# STEEL CAN RECYCLED CONTENT

## WHITE PAPER

The technical, environmental and market issues that currently limit the use of recycled content in steel cans

## EXECUTIVE SUMMARY

This white paper explains the technical, environmental and market issues that currently limit the use of recycled content in steel cans. The intention of this research is to provide policymakers insights into the steel industry, which has one of the highest levels of material recapture through an extensive domestic recycling network built over 100d years. The U.S. steel industry includes steel produced by Electric Arc Furnace (EAF) and basic oxygen furnace (BOF) production technology. While EAFs can accept higher levels of recovered scrap, it produces steel of lower technical quality than that produced via BOF. Together these production methods have allowed steel products multiple production pathways to use recycled material and support circularity. The American Iron and Steel Institute (AISI) determines high industry recycling rates from short-term steel products like packaging (58%)[1] to durable goods like construction products (74%), cars (96%) and appliances (78%). These high recycling rates demonstrate that steel is one of the most robust examples of a circular commodity, both domestically and globally. To increase circularity in packaging, policymakers have been implementing policies such as Extended Producer Responsibility (EPR) schemes with eco-modulated fees for packaging and recycled content mandates. Together, these policies aim to increase the supply of recovered materials and drive end-market development. **Given current U.S. policy developments, this paper seeks to clarify how policies mandating eco-modulated EPR[2] fees or recycled content mandates intended to grow package level circularity may have unintended economic as well as adverse environmental consequences due to the quality and safety requirements for steel cans and the technical limitations on how the steel for cans is produced today.**

There are several important findings from the research conducted for this paper that will be explained in detail in later sections.

- **Steel Cans are a Small Share of Steel Use:** As of 2018, steel cans and packaging represent 12% of all ferrous municipal solid waste (MSW), according to the U.S. Environmental Protection Agency (USEPA)[3] and

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[1] 58% refers exclusively to the recycling rate for End of Life (EOL) scrap which, is post-consumer waste steel that is captured for recycling at the end of life. The collection rate would naturally be higher for "Home scrap"– waste steel generated either from within a steel production facility and captured prior to exiting the facility or "New scrap" – waste steel generated by the manufacturing steel-containing products and do not go through end-use as compared to EOL scrap. For steel containers, the overall recycling rate (i.e., inclusive of EOL + New Scrap) is 62%.
2021. Technical Report - Determination of Steel Container Recycling Rates in the United States. Accessed July 27. https://www.steel.org/wp-content/uploads/2021/08/AISI-and-SMA-Steel-Container-Recycling-Rates-Report-Final-07-27-2021.pdf.

[2]2 Eco-modulation refers to fee modulation or changing fees paid by producers in a collective EPR scheme based on product design with the purpose of providing producers incentive to design for the environment.
OECD library. Modulated fees for Extended Producer Responsibility schemes (EPR). Accessed August 1, 2023.
https://www.oecd-ilibrary.org/environment/modulated-fees-for-extended-producer-responsibility-schemes-epr_2a42f54b-en

[3] U.S. Environmental Protection Agency Clean Air Markets Division. Clean Air Status and Trends Network (CASTNET) Table 7. Accessed August 1, 2023.Available at www.epa.gov/castnet.

less than 3% of annual steel production in the United States, according to AISI[4]. Steel packaging as a share of total MSW is significantly different from other commodities, where more than 40% of annual waste generation is represented by packaging. For instance, plastic packaging is 41% of all plastic MSW, aluminum packaging is 49%[5] of all aluminum MSW, fiber-based packaging is 62%[6] of all fiber MSW and glass packaging is 80%[7] of all glass MSW. This makes steel cans a niche product category within the steel industry.

- **Sortability of Steel Cans:** Steel can recycling benefits from the ease with which steel can be identified and sorted using a magnet allowing for the collection of high volumes of steel cans and other diverse steel products.
- **National Collection Network:** Steel can recycling benefits from material recovery facilities (MRF) and the widespread collection infrastructure of metal scrap yards present in thousands of U.S. communities. MRFs are where single-stream residential recyclables are sorted. Scrap dealers purchase can bales from MRFs and also collect high volumes of other steel products from construction, automotive, and white goods. Like other commodities, scrap steel is sorted into different grades of scrap to meet the input specifications of steel mills depending upon the products they produce.
- **Technical Specifications for Steel Cans:** The steel used to produce tin coated or uncoated can sheet must meet strict food safety and formability requirements. The quality specification for the steel sheet used in cans has strict limits for residual elements like copper, tin, silicon, and nickel.
- **Scrap Quality:** The tin coating on steel cans is considered a contaminate and does not meet the low residual input specification for BOF steel production. BOFs produce high quality steel (i.e., automotive sheet) with very low residual requirements. In contrast, EAFs readily accept consolidated can bales as scrap inputs because EAFs produce steel products with less stringent residual requirements like rebar and structural steel products.
- **Localized Supply Chains:** Due to high cost of transporting steel scrap, the collection and aggregation of steel and steel cans is optimized around local and regional supply chains that ensure steel scrap of the appropriate quality is sent to nearby furnaces.

