by its *recovery rate*. This is a measure of how often a product is recycled at the end of its useful life. Steel's high recovery rate is a direct result of the fact that it is a cradle-to-cradle material constantly being multi-cycled into the array of steel products in our economy.

ductwork

steel siding

corrugated steel pipe

Thus, steel is an exceptional performer by both measurements. In the construction industry, increased interest in recycling has been driven largely by the U.S. Green Building Council's *Leadership in Energy and Environmental Design* (LEED®) rating system. The LEED rating system provides credit for the use of materials with high levels of recycled content. No credits are granted for the equally important recovery rate of the materials. However, the International Green Construction Code considers both the recycled content and the recovery rate of materials.

other steel components

Scrap consumption in the United States is maximized between the two types of modern steel mills, each of which generates products that are 100% recyclable and therefore contribute to steel's high recovery rate. One process produces much of the steel for light flat-rolled steel products, with about 30% *recycled content*. The other process makes steel for a wide range of products, including flat-rolled, but is the only method used domestically for the production of structural shapes, which have over 90% *recycled content*. (These processes are covered in detail on the following pages.)



American Iron and Steel Institute

The amount of recycled content in steel products will vary as a function of the cost and availability of steel scrap, as well as metallurgical requirements. As the worldwide demand for steel increases, the available scrap will be stretched among more and more steel products, meaning that more steel from virgin materials will enter the production stream to meet the demand. However, because of steel's high recovery rate, more scrap will also be available for future recycling, thus minimizing the long-term amount of virgin material required.

In addition to recycled content, steel can contribute toward several other LEED credits, either directly or indirectly. Steel is dimensionally stable and, when properly designed, can provide an exceptionally tight building envelope for less air loss and better HVAC performance over time. Steel is made to exact specifications, so on-site waste is minimized. Material from demolition or construction can be easily recycled, with the magnetic properties of steel greatly facilitating its separation from other materials. Thus, in addition to its outstanding recycled content and an enviable recovery rate, steel's other functional properties contribute to the material's solid environmental performance.

As with any building process or material, there are areas for improvement. A great benefit of LEED is that it can help the steel industry recover even more scrap, as contractors improve their recycling collection methods at the job site so that less incidental iron and steel scrap escapes

Online Steel Recycling Resources

www.recycle-steel.org

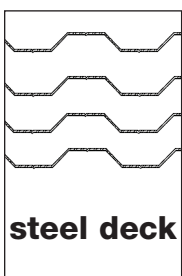
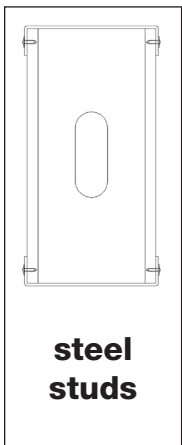
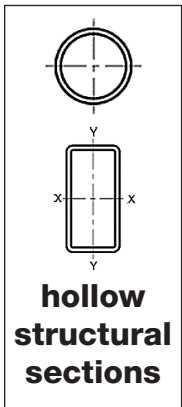
Includes detailed information on recycling rates, recycling databases, and the environmental benefits of steel for homes, buildings, steel roofing, and bridges.

www.aisc.org/sustainability

Includes detailed information on how steel factors into the LEED® rating system, steel mill recycled content documentation, and articles about the use of steel in sustainable projects.

Modern Steel Production Technologies

Typical BOF Products



to landfills. Similarly, commercial buildings and residential housing can have better disciplined recycling systems for increased recovery. As steel products reach the end of useful life, we want to see the recovery rate continue to increase so that even more scrap is recycled into new steel products for future service to society.

