MM Markets

Report

Available Recycled Aluminum and Copper in the United States – Aluminum Highlights

Prepared for the Recycled Materials Association

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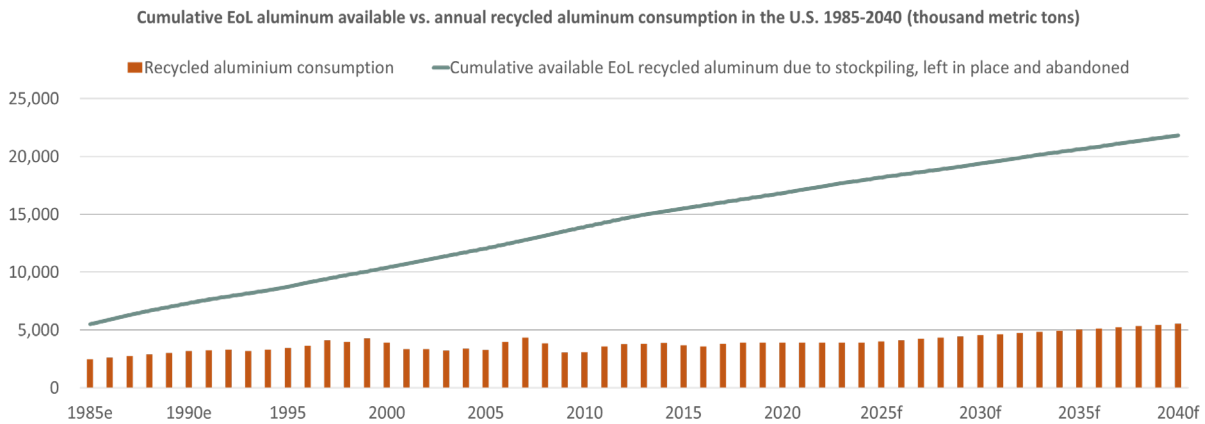
EXECUTIVE SUMMARY - Aluminum

New research performed by MM Markets indicates that there is no shortage of available End of Life (EoL) aluminum material in the United States.

The investigation examined and modelled current and projected levels of supply and demand of this recycled material over the period 1920 through 2040, using the material use period from 1940-2040. Available supply is defined as EoL aluminium left in place, stockpiled, and/or abandoned, therefore, not recycled, landfilled or lost, and is also referred to as the “reservoir” of available supply.

Based on primary and secondary research conducted by MM Markets, the report findings indicate that available US end-of-life aluminum tonnage significantly exceeds annual US recycled aluminum consumption. Available EoL reservoirs will continue to grow faster than US recycled consumption. This ensures adequate material supply to meet future recycling needs.



- Available US end-of-life aluminum tonnage significantly exceeds annual US recycled aluminum consumption.
- In 2025, available US EoL aluminum tonnage is estimated to be 4.5 times larger than consumption.
- The largest identifiable contributors to EoL aluminum available are: aluminium in construction left in place and consumer goods not recycled.

Aluminum	Kte 2025	Ktf 2040
EoL Aluminum Available	18,185	21,829
Recycled Aluminum Consumption	4,027	5,554

Note: Kte – Kilo tonne estimate. Ktf – Kilo tonne forecast. Source: USGS/MM Markets

Available US Reservoir

Available EoL reservoirs will continue to grow faster than US recycled consumption. This ensures adequate material supply to meet future recycling needs.

Regulatory Issues and International Trade

- Given ongoing trade regulatory/tariff activity, there is no justification for trade restrictions on exports of aluminum recycled materials out of the US. The need to retain recycled tonnage in the country to meet domestic demand is not supported. With substantial amounts of aluminum EoL material available now and into the future, the market—if allowed to operate freely—can continue meeting demand needs.

Background Documentation/Methodology

- The work methodology covered secondary research to screen existing statistics, and primary research to survey key organizations in the value chain. Analysis and reporting merged results of the secondary and primary research, and a base model was originated. This report is supported by a dataset, modelling, slide deck and technical appendix.

Legal Disclaimer

No Warranty or Liability: The calculations, information and forecasts are provided “as is” without warranties of any kind, express or implied, including accuracy, completeness, or fitness for a particular purpose. The author(s) assume no responsibility for any losses, damages, or other consequences arising directly or indirectly from the use of these data and information.

The historical data, calculations, and projections provided herein are based on publicly available sources, including but not limited to U.S. Geological Survey (USGS) publications, trade statistics, industry reports, and other third-party datasets. Where explicit figures were unavailable, data have been interpolated or extrapolated using statistical methods (e.g., linear regression, moving averages) and assumption-driven modelling.

