Closing the Loop on Automotive Aluminum Scrap to Minimize Carbon Emissions

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Closed-loop recycling is a potent solution to lower CO_2 in automotive aluminum sheet.

The world needs more aluminum. Thanks to its light weight and infinite recyclability, aluminum is a key driver of our transition to a circular economy, and the second-most used metal by mass in the automotive sector. Its numerous attributes that contribute to vehicle efficiency, performance, safety, and sustainability mean that it will play an increasingly important role in the auto industry, especially with the shift to electric vehicles. It is expected that from now until 2050, the market for aluminum sheet will expand by over 50%.[1]

To meet this growing demand while mitigating climate change will require both primary and recycled aluminum; recycled scrap is not sufficient on its own. Smelting operations are working to decarbonize the power supply and lower greenhouse gas emissions when producing primary metal. Nonetheless, this decarbonization will take time, especially where green electricity is not widely available, whereas low-carbon aluminum from recycling is available immediately. To minimize global warming, it is crucial to maximize recycling—the most efficient lever for reducing emissions—without delay.

When aluminum is produced by recycling, it has a significantly lower CO_2 footprint than any other aluminum solution. Aluminum can be recycled indefinitely at a low melting point, so recycling uses ~5% of the energy it takes to produce primary aluminum, reducing carbon emissions by as much as 95%.[2] Aluminum produced via the recycling process results in greenhouse gas emissions of 0.5 metric tons for each metric ton of metal, compared with a range of four to 20 metric tons for primary aluminum production, depending on region and power supply.[3]

In short, recycled aluminum is the low-hanging fruit when looking to decarbonize automotive manufacturing in the immediate future.

[1] https://www.european-aluminium.eu/vision-2050/

[2] https://www.aluminum.org/Recycling

[3] Source: Coal based production and global average: Life cycle inventory data and environmental metrics for the primary aluminium industry, World Aluminium, 2015. Addendum, August 2018. Other: Environmental Profile Report 2018, European Aluminium

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CO_2 Footprint of Average Primary Aluminum Production