Steel is the most recycled material in North America and, indeed, the world. In the United States alone, almost 86 million tons of steel were recycled or exported for recycling in 2011. This is done for economic as well as environmental reasons. However, it should also be clearly understood that many steel products 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 extract 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, recycling in the steel industry is second nature. The **North American steel industry** has been recycling steel scrap for over 170 years through a vast network of scrap facilities. Today, this network includes some 2,500 scrap processors and 12,500 auto dismantlers. Many have been in the business for more than 100 years. The pre-consumer, post-consumer, and total recycled content of steel products in the United States can be determined for the calendar year 2011 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.

The steel and iron industries enjoy an open-loop recycling capability, 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; 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. For this reason, average industry statistics more accurately portray the overall impact of industry recycling activity than do those of an individual company.

Basic Oxygen Furnace

Domestic basic oxygen furnace (BOF) facilities consumed a total of 13,957,000 tons of ferrous scrap in the production of 37,798,500 tons of raw steel during 2011. Based on U.S. Geological Survey statistics, 4,971,000 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 a mix of “runaround scrap” and pre-consumer scrap. (The runaround scrap is specifically excluded from recycled content since it is scrap that is recovered within the same steel mill process that generated it.) Estimates by the Steel Recycling Institute identify about 80% of this unsalable steel as pre-consumer scrap, equating to 3,976,800 tons (4,971,000 x 80%). Additionally, these operations reported that they consumed 45,000 tons of obsolete scrap (buildings and warehouses dismantled on-site at the mill) during this timeframe. 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 8,941,000 tons [13,957,000 – (4,971,000 + 45,000)]. According to the Fordham University study, the post-consumer fraction of the purchased ferrous scrap would be 83.4%, while 16.6% of these purchases would be pre-consumer. This equates to 1,484,200 tons of pre-consumer scrap (8,941,000 x 16.6%) which is mainly generated by manufacturing processes for products made with steel.

Therefore, the **total recycled content** to produce the 37,798,500 tons of raw steel in the BOF is:

$$13,957,000 / 37,798,500 = 36.9\%$$

(Total Tons Ferrous Scrap / Total Tons Raw Steel)

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

$$(8,941,000 - 1,484,200) + 45,000 = 7,501,800$$

and

$$7,501,800 / 37,798,500 = 19.8\%$$

(Post-Consumer Scrap / Total Tons Raw Steel)

Finally, the **pre-consumer recycled content** is:

$$(3,976,800 + 1,484,200) / 37,798,500 =$$

$$5,461,000 / 37,798,500 = 14.4\%$$

(Pre-Consumer Scrap / Total Tons Raw Steel)

Electric Arc Furnace

The electric arc furnace (EAF) facilities consumed a total of 49,575,000 tons of ferrous scrap in the production of 55,152,600 tons of raw steel during 2011. Based on U.S. Geological Survey adjusted statistics, 3,968,000 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 a mix of “runaround scrap” and pre-consumer scrap. Estimates by the Steel Recycling Institute identify about 80% of this unsalable steel as pre-consumer scrap, equating to 3,174,400 tons (3,968,000 x 80%). Additionally, these operations reported that they consumed 69,000 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, based on the total scrap consumed, outside purchases of scrap equate to 45,538,000 tons [49,575,000 - (3,968,000 + 69,000)]. According to the Fordham University study, the post-consumer fraction of the purchased ferrous scrap would be 83.4%, while 16.6% of these purchases would be pre-consumer. This equates to 7,559,300 tons of pre-consumer scrap (45,538,000 x 16.6%) which is mainly generated by manufacturing processes for products made with steel.

Therefore, the **total recycled content** to produce the 55,152,600 tons of raw steel in the EAF is:

$$49,575,000 / 55,152,600 = 89.89\%$$

(Total Tons Ferrous Scrap/Total Tons Raw Steel)

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

$$(45,538,000 - 7,559,300) + 69,000 = 38,074,700$$

$$38,074,700 / 55,152,600 = 69.0\%$$

(Post-Consumer Scrap / Total Tons Raw Steel)

and

Finally, the **pre-consumer recycled content** is:

$$(3,174,400 + 7,559,300) / 55,152,600 =$$

$$10,733,700 / 55,152,600 = 19.5\%$$

(Pre-Consumer Scrap / Total Tons Raw Steel)

The above discussion and calculations demonstrate conclusively the inherent recycled content of **steel produced today in North America**. To buy domestic steel is to “Buy Recycled.”