Key limitations and caveats:

- Historical Data Quality – While the underlying sources are considered credible, historical statistics may contain inconsistencies due to methodological changes, revisions, or incomplete records.
- Forecast Methodology – Projections for 2025–2050 are estimates based on the parameters, not predictions. They rely on assumptions regarding economic growth, recycling rates, technology adoption, trade patterns, and policy developments.
- Parameters and Uncertainty – Where no explicit forecast data existed, assumptions were applied, including trend continuity, stable market drivers, and absence of major geopolitical or macroeconomic shocks. These assumptions may not hold in real-world conditions.
- Exclusion of Extreme Events – Forecasts do not incorporate the impact of rare but high-impact disruptions such as global pandemics, commodity price crashes, wars, trade embargoes, or severe supply chain breakdowns.
- Policy and Regulatory Risk – Changes in environmental regulation, trade tariffs, decarbonisation mandates, or recycling incentives could significantly alter consumption and trade flows beyond what the model projects.
- Technological Shifts – Potential breakthroughs in materials science, product design, or recycling technologies could reduce or increase copper/aluminium demand in ways that differ substantially from the historical trend.
- Use of the Data – The results are provided for informational and analytical purposes only and should not be relied upon for investment, commercial, or operational decision-making without further validation and context-specific due diligence.
- Recommendation: Users should treat these figures as indicative estimates, supplement them with updated market intelligence, and test multiple scenarios—particularly when informing strategic or financial decisions.

TECHNICAL APPENDIX

Purpose

The report's purpose was to provide detailed information on the US markets for EoL available recycled copper and aluminum, including current levels of demand and availability, in addition to projected availability, and indicate the available material tonnage reservoir, now and in the future. The report will be used to address concerns on potential shortages of recycled material in the US and support the association's efforts to promote the free and fair trade of recycled copper and aluminum.

Supporting Materials

A slide deck and dataset accompany this report.

Methodology

- Secondary research to screen existing statistics. Searching existing academic studies and projects on the topic.
- Primary research surveyed key organizations in the value chain. MM Markets was given important access to ReMA membership.
- Analysis and reporting merged results of the secondary and primary research.
- A base model was originated to calculate vital figures from key sources and set parameters.
- A slide deck, dataset, executive summary, technical appendix and meetings formed the output materials.
- See methodology slides and dataset parameters for further detail.

Acronyms, Definitions
(Not exhaustive)

1. Abandoned - A metal shape or product which has been left behind and is no longer used. The metal has not entered the recycling chain and has not been landfilled
2. Available EoL – available end-of-life material left in place, stockpiled or abandoned
3. Construction - Buildings, tubes, building wiring, telecommunications, general wiring
4. Consumer Products (appliances, tools)
5. Material in use: material consumed be different
6. EoL recycled copper/aluminium: US apparent copper/aluminium consumption (including copper/aluminium exported and imported as metal or semis), recovered after the life time of the sector specific applications.
7. Cumulative - Increasing by successive additions
8. DoE - Department of Energy
9. Electrical and Electronic Products – Including utilities easily accessible electrical equipment switchgear cabinets, rack-mounted gear, modular transformers, embedded/larger infrastructure duct banks, underground feeders, cable in conduit, embedded busways, power cable
10. EoL – End of Life. Materials and products reaching end of use, transitioning to a resource for future use through recycling or reuse
11. EPA – Environmental Protection Agency
12. ICSG – International Copper Study Group

13. Industrial Machinery - High value machinery motors, transformers, process lines, large, embedded machinery, mining equipment, turbines, ship-mounted systems). In the context of industrial construction machinery building plant
14. IAI - International Aluminum Institute
15. Kte – Kilo tonne estimate
16. Ktf – Kilo tonne forecast
17. Left in place - A metal shape or product which has not been moved. The metal has not entered the recycling flow
18. Other - e.g., coins, military, art
19. Post consumer – Aluminum and copper originating from flows such as households and businesses after the consumer has used the product for its intended purpose
20. Prompt - Residuals of industrial processes, the remainder from production of products such as sheet metal, automobiles, and electronics, power cables etc. Immediately reused in-house, never reaching the marketplace
21. Stockpiled - Gathering in a supply of metal shapes or product in preparation for possible future use/recycling. The product is not in use, has not been landfilled, and has not entered the recycling stream
22. Transportation (cars, trains, aircraft)
23. UNEP - United Nations Environment Programme
24. US recycled copper/aluminum provision = recycled material produced and imported
25. US recycled copper/aluminum requirements = consumption and exports
26. USGS – United States Geological Survey