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4 American Iron and Steel Institute. Steel Profile Book 2020. Accessed August 1, 2023. https://www.steel.org/wp-content/uploads/2020/12/2020-AISI-Profile-Book.pdf.

5 U.S. Environmental Protection Agency Clean Air Markets Division. Clean Air Status and Trends Network (CASTNET) Table 7. Accessed August 1, 2023.Available at www.epa.gov/castnet.

6 U.S. Environmental Protection Agency Clean Air Markets Division. Clean Air Status and Trends Network (CASTNET) Table 5. Accessed August 1, 2023.Available at www.epa.gov/castnet.

7 U.S. Environmental Protection Agency Clean Air Markets Division. Clean Air Status and Trends Network (CASTNET) Table 6. Accessed August 1, 2023.Available at www.epa.gov/castnet.

- **Technical Limits of Steel Production:** Given current steel production technologies, can sheet can only be produced by a BOF steel mill as they can carefully control the metallurgy of the steel they produce and can meet the specifications for can sheet (verified by can makers and steel manufacturers interviewed). Today, U.S. BOF capacity as well as rolling mill infrastructure is optimized for large end users of high quality BOF steel, like the automotive industry, which has a steel quality and rolling specification different from can sheet. For this reason, U.S. capacity to produce can sheet for steel cans is highly constrained and the industry is highly reliant on imported can sheet.
- **Technical Limits of EAF Production:** In the United States most steel is produced using EAFs, which can accept up to 90% steel scrap. However, steel produced through EAF steelmaking process cannot today readily meet the quality specification needed for steel can sheet due to the high levels of residual elements (i.e., tin, copper, silicon, and nickel) from the diverse forms of scrap they recycle. There is one North American manufacturer working to develop an EAF steelmaking process that will increase the feasibility of manufacturing steel can sheet, but it has no commercial operation to date. There is generally insufficient economic incentive for EAF operators to broadly invest in such technology given the relatively small size of the steel can industry.
- **Scrap Limits of BOF Production:** The technical limit for using steel scrap in a BOF is 30% (the limit was corroborated by available literature and interviews) and as noted previously, the scrap needs to have low levels of residuals. To use scrap beyond the 30% technical limit in a BOF requires the addition of energy to the furnace to melt the additional volumes of scrap. In a BOF, additional energy is in the form of virgin liquid iron. The use of additional energy results in higher greenhouse gas and environmental impacts to produce the same volume of steel. To ensure the steel produced meets quality specifications, today BOFs typically use scrap levels below the 30% technical threshold. The research for this paper identified estimated ranges between 12%-20% of recycled content in can sheet. In other words, mandating recycled content above this range would mean requiring steel tinplate be made with so much recycled content that steel cans could not be made from it.
- **Environmental Performance:** Unlike aluminum cans, can-to-can recycling is not feasible given the reliance on BOF steelmaking to produce the appropriate quality of steel for can sheet. Mandating can-to-can recycling would increase the cost and negatively impact the environmental performance of steel can production due to the increased transportation to get sufficient volumes of scrap from cans to a BOF. In addition, cans would have to go through an energy-intensive detinning process to reduce the presence of residuals in order to be processed in a BOF. Higher volumes of virgin resources and energy would be needed to melt the scrap if it exceeded the scrap limit of the BOF. The size of the U.S. steel can industry is not sufficient to justify the disruption of steel production systems that are currently optimized for higher volume steel products.

- **Decarbonization Driving Circularity:** The U.S. steel industry is shifting to more carbon efficient steel production through EAFs. EAFs have created strong domestic demand for scrap steel, which creates a strong economic market signal that drives the collection and recycling of steel across all steel products. In the United States demand exceeds the supply of scrap steel, ensuring that all collected steel has a market. Policy interventions to increase recycled content in steel cans would not grow the recycling of steel cans as there is no economic signal to encourage consumers to recycle. It would shift steel from one end market to the mandated market adding cost and greater environmental impact to the production of cans without increasing the amount of steel cans recycled.

The steel industry is a mature commodity industry with a well-established scrap industry that touches almost every community in the United States. This ensures that not only steel cans, but a vast array of durable steel products are also recovered and made into new steel–creating a high degree of material circularity for steel products. Steelmaking is optimized for efficient production of the largest end users of steel like the automotive and construction industries. Steel packaging represents only 3% of steel production[8] and thus has limited influence over the operational practice of mills. Growing the supply of recovered steel from all end uses is a critical priority for the steel industry to reduce dependence on virgin resources and support steps to decarbonize the industry. Given the extensive recovery infrastructure for steel products that supports steel can recycling, focusing on increasing the recycling rate of steel cans rather than the recycled content of steel cans would better enhance the circularity and sustainability of steel cans.