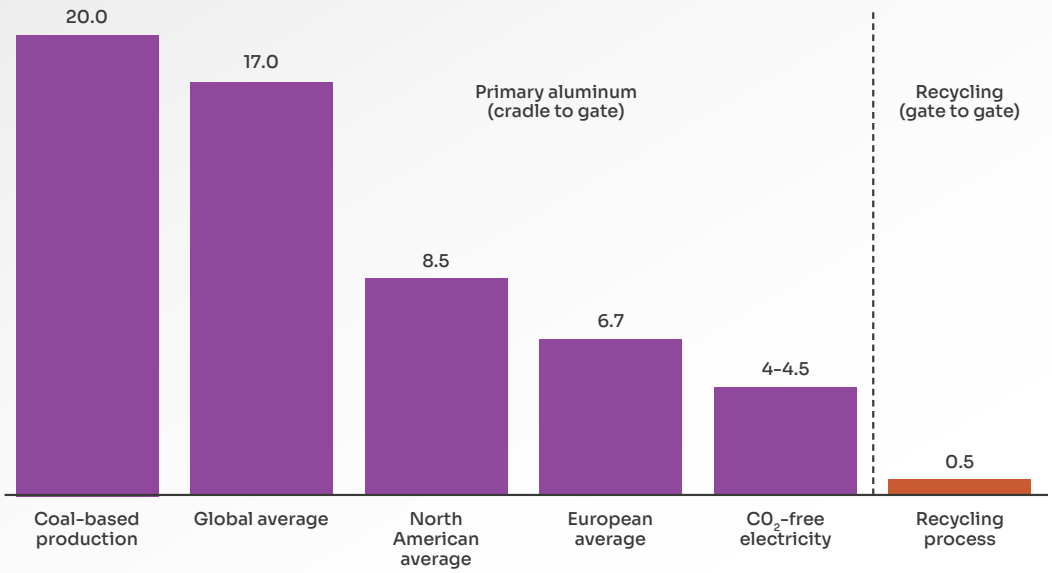

Figure 1: Metric tons of CO_2-eq per metric ton of production

Energy savings and carbon footprint reduction associated with aluminum recycling

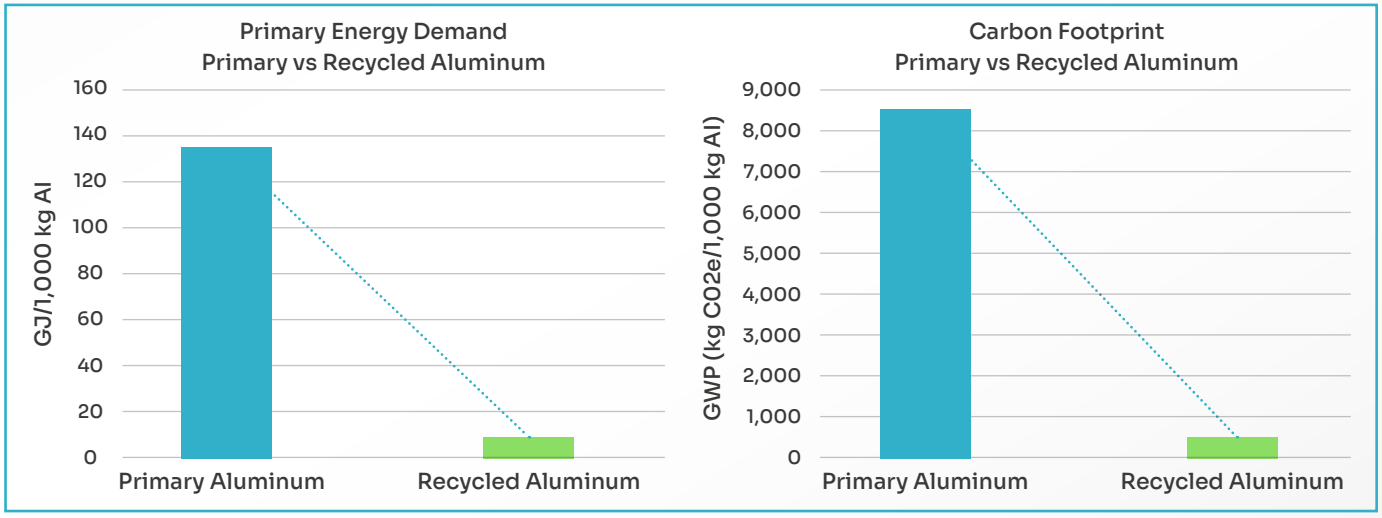

Figure 2: Energy savings and carbon footprint reduction associated with aluminum recycling

Sources:
- https://european-aluminium.eu/media/2903/european-aluminium-circular-aluminium-action-plan.pdf
- https://www.european-aluminium.eu/resource-hub/environmental-profile-report-2018/
- https://www.aluminum.org/sites/default/files/2022-01/2022_Semi-Fab_LCA_Report.pdf

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Closed-Loop Recycling is Key

It is important to note that not all recycling is the same. To achieve true circularity, Alumobility supports the use of a closed-loop model.[4]

One of aluminum's greatest attributes is that it can be recycled over and over again without losing its inherent properties, such as lightness, formability, and durability. Almost 75% of all the aluminum ever produced is still in use today.[5]

Aluminum is rarely used in its pure form; normally it is alloyed with other elements to attain the desired properties. Wrought alloys used for rolled sheet or extruded profiles contain smaller quantities of alloying elements than casting alloys. While wrought alloys can be recycled into casting alloys, the process is generally too inefficient to make sense the other way around.

Recycling within the same alloy family is key to maximizing efficiency and achieving circularity. In order to recycle wrought aluminum scrap into a secondary metal of equal value, the alloying composition must be the same. Any deviation might change an alloy's properties so that it can no longer be used for the same purpose as before.

For example, if wrought aluminum scrap from a car door manufacturing process is sorted, sent back to a rolling mill, and recycled in a closed-loop process, it can be manufactured as brand new material for car doors. On the other hand, if different alloy families are mixed together, rather than being properly sorted by grade, the recycling becomes open-loop. The resulting metal is much more difficult to reuse for its original purpose, often requiring the addition of large quantities of primary aluminum to compensate for the mixed scrap. In the worst case, it can no longer be used to manufacture a wrought material (e.g., to produce a door), but will serve as a casting alloy or used in another value stream. This is a serious missed opportunity for circularity, with a loss in CO_2 savings and potential cost benefits for the OEM.

A lot of aluminum scrap recycling in the automotive sector is currently open-loop, with the material turned into cast aluminum. For now, global demand for recycled cast aluminum still meets supply, notably for internal combustion engines. But as our markets transition to electric vehicles, with their smaller motors, there will be a corresponding change in the aluminum product mix, and a higher demand for wrought metal. It is therefore a good time to substantially increase the implementation of closed-loop recycling with more OEMs.

[4] This paper reflects Alumobility's position. It does not involve any coordination of the individual recycling strategies of its members.

[5] https://www.aluminum.org/policy-agenda/policy-agenda/recycling

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Source:
European Aluminium -
The Recycling Process - 2015

* Input from municipal plants, incineration, voluntary schemes, consumers.
** Input from plants producing aluminum and its alloys, fabrication of semi-fabricated (mill) products and end products.

