American Iron and Steel Institute

and Steel Manufacturers Association

TECHNICAL REPORT

Determination of Steel Container Recycling Rates in the United States

July 27, 2021

INTRODUCTION

Steel is widely recognized as the most recycled material on the planet. Recycling of steel has long benefited the industry by saving on raw material costs, reducing the environmental footprint of steel production, and providing feedstocks of benefit to the metallurgical needs of steel producers.

Steel container recycling rates were last published by the Steel Recycling Institute (SRI) in 2015. Accordingly, the American Iron and Steel Institute (AISI) and the Steel Manufacturers Association (SMA) retained Franklin Associates, A Division of Eastern Research Group (ERG), to conduct research to better understand: 1) the robustness of current approaches to calculating recycling rates, and 2) whether there are ways to improve upon how these rates might be calculated and expanded to represent market sectors such as steel containers. The research project was completed in November 2020, with follow-up research completed in May 2021.

The Can Manufacturers Institute (CMI) also supplied important information as part of the research process. CMI developed internal surveys of its membership relative to total steel purchased and steel scrap produced in the manufacturing of steel cans. This data was used to develop estimates of the total steel purchased and scrap produced across the entire product category. The data supplied by CMI proved useful in the validation of the quantities of steel used in steel container manufacturing and established the basis for the new scrap rate for steel containers.

This document specifically addresses the recycling rate for steel containers, defined herein as steel packaging containers with a capacity of less than 13.2 gallons.

STEEL SCRAP DEFINITIONS

Home scrap – Scrap generated within a steel production facility and captured prior to exiting the facility. In this report, home scrap quantities are excluded from recycling rate calculations. (Note: Scrap generated by a downstream process in the same facility may be classified as "new scrap.")

New scrap – Scrap generated by manufacturers of steel-containing products and removed from the system prior to end use. In this report, new scrap is the scrap generated in the container manufacturing process. (Note: New scrap may also be called "prompt scrap" or "manufacturing scrap.")

Old scrap – Scrap that entered service as a consumer product and is captured for recycling at end of life (EOL). In this report, old scrap is scrap from steel containers generated after the container's intended use. (Note: Old scrap may also be called "obsolete scrap" or "EOL scrap.")

LITERATURE REVIEW

The original phase of the project included a review of relevant research and technical articles on recycling of steel and other metals. Most of the studies compared the amount of material recycled to the total amount of steel available for recycling, with the recycling rate then being calculated by dividing the amount of material recycled by the total amount of steel. (Imports, exports and stock changes of scrap are also considered.) It is the denominator that differs across various published methods for calculating recycling rates. In some cases, the consumed scrap is reported as a percentage of the total amount of new steel entering the market (production), while in others, it is reported as a percent of the total amount of steel scrap generated (new scrap + old scrap). The two basic calculation approaches are therefore: 1) **[(scrap consumed)/(steel produced)]** and 2) **[(scrap consumed)/(scrap generated)]**.

STEEL RECYCLING INSTITUTE METHODOLOGY VS. CURRENT METHODOLOGY

The Steel Recycling Institute (originally the Steel Can Recycling Institute) was formed in 1988 with the goal of increasing the U.S. recycling rate for steel cans. In order to measure progress toward that goal, SRI began reporting annual recycling rates for steel cans, using the first of the two methodologies described above. The use of a basic **[(scrap consumed)/(steel produced)]** approach made sense for this purpose, since the lifespan of a steel can is typically very short. This short lifespan means that the two possible denominators (steel produced vs. scrap generated) would be nearly equivalent in a given year. However, SRI eventually began reporting annual overall steel recycling rates as well as recycling rates for specific sectors in addition to cans, such as appliances, construction and automotive. The same basic methodology was used to calculate these rates, but since the lifespans of these products were often much longer, the use of the **[(scrap consumed) /(steel produced)]** approach resulted in specific sector recycling rates of over 100 percent in some cases (e.g., 2008-2009). The research by Franklin Associates concluded that the use of the alternate methodology, i.e., **[(scrap consumed)/(scrap generated)],** is more appropriate for calculation of steel recycling rates, especially when applied to longer lifespan steel products. For consistency, this methodology is also applied to the calculation of steel container recycling rates.

Therefore, for the purposes of this report, the basic calculations for steel container recycling rates (which also consider imports, exports and net trades of scrap) can be described as follows:

$$\textbf{new scrap recycling rate} = \frac{(new\ scrap\ consumed \pm net\ trades\ of\ new\ scrap)}{(new\ scrap\ generated)}$$

$$\textbf{old scrap recycling rate} = \frac{(old\ scrap\ consumed \pm net\ trades\ of\ old\ scrap)}{(old\ scrap\ generated)}$$

$$\textbf{total recycling rate} = \frac{(new + old\ scrap\ consumed \pm net\ trades)}{(new + old\ scrap\ generated)}$$

DATA REQUIREMENTS AND SOURCES

Implementation of the recommended recycling rate calculations requires a considerable amount of data, not all of which is readily available when attempting to develop recycling indicators for specific product categories. This section provides information on data availability and sources.