## OBJECTIVES FOR STUDY

The Can Manufacturers Institute (CMI) is the national trade association of the U.S. metal can manufacturing industry and its suppliers. CMI actively participates in dialogues regarding legislative, regulatory, and administrative policies of interest to can makers by providing objective data and analysis related to the sustainability of its products and advancing product stewardship efforts to protect human health and environment. Efficient production of steel cans with the lowest environmental footprint is a shared goal across the steel and metal can industries.

The purpose of the white paper is to inform conversations around industry standards for steel can packaging in view of developing minimum recycled content standards or proposed eco-modulated EPR fees that are adjusted based on the level of recycled content. There is concern that due to the nature of steel production in the United States and the small share of the industry represented by steel cans that eco-modulated fees that exceed typical

[8] Steel food cans are included in the steel container category that also comprises sheet for paint and aerosol cans. American Iron and Steel Institute. Steel Profile Book 2020. Accessed August 1, 2023. https://www.steel.org/wp-content/uploads/2020/12/2020-AISI-Profile-Book.pdf.

limits for recycled content in steel cans may have the perverse outcome of driving up costs and negatively impacting the environmental performance of steel cans. In the United States, the number of states with enacted EPR laws for packaging is on the rise with Colorado notably including metal as part of the materials with minimum recycled content requirements[9]. New York is another state contemplating EPR for packaging and has a bill drafted that could include minimum recycled content requirements for metal packaging[10]. Details of related policy developments in the United States may be referenced in Appendix D . This study was commissioned to create a fact base and develop a better understanding on the use and implications of postconsumer steel scrap in manufacturing steel can sheet, in light of these packaging policy discussions. The intent is to mitigate the risk of developing eco-modulated EPR policies that penalize steel can makers for not raising recycled content when it is in fact less environmentally beneficial.

## METHODOLOGY

In addition to a literature review of technical research into the use of recycled content in steel can making, a total of seven primary interviews with representatives from across the steel can making supply chain and steel trade associations from the United States and the European Union were conducted for this paper. Importantly, the firsthand information provided insights on the subtleties of supply chain dynamics within the industry, beyond technical steel can making processes. Furthermore, the trade associations interviewed for this paper represented diverse industry viewpoints, observations on industry trends and helped to verify as well as provide updated data for this paper. This was important in providing economic and practical insights into steel can manufacturing in the context of the overall steel manufacturing and recycling landscape. Resources and references are listed in Appendix A.

[9] Colorado legislation. House Bill 22-1355. Accessed August 1, 2023. https://leg.colorado.gov/sites/default/files/2022a_1355_signed.pdf.

[10] New York State Assembly. "BILL NO A05322A.". Accessed August 1, 2023. https://nyassembly.gov/leg/?default_fld=&leg_video=&bn=A05322&term=2023&Summary=Y&Text=Y.

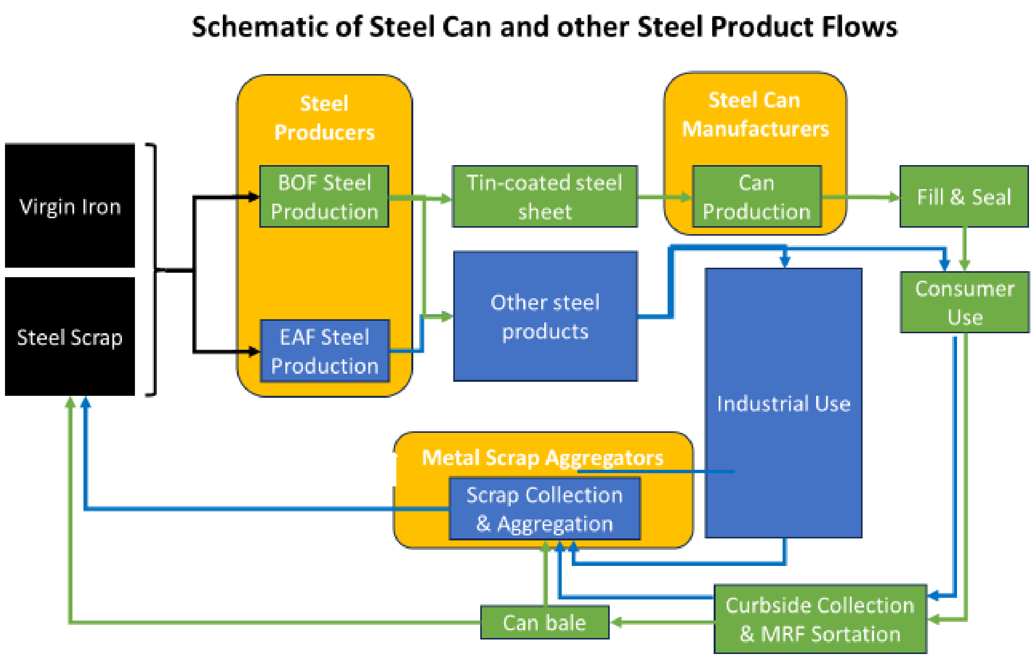



*Figure 1: Manufacturing of steel can and other steel products*

## STEEL CAN SUPPLY CHAIN

The key players of the steel can supply chain (Metal Scrap Aggregators, Steel Producers, and Steel Can Manufacturers) are referenced in Figure 1. Their roles and processes in the supply chain are summarized as follows:

**Metal Scrap Aggregators** collect diverse types of steel products and grade it into different categories with known specifications. The scrap may be shredded to make transport more efficient and increase the surface area to volume ratio, which allows the heating process to melt scrap more efficiently. Aggregators also purchase steel from local MRFs or municipal drop off programs. Scrap steel is sorted into different grades for mills producing different products. For example, due to the tin on steel cans, can bundles are considered a lower grade as compared to home scrap (clean cuttings, clippings, or stampings from manufacturing processes such as busheling).