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An Immediate Opportunity to Reduce CO_2

Automotive press shops are able to effectively use up to around 60% of the aluminum they receive from sheet suppliers, with a typical scrap rate of around 40% or more. This represents a significant quantity of scrap sheet metal, and provides a huge opportunity to increase sustainability in the supply chain and reduce carbon emissions, as well as lower costs.

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Rectangular Sheet | Stamping Blank | Finished Part

(1) Rectangular Sheet is produced from a coil, then **(2)** blanked into the part specific shape, finally **(3)** drawn & trimmed to the finished part

Figure 3: Example of the Production Steps for a Body Side Panel

Currently, many OEMs and suppliers do not sort and return their aluminum scrap to rolling mills. Instead, they might transform it into motor castings that use a mix of alloys, or else sell it to scrap dealers with limited control over the sheet materials' final use.

In some cases, OEMs do return it to the mill, but without sorting it first. Though better than not returning it at all, this is still a missed opportunity. Mixing different aluminum alloy grades limits their recycling potential, leading to inefficiencies and a potentially higher carbon footprint and lower value.

OEMs that segregate and send their scrap to the mill can be sure they have minimized the footprint of the metal they receive in return.

It is true that sorting sheet scrap requires investment and a certain operational organization. However, the value of aluminum scrap, when preserved in secondary materials, compensates for the investment in collection and sorting equipment.[6]

[6] https://www.european-aluminium.eu/media/2545/sample_vision-2050-low-carbon-strategy_20190401.pdf

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Joint Action Throughout the Value Chain

As the automotive industry is well aware, aluminum is a vital material for a more sustainable future, because it is both lightweight and strong. As we have demonstrated, another reason that it is so valuable is its superior recyclability. At the manufacturing stage, circularity is the most powerful lever for OEMs to reduce their CO_2 footprint. Introducing as much recycled aluminum sheet as possible is fundamental to reducing the industry's emissions.

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To achieve that goal, the aluminum industry is only as good as our partnerships with OEMs.

Alumobility supports joint action throughout the value chain to maximize the collection and sorting of aluminum scrap, and to increase recycling rates and efficiency. **OEMs and stamping suppliers can work together with producers of aluminum alloys for greater circularity and sustainability, by:**

- **improving scrap collection and sorting to limit the mixing of alloys,**
- **and closing the loop by sending scrap back to the rolling mills rather than turning it into casting alloys or selling it to scrap dealers.**

OEMs and stamping suppliers should consider scrap return as an immediate opportunity and the most efficient way to substantially reduce their carbon emissions today. Likewise, scrap dealers who receive scrap from automotive manufacturers can play an important role, by sorting and returning it to rolling mills rather than sending it to casting companies, or worse, exporting it overseas. OEMs can contract with scrap handlers who guarantee they will send the scrap to a rolling mill.

Increasing OEMs' use of recycled aluminum directly translates into a consequential drop in the carbon intensity of their operations and helps them meet their decarbonization targets. At the same time, it responds to growing consumer demands for the automotive industry to engage in more sustainable practices and accelerate our journey to a low-carbon future.

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End-of-Life is Also Rebirth

While recycling aluminum scrap offers an immediate solution to reducing emissions today, the collection, sorting, and efficient recycling of end-of-life metal is an opportunity for tomorrow.

Aluminum material in products, such as cars, that reach their end of life represents a major source of scrap that can be reintroduced into the circular economy.

Currently, very little end-of-life material is sent back to the rolling aluminum industry for recycling and reuse. Statistics are unclear, but we know that the EU exports one million metric tons of aluminum scrap per year to other regions (mainly Asia), where it is unlikely to reach its full potential value in the recycling process.[7]

OEMs can support a more circular business model by designing vehicles for recycling and disassembly. Designing components in a single alloy family makes them easier to sort. OEMs can also support improvements in dismantling flows, to ensure that end-of-life material is sent back to rolling mills.

The best way to take advantage of this future opportunity is by starting to tackle it right away.

[7] https://european-aluminium.eu/media/2903/european-aluminium-circular-aluminium-action-plan.pdf

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About Alumobility

Alumobility is a global ecosystem of leading aluminum and downstream technology partners that supports automotive manufacturers in creating lighter, safer, smarter, and more sustainable vehicles. The non-profit association was founded to focus on technical studies to advance the adoption of aluminum automotive body sheet (ABS). Working with global automakers, Alumobility is helping to fulfill the promise of a lighter, more efficient, more sustainable mobility future.

For more information on our studies and events, visit **alumobility.com** or contact us at **info@alumobility.com**.

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Sustainability

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