Understanding the recycled content of steel, 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. After its useful product life, steel is recycled back into another steel product. Thus steel with about 30% recycled content or with about 90% recycled content are both complementary parts of the holistic cradle-to-cradle infrastructure of steelmaking, product manufacture, scrap generation, and recycling.

Steel is truly the most recycled material.

Contact Us

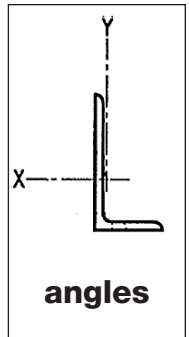
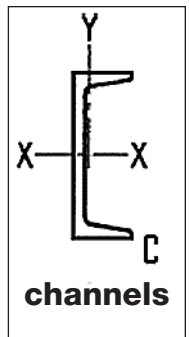
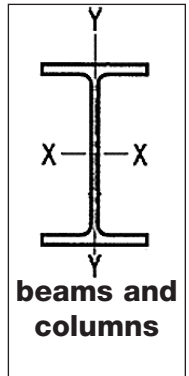
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Typical EAF Products



plate

steel deck

piling

To: Architects, Engineers, Designers, and Specifiers

Re: LEED®-NC 2009 Recycled Content Value of Steel Building Products

The U.S. Green Building Council's Leadership in Energy & Environmental Design (LEED®) Green Building Rating System aims to improve occupant well-being, environmental performance, and economic returns of buildings using established and innovative practices, standards, and technologies.

Materials & Resources Credit 4: Recycled Content intends to increase demand for building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials. As discussed and demonstrated below, **North American** steel building products contribute positively toward both available points. The following is required by LEED-NC:

Credit 4 (1 or 2 points) "Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% or 20% (based on cost) of the total value of the materials in the project."

"The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value." Since steel (the material) and steel (the building product) are the same, the value of the steel building product is directly multiplied by steel's recycled content, or:

$$\text{Steel Recycled Content Value} = (\text{Value of Steel Product}) (\text{Post-Consumer \%} + \frac{1}{2} \text{Pre-Consumer \%})$$

The information contained within this brochure provides post-consumer and pre-consumer recycled content percentages for **North American steel building products** and is considered acceptable documentation by the USGBC LEED rating system and green codes and standards. These percentages and values of steel building products are easily entered into the LEED Letter Template spreadsheet for calculation.

To illustrate the application of these steel recycled content values to LEED, manual calculations are shown below for typical Basic Oxygen Furnace (BOF) and Electric Arc Furnace (EAF) steel building products with nominal \$10,000 purchases, using 2011 data. Steel building products include steel stud framing, structural steel framing (wide-flange beams, channels, angles, etc.), rebar, roofing, siding, decking, doors and sashes, windows, ductwork, pipe, fixtures, hardware (hinges, handles, braces, screws, and nails), culverts, storm drains, and manhole covers.

BOF Steel Recycled Content Value for Typical Product:

Steel Stud Framing

$$\text{BOF Steel Recycled Content Value} = 19.8\% + (\frac{1}{2} \times 14.4\%) = 27\%$$

$$\text{Value} = (\$10,000) (27.0\%) = \$2,700$$

(Positive net contributor to 10% and 20% minimum percentage for each point threshold)

EAF Steel Recycled Content Value for Typical Product:

Wide-Flange Structural Steel Framing

$$\text{EAF Steel Recycled Content Value} = 69.0\% + (\frac{1}{2} \times 19.5\%) = 78.8\%$$

$$\text{Value} = (\$10,000) (78.8\%) = \$7,880$$

(Positive net contributor to 10% and 20% minimum percentage for each point threshold)



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