**Steel Producers** use BOFs and EAFs in the United States to produce different steel products. According to AISI, EAFs account for more than 70% of U.S. steel production. Since EAFs can use high amounts of recovered steel scrap and rely on electricity rather than coal, it is a key technology to decarbonize steel production. However, today EAFs cannot produce the low-residual steel that meets can sheet specifications. BOFs and EAFs produce different quality steel and have different limitations when it comes to their ability to use scrap steel. In 2021, AISI estimated the average proportion of scrap used in BOF production was 23% versus an average of 82% for EAFs[11]. Details on scrap composition for each process may be referenced in Determination of Steel Recycling Rates in the United States.

In BOF steelmaking, steel scrap and a calcium flux, which promotes melting and the removal of impurities, are combined with liquid iron from a blast furnace to heat and melt the scrap. Oxygen is blown into the liquid metal to oxidize and remove undesired elements and convert the iron to steel. In an EAF, steel scrap is combined with pig or sponge iron[12] and uses electricity to heat the mix and convert iron into steel. The liquid steel from either a BOF or EAF may undergo a ladle metallurgy process to add alloying agents to ensure the steel meets the desired quality specification. For can sheet, the liquid steel is cast into a slab, which is then hot and cold rolled into a thin sheet that is annealed[13], tempered, and finally electrolytically coated with tin (or a chrome or zinc coating for other applications). Depending on the can manufacturer, the desired product is either uncoated can sheet coil or tin coated can sheet coil. There are few U.S. mills that have the appropriate rolling and tin coating lines to produce can sheet in the width required by can manufacturers (personal communication from industry interviews). Due to the lack of U.S. producers with the appropriate capacity and equipment to make can sheet, most can manufacturers in the United States have to import can sheet.

**Steel Can Manufacturers** receive either tin coated or uncoated coils of can sheet. The steel sheet is formed into cans according to the requirements of customers. There are two main types of can designs, 3-piece and 2-piece, which comprise 25% and 75% of all steel cans produced, respectively (according to CMI data from 2022). For 3-piece cans, the can body is formed and welded before the ends are seamed onto the body. For 2-piece cans, a single sheet of metal is drawn up from the can bottom (in a “cylinder shape”) before the top end is seamed on. The product of these can conversion processes is an unfilled steel can that is sent to be filled and sealed.

### THE NICHE MARKET OF STEEL CAN MANUFACTURING

According to the United States Geological Survey (USGS), the steel production in North America is increasingly dominated by EAFs which represented 60% of steel produced in 2012 and increased to 71% in 2022.

[11] American Iron and Steel Institute and Steel Manufacturers Association. 2021. Technical Report - Determination of Steel Recycling Rates in the United States. Accessed July 27. https://www.steel.org/wp-content/uploads/2021/08/AISI-and-SMA-Steel-Recycling-Rates-Report-Final-07-27-2021.pdf.

[12] The key difference between sponge iron and pig iron is that we can produce sponge iron by direct reduction of iron ore through reducing agents whereas the production of pig iron is by melting iron ore with charcoal and limestone at very high pressures.

[13] The cold rolling process breaks down the crystal structure of steel, resulting in a product that is brittle/not suitable for manufacturing processes requiring the steel to stretch or draw. To reset the internal crystal structure (improve the formability) of the steel, the coils must be heat treated. Annealing is the process of heat-treating low carbon steels.

Correspondingly, the share of steel produced by BOFs decreased from 40% in 2012 to 29% in 2022[14] (Figure 2 in Appendix B). This trend is expected to continue, though a 100% conversion is unlikely as not all steel products can be made using EAFs[15]. For similar reasons, the Alliance for American Manufacturing has released official statements supporting the need for both of these steel production processes[16]. The steel can sheet produced for can manufacturing is an example of a steel product currently limited to BOF production.

Given steel cans make up less than 3% of the U.S. steel industry[17], there is little market incentive for steel producers to prioritize the can industry (see Figure 3). The majority of BOF capacity and related rolling mill infrastructure focuses on the largest end consumers of BOF steel, like the automotive industry. Similarly, given its small market share, increasing recycled content requirements for steel cans would not significantly grow demand for recycled scrap.