At a high level, the data requirements for recycling rate calculations are relatively straightforward. Information is required on:

- Steel production and shipments
- Scrap generation and consumption, and steel entering EOL
- Trade of steel products

Data on the domestic production and shipment of semi-finished and intermediate steel products is available primarily from AISI. Additionally, data on the end-use sectors that consume steel mill products are reported by AISI and the United States Geological Survey (USGS).

Steel scrap data is available from several entities. AISI reports scrap consumption data noting that the data is derived from information collected by the USGS. Scrap consumption refers to scrap recycled in domestic steel furnaces and includes scrap of both U.S. and international origin (i.e., imported scrap). The USGS issues several publications that report scrap generation and consumption data, including the "Mineral Commodity Summaries" and the "Minerals Yearbook." USGS scrap production values include all scrap generated in the U.S. as well as scrap that is ultimately exported to international markets.

Scrap consumption data from AISI represents the portion of scrap consumed by manufacturers of pig iron and raw steel. Scrap consumption values reported by AISI include both home and purchased scrap, while purchased scrap includes both new and old scrap.

Trade data, with some overlapping scope, is available from several sources including AISI, USGS, the World Steel Association (worldsteel) and numerous national and non-governmental trade bureaus and institutions. AISI and USGS import/export data is compiled by the U.S. Census Bureau within the Department of Commerce.

CONTAINER RECYCLING RATE (U.S.)

The general formula for total recycling rate has been described previously. The following formula is more specific to the calculation of an overall steel recycling rate as well as a steel container recycling rate:

$$\textbf{recycling rate} = \frac{[Scrap\ Consumption\ (U.S.) - Home\ Scrap\ Consumption + Scrap\ Exports - Scrap\ Imports]}{[EOL\ Steel + New\ Scrap \pm Stock\ \Delta]}$$

The container recycling rate has been calculated based on the two components *EOL scrap* and *new scrap*, which are then combined into a total recycling rate. EOL and new scrap recycling rates are calculated separately to isolate scrap recovery estimates for old and new scrap associated with the sector. New scrap is assumed to be recovered at a rate of 98 percent.

Scrap recovered at EOL is estimated using USGS scrap consumption data plus exported scrap minus imported scrap, given the assumption that exported scrap will be recycled in the receiving country. "Steel can scrap (post-consumer)" is allocated entirely to the container end-use sector, and portions of certain other scrap categories are also allocated to the sector. Based on available data and expert interviews, a relatively modest share of shredded or fragmentized scrap is used to estimate the share of shredded scrap sourced from the container sector. Small quantities of container steel are also expected to be found in No. 2, electric furnace bundles, and other mixed scrap categories.

Containers are assumed to be disposed in the same year that they enter use. The quantity of steel entering use in a given year is estimated by net shipments of steel mill products to this sector, with consideration of semi-finished and indirect imports and exports. Consumption of domestic steel mill products by the container sector was estimated by allocating net shipment data, and consumption of imported steel mill products by the container sector was estimated using the allocated USGS import data. Imports of finished (empty) containers are a relatively small contributor to domestic steel container consumption when compared to containers produced from domestically produced or imported intermediate tin mill products. A yield loss of 11 percent was assumed during container production (not applied to imported empty containers)

based on data from CMI with an additional 1 percent loss rate applied to all containers during the filling process.

TOTAL RECYCLING RATE FOR STEEL CONTAINERS

This report produces container recycling rates that reflect the general paradigm of scrap consumption over scrap generation. Recent trends in the literature support this definition of recycling rate. The recycling rates in this report are appropriate for use in a life cycle assessment and convey a clear and consistent message regarding the capture of steel scrap for recycling.

The container recycling rate is currently available as a single-year estimate for the year 2019, the most recent year for which all the relevant data is available. The calculation of a container recycling rate is subject to some degree of uncertainty since it requires data from a wide variety of sources as described previously. The calculated rates in the table below represent a best estimate based on multiple data sources and the process described in this report, and should thus be considered reasonable and credible values for steel container recycling in the United States.

Data Year: 2019		Total Steel Available for Recovery *(Short tons)*	Total Scrap Recovered *(Short tons)*	Recycling Rate *(Percent)*
EOL Scrap (Old):	Containers	1,965,228	1,138,958	58%
New Scrap:	Containers	250,809	245,793	98%
Total: (Old+New Scrap)	Containers	2,216,037	1,384,751	62%

Note: This recycling rate should not be compared directly to previous rates published by the Steel Recycling Institute due to differences in calculation methodology.

For more information on steel container recycling, visit www.steel.org, www.steelnet.org or www.cancentral.com.