The majority (97%) of U.S. steel is in the form of durable and non-durable goods. The high rate of durable goods recycling (83%[18]) as well as strong rates for non-durables (52%) and steel containers (58%)[19] results in a very high degree of overall material circularity for steel at the commodity level. Focusing on improving recycling rates for steel containers and non-durables would further improve the circularity of steel as a commodity.

[14] U.S. Geological Survey. "Iron and Steel Statistics and Information Annual Publications." Iron and Steel Statistics and Information. Accessed August 1, 2023. https://www.usgs.gov/centers/national-minerals-information-center/iron-and-steel-statistics-and-information.

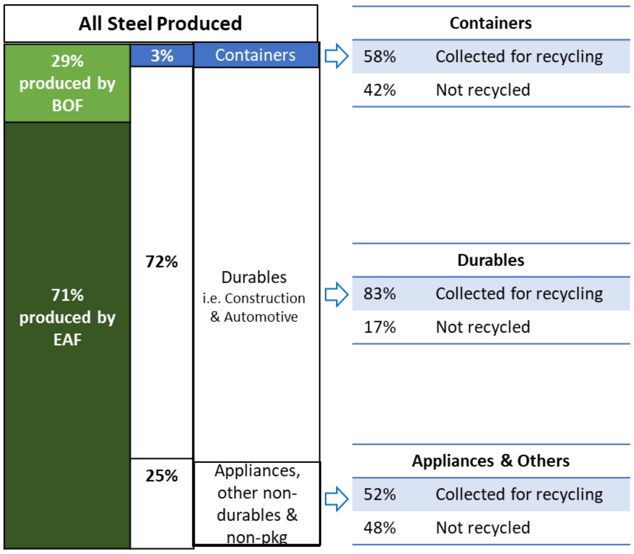
[15] 2018. Path to 2060: Decarbonizing the Industrial Sector. Duff, Rebecca & Lenox, Michael. Accessed June 26, 2023. https://www.researchgate.net/figure/US-Steel-Production-BOF-vs-EAF-Process_fig2_329810198.

[16] https://www.americanmanufacturing.org/press-release/aam-statement-new-buy-clean-guidelines-will-incentivize-cleaner-steel-production/.

[17] Steel food cans are included in the steel container category that also comprises sheet for paint and aerosol cans. American Iron and Steel Institute. Steel Profile Book 2020. Accessed August 1, 2023. https://www.steel.org/wp-content/uploads/2020/12/2020-AISI-Profile-Book.pdf.

[18] 83% represents the weighted average recycling rate of all construction (74%) and automotive segment (96%).

[19] 58% refers exclusively to the recycling rate for End of Life (EOL) scrap which, is post-consumer waste steel that is captured for recycling at the end of life. The collection rate would naturally be higher for "Home scrap"– waste steel generated either from within a steel production facility and captured prior to exiting the facility or "New scrap" – waste steel generated by the manufacturing steel-containing products and do not go through end-use as compared to EOL scrap. For steel containers, the overall recycling rate (i.e., inclusive of EOL + New Scrap) is 62%.




Note: Please see footnotes 20 and 21 for details on these values.

### TECHNICAL SPECIFICATIONS

To meet both the food safety and formability requirements, steel cans need to be manufactured in adherence to strict limits for residual elements like copper, silicon, and nickel[20]. These specifications may be referenced in Appendix C.

### TECHNICAL LIMITS OF BOF PRODUCTION

During the BOF steelmaking process, a combination of steel scrap and liquid iron is combined and then treated with an oxygen lance to convert the iron to steel. Unwanted residuals from scrap steel may form oxides that can then be removed in the slag. However, if the residuals from scrap do not form oxides (e.g., tin and copper), they can remain and accumulate in the steel substrate. This is why the quality of scrap inputs are carefully controlled at a BOF. In general, the higher the proportion of scrap content introduced into the BOF steelmaking process, the higher the level of residuals present in the resulting steel. Given the very tight requirements for food grade can sheet for tinplate products, using higher levels of steel scrap and particularly steel can scrap, represents a technical challenge to the production of can sheet that meet the requirements for tinplate products.

An additional concern is that increasing the amount of steel scrap increases the unpredictability of the quality of steel produced from the BOF. It is challenging to adjust the ladle metallurgical process to control steel quality when there is a high degree of variance between steel produced in different batches. Liquid iron from the blast furnace

[20] Tinplate products must comply with standard ASTM A623M – 03 where the non-ferrous content of the steel substrate is limited to the specifications of Type L or Type MR sheet steel.

(i.e., virgin iron) or pig iron, has a predictably low residual content and reduces the variance of the residual content in the resulting steel. In practice, the proportion of steel scrap to liquid or pig iron needs to be consistently capped for BOF manufacturers to reliably produce steel that meets the desired standards for chemical composition. Steel manufacturers cannot sell steel that does not meet customer requirements and inconsistent quality results in wastage and yield loss.

Based on the technical specifications for tinplated can sheet, today only the BOF process can produce the required quality. Increasing recycled content requirements beyond the technical threshold of 30% of a BOF negatively impacts the heat balance of the BOF and makes it impossible to melt additional scrap without additional energy use. Steel melts at 1600°F and the economic and environmental impact of additional energy use is significant. Two processes contribute to the melting of the steel scrap. First hot liquid iron is added. Next, as oxygen is blown into the BOF carbon in the liquid iron is reduced in a heat producing (i.e., exothermic) reaction. Increasing the proportion of scrap steel to liquid iron alters the heat balance of furnace and reduces the amount of heat produced from the exothermic reaction. More scrap requires more heat to melt the additional scrap. If the scrap-to-liquid iron ratio is increased beyond technical thresholds, there is insufficient heat to melt all the scrap and it would not be possible for the BOF to produce steel without significantly increasing the use of energy and virgin resources in the form of more liquid iron. Therefore, it is costly and impractical to increase the recycled content used in steel can sheet manufacturing beyond the BOF process thresholds. The SPC's recycled content guide has a "practical limit of 30 percent,"[21] which aligns with interview findings where a steel manufacturer indicated it would be "impossible" to melt the iron and scrap mixture if the recycled content was to be increased to 30% from the current baseline of 20%.

### TECHNICAL LIMITS OF EAF PRODUCTION

As noted, EAFs use a much higher proportion of scrap than BOFs. The high-scrap content used in EAFs introduce high level of impurities and make it impossible to meet the technical specifications of tinplate products. There are efforts being made by one manufacturer to develop an EAF steelmaking process that produces higher quality steel by only using scrap grades low in impurities. The hope is to increase the feasibility of manufacturing steel can sheet via EAF but to date there is no commercial EAF operation able to do this. This aligns with research reports describing pathways to reduce the impurities of steel produced by EAFs[22]. Despite the promise of some of these strategies, there is generally insufficient economic incentive for mills to invest in doing so given the small size of the steel can industry.

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[21] Sustainable Packaging Coalition. "Design for Recycled Content Guide" Accessed August 1, 2023, https://recycledcontent.org/.

[22] Institute of Energy Economics and Financial Analysis. "Solving iron ore quality issues for low-carbon steel" Accessed August 1, 2023. https://ieefa.org/resources/solving-iron-ore-quality-issues-low-carbon-steel.

### STEEL RECYCLING BUILDS ON INHERENT MAGNETIC PROPERTIES AND A ROBUST NATIONAL COLLECTION NETWORK

The magnetic properties of steel contribute to the high capture rate of postconsumer steel cans at MRFs, which is typically close to 90%[23], [24]. The magnetic property of steel also makes steel cans and other steel products easily sorted from other types of metal at scrap yards. Steel cans may be sorted and baled at MRFs or collected in drop off programs and then sold to scrap metal aggregators or sold directly to steel producers. According to IBIS World market research, there are 565 scrap metal recycling businesses in the United States.[25]. The prevalence of scrap metal recycling businesses in communities across the United States is due to the inherent market value of scrap metals and the fact that metal recycling has been built up over more than a century. The resulting network of collectors and aggregators provides a robust infrastructure to support steel can recycling in communities across the United States and ensures it gets to a mill. As long as consumers put their steel cans in a curbside bin, drop-off bin, or sell them at a scrap yard, they are very likely to be recycled into a new generation of steel products.

### LOCALIZED SUPPLY CHAINS

Sorted and aggregated iron and steel scrap is typically sent to local or regional mills, as freight is a key cost driver for the industry. Currently, there are 15 BOFs and 123 EAFs in the United States (personal communications with AISI)[26]. In general, it is much more efficient for the highly distributed and dense network of EAFs to process scrap steel than the more limited BOF network. In addition, EAFs are able to accept a wider range of steel scrap grades with higher levels of residual as compared to BOFs. The number and distribution of mills across the United States creates a large and diverse end market to accept steel of all qualities and allows the scrap steel recycling supply chain to be regionally optimized. As of 2018, only 8.8 million tons of steel were exported compared to 25.7 million tons imported (2020 AISI Profile book)[27]. Local and regional sourcing of scrap makes steel recycling efficient in terms of transportation costs and corresponding carbon impacts and creates a robust circular economy for steel domestically.

### EFFICIENCY AND ENVIRONMENTAL PERFORMANCE

Requiring steel cans to be recycled in a can-to-can system or mandating eco-modulated EPR fees that require scrap content levels above technical thresholds for a BOF would result in a cascade of negative environmental and

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[23] Source: RRS material flow studies
[24] Recovery rate is about 87% at MRFs, including cans that are too small and lost to the fibre line.
[25] IBISWorld Industry Reports. "Scrap Metal Recycling in the US - Number of Businesses 2004–2029." IBISWorld Industry Reports. Accessed August 1, 2023. https://www.ibisworld.com/industry-statistics/number-of-businesses/scrap-metal-recycling-united-states/.
[26] These are individual furnaces, not sites. A site may have more than one furnace.
[27] American Iron and Steel Institute. Steel Profile Book 2020. Accessed August 1, 2023. https://www.steel.org/wp-content/uploads/2020/12/2020-AISI-Profile-Book.pdf.

carbon impacts. To start, the tin coating on steel cans that provides corrosion resistance and ensures food safety is an undesired residual element in new can sheet. Because of the tin coating, steel cans do not meet the scrap quality specifications for most BOF mills and need to be detinned before they can be used in a BOF. “Detinning” is a chemical and electrolytic process to remove tin from tinplate scrap. It is costly and a small niche market. Detinning operations in the United States have been largely eliminated to improve the economies of scale of steel operations (industry interviews). Detinning is currently dominated by AMG Resources at its facility in Baltimore, MD[28]. The product of “detinned steel” is high-quality steel but due to transportation costs it is currently sold to local EAFs as high-quality scrap. If detinned steel was required to be recycled at a BOF, the scrap would need to be transported further distances disrupting regional supply chains, incurring greater cost, and generating more carbon impacts from transportation.

Altogether, the need to undergo detinning, increased transport distances, and the need for greater energy to achieve content requirements above technical thresholds would be economically inefficient and more environmentally impactful than current production methods. This may change if EAF technologies advance to a point where they can produce the appropriate quality of steel for tinplated steel products like steel cans.

## DECARBONIZATION DRIVING CIRCULARITY

As the shift towards EAF infrastructure to produce steel continues, especially for large end users of steel, the demand for recycled scrap will increase. For the steel can industry, increasing the collection of post-consumer steel cans for recycling would boost recycling and continue to drive decarbonization. This is especially true given recycled steel’s ability to retain its quality through the recycling process, meaning it can be recycled an infinite number of times into other steel products. This suggests the industry should focus on improving the recycling rate of steel cans rather than on having steel cans be recycled into new steel cans. This aligns with the view of other organizations such as The Association of European Producers of Steel for Packaging (APEAL)[29].

## SUMMARY OF KEY FINDINGS AND ANALYSIS

The objective of a circular economy is to drive better environmental performance. The U.S. steel industry is very mature and has achieved a high degree of material circularity due to a robust nationwide infrastructure that supports the collection, sortation, and recycling of steel cans and other diverse steel products. The findings of this paper reinforce CMI’s Recycling Policy Position and Principles where policy interventions may be necessary to

[28] AMG Resources. “AMG Resources Scrap Metal Products - Ferrous Metal.” AMG Resources Company Website. Accessed August 1, 2023. https://www.amgresources.com/scrap-metal/products/ferrous-scrap.re

[29] APEAL has taken the position that given the objectives of the steel for packaging industry is to meet the requirements for safe and efficient packaging in a responsible manner while promoting more sustainable steel packaging, focusing on the recycling rate rather than the recycled content is the most accurate indicator of material circularity and product sustainability.

increase the collection of steel cans. The presence of strong domestic end markets for steel cans ensures that if a steel can is collected, it is recycled through a highly optimized supply chain. The research finding of this white paper is that recycled content requirements through eco-modulated EPR fees or mandating can-to-can recycling would drive a cascade of negative economic and environmental outcomes. Specifically, it is not technically possible to increase the recycled content in steel can sheet produced at BOFs beyond technical thresholds without requiring additional energy and virgin resources. Today, steel scrap supply chains are regionally optimized. Mandating recycled content in steel cans beyond the technical limit would require transport to a single detinning operation and require greater transportation distances to BOFs, which translates to higher cost and carbon impacts. Further, given steel cans represent such a small proportion of steel end-use products, mandating increased recycled content would not materially drive higher recycling rates as consumer recycling is inelastic to market demand and the shift to EAFs is the stronger market signal driving recycling rates. Increasing consumer recycling of steel cans to reap the benefit from robust domestic steel recycling infrastructure continues to be the best way for the steel can industry to drive circularity and environmental performance. Improving consumer education and participation in recycling programs and investing in technology to recover steel cans from municipal solid waste are all avenues worth exploring and investing in to grow steel can recycling and circularity. Given the negative economic and environmental consequences from can-to-can recycling of steel cans, there should be no mandated recycled content minimums for steel cans or eco-modulation of recycled content for this steel product.

## APPENDIX

Appendix A: Resources and references

| Type | Organization |
|---|---|
| Steel Can Manufacturer | Crown Holdings, Inc. |
| Steel Can Manufacturer | Silgan Containers |
| Steel Producer | ArcelorMittal Dofasco |
| Steel Producer | Tata Steel |
| Metal Scrap Aggregator | AMG Resources |
| Trade Association | American Iron and Steel Institute |
| Trade Association | APEAL (The Association of European Producers of Steel for Packaging) |

Appendix B: Raw steel production by process (EAF vs. BOF)

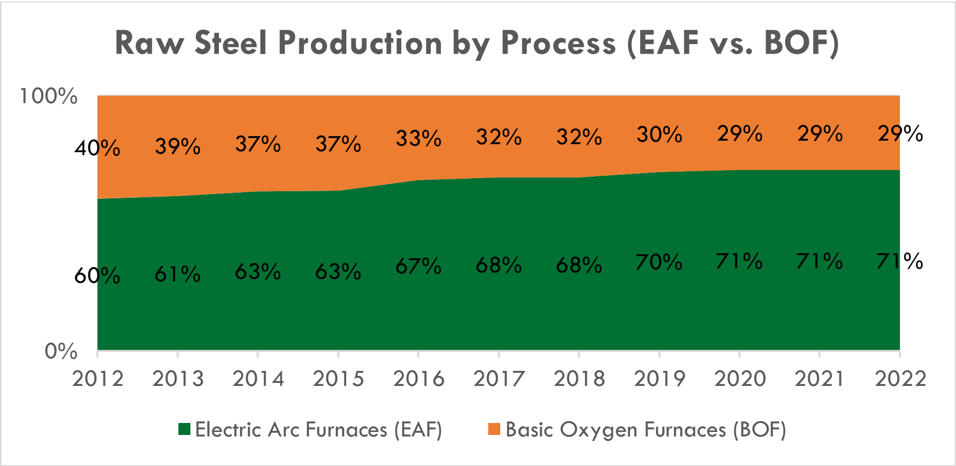


*Figure 2: Raw Steel Production by Process (EAF vs. BOF)*

Appendix C: Table 1 of the ASTM A623M – 03 standards

**Designation: A 623 – 03**

**Standard Specification for**
**Tin Mill Products, General Requirements**

TABLE 1 Chemical Requirements for Tin Mill Products

| Element | Cast Composition, max % | | |
|---|---|---|---|
| | Type D | Type L | Type MR |
| Carbon | 0.12 | 0.13 | 0.13 |
| Manganese | 0.60 | 0.60 | 0.60 |
| Phosphorus | 0.020 | 0.015 | 0.020 |
| Sulfur | 0.03 | 0.03 | 0.03 |
| Silicon[A,B] | 0.020 | 0.020 | 0.020 |
| Copper | 0.20 | 0.06 | 0.20 |
| Nickel | 0.15 | 0.04 | 0.15 |
| Chromium | 0.10 | 0.06 | 0.10 |
| Molybdenum | 0.05 | 0.05 | 0.05 |
| Aluminum[C] | 0.20 | 0.10 | 0.20 |
| Other elements, each | 0.02 | 0.02 | 0.02 |

[A] When steel produced by the silicon killed method is ordered, the silicon maximum may be increased to 0.080 %.
[B] When strand cast steel produced by the aluminum killed method is ordered or furnished, the silicon maximum may be increased to 0.030 % when approved by the purchaser.
[C] Types L and MR may be supplied as non-killed or killed, which would respectively be produced without and with aluminum additions. Minimum aluminum level for Type D is usually 0.02 %.

Appendix D: States with EPR Polices on Packaging or Deposit Beverage Containers

| State | Policy | Description |
|---|---|---|
| CA | SB 54 | Enacted EPR policy covering packaging with minimum recycled content requirements for plastic. |
| CO | HB 1355 | Enacted EPR policy covering packaging with minimum recycled content requirements for plastic, glass, paper, and metal.[30] |
| ME | LD 1541 | Enacted EPR policy covering packaging with no minimum recycled content requirements. |
| OR | SB 582 | Enacted EPR policy covering packaging with no minimum recycled content requirements. |
| NY | A05322<br><br><br>S00237 | Proposed EPR policy covering packaging with minimum recycled content requirements for glass containers, paper carryout bags and plastic trash bags. States that content requirements will be established for other materials.<br>Enacted deposit beverage container policy that includes soft drinks (i.e., aluminum can) but does not cover minimum recycled content requirements. |
| HI | HB179<br>HD1 | Enacted deposit beverage container policy states a deposit beverage distributor that sells, offers for sale, or distributes deposit beverage containers in or into the State shall meet incremental annual minimum percentages of either postconsumer recycled content or minimum non-petroleum materials content on average for the total quantity of deposit beverage containers that are sold, offered for sale. |

Appendix E: Comparison of EAF and BOF

| | EAF | BOF | Reference |
|---|---|---|---|
| Dist. of raw steel production (2022) | 71% | 29% | U.S. Geological Survey |
| Raw materials | recycled steel and | iron ore, coal, and | World Steel Association |

[30] While the bill does not set minimum recycled content requirements for producers, the PRO is to include minimum post-consumer recycled content for metal (and the other material types). The state will strive to achieve goals set out by Jan. 1, 2030. and Jan. 1, 2035.

| | | | |
|---|---|---|---|
| | electricity | recycled steel | AISBL |
| % of recycled content or scrap | 82% | 23% | AISI and SMA |
| Production site | Electric arc furnace at a mini mill | Blast furnace in an integrated steel facility (integrated mill) | Alliance Metal Products |
| Quality (purity) and variety of steel | Steel produced tend to be of lower quality and can be used for a narrower range of applications. | Steel produced tend to be of higher quality and can be used for a wider range of applications. | |