References

<u>ALUMINUM</u>

Sources for the EoL aluminum left in place, abandoned or stockpiled	
Automotive & transportation	US EPA – End-of-Life Vehicle (ELV) Management Guide “End-of-Life Vehicle Management: A Guide for Policymakers and Stakeholders” (EPA, 2020). epa.gov • International Aluminium Institute (IAI) – Automotive Aluminium Recycling at End of Life (2021, WPI study) https://www.aluminum.org/sites/default/files/2021-10/Final-Report-Automotive-Aluminum-Recycling-at-End-of-Life-A-Grave-to-Gate-Analysis.pdf • Graedel, T. et al. (2002, 2004, 2011) – Yale University Material Flow Studies (See Proceedings of the National Academy of Sciences, 2011 on metal stocks in society). • USGS Circular 1196 – Flow Studies for Recycling Metal Commodities in the United States (2002) • PopCenter – Abandoned Vehicles Problem-Oriented Policing Guide: https://popcenter.asu.edu/content/abandoned-vehicles-0. Automotive • Abandoned vehicles: Cars/trucks dumped on farmland, forests, or urban lots. The aluminum content in wheels, hoods, cylinder heads, transmission casings remains stranded. “Hibernating” vehicles: Old pickups or classic cars kept in barns or backyards indefinitely, never re-entering the recycled material scrap cycle. Junkyards with incomplete recovery: Some ELVs are partially stripped (tires, engines) but aluminum components like doors, panels, or cast parts are left to corrode in place. Aircraft: • Aircraft boneyards (e.g., Mojave Desert, Arizona storage): Decommissioned planes often sit for decades with aluminum fuselages, wings, and internal structures intact. Not all are dismantled for recycling. Military aircraft: Many decommissioned units are parked in storage (e.g., Davis-Monthan AFB “aircraft graveyard”), where huge amounts of aerospace aluminum remain in hibernation rather than reprocessed. Rail: • Railcars in sidings/yards: Retired aluminum-bodied freight cars or passenger coaches

	stored long-term. Some are never scrapped. Urban transport stock: Old aluminum subway or light rail cars sometimes dumped or “reefed” (sunk for artificial reefs) — aluminium remains trapped in those structures. Marine • Decommissioned ships with aluminum superstructures: Naval vessels, ferries, and yachts in ports or scrapyards for decades.
Construction (building and demolishing)	• • EPA – Advancing Sustainable Materials Management: Facts & Figures This series (e.g., 2018, 2020 editions) includes data on the generation, recycling, and disposal of Construction & Demolition (C&D) debris, including metal recovery rates. While it doesn’t isolate aluminum left in place, it provides the basis for comparing recovered vs. total debris, from which the "left in place" share (by difference) can be estimated. https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/advancing-sustainable-materials-management? • International Aluminium Institute (IAI) – Global Recycling Data The IAI publishes global aluminum recycling efficiency stats (~76%) and material flow analyses. Their insights on building-related aluminum recycling can be applied to infer “left in place” in C&D. https://international-aluminium.org/international-aluminium-institute-publishes-global-recycling-data • Yale/Material Flow Analysis (Graedel et al.) While not directly sourced by our search, foundational MFA studies describe “hibernation” or stranded aluminum stocks in long-lived infrastructure - Building Envelope Window & door frames, . Curtain wall & façade extrusions Often left embedded in concrete or brickwork during demolition, especially in large residential tear-downs. Contractors may remove glass but leave the aluminium frame in the wall - Roofing & Siding Aluminium siding panels Roofing sheets & flashing Small surface aluminium (e.g., flashing, gutters) is often ignored as low-value material during demolition and ends up left in place. - Electrical & Mechanical Systems Aluminium wiring & conduit HVAC ducting & foil insulation Especially in older buildings (1960s–70s), aluminium wiring in walls is usually left behind when the structure is demolished because extracting it is too labor-intensive. - Infrastructure Streetlight poles, signage frames In some road demolitions or replacements, aluminium poles and sign frames are buried in rubble or left in the ground if removal costs outweigh material value. Window walling in bridges or terminals Aluminium elements in transport infrastructure (stations, airport terminals) often stay in place if structures are only partially demolished.
Foil, cans & other packaging	For all periods (1985, 2000, 2020s, 2040), the share of packaging aluminium “left in place/abandoned” is effectively 0%, because packaging doesn’t remain embedded in infrastructure — it either gets recycled, landfilled, incinerated, or dissipated as litter. • EPA – Advancing Sustainable Materials Management: Facts & Figures: Provides long-term U.S. recycling, landfilling, and combustion rates for aluminum packaging (cans, foil, other containers). Shows that discarded packaging flows into MSW management (recycled / landfill / combustion) — no stock is stranded in place. https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling • USGS – Aluminum Statistics and Information Packaging aluminum always appears in MSW flow, not in “hibernating stocks.” • The Aluminum Association – U.S. Aluminum Can Recycling Rates: Historical series: UBC recycling peaked 60% in 1990s, fell to 45–50% in 2020s. Confirms that unrecovered cans are discarded (landfilled/incinerated), not left embedded. https://www.aluminum.org/Recycling • International Aluminium Institute (IAI) – Global Recycling Data: Mass Flow model (2021) allocates packaging into recycled, landfill, and dissipation pathways. • Graedel et al. (Yale MFA studies, e.g. PNAS 2011: “Metal Stocks in Society”): Packaging explicitly classified as not retained in place but as dissipated or landfilled.

Electrical engineering & electronics including utilities	Left in place" category is dominated by cables, wires, and utility hardware embedded in infrastructure. • Underground or building cabling: Large volumes of aluminum wiring are simply cut and abandoned during building demolition or infrastructure replacement. • Utility lines: Some old overhead/underground conductors are de-energized and left in place if removal costs higher than material value. Sources • USGS Circular 1196 (2002, Flow Studies for Recycling Metals) – highlights that aluminium wiring/cabling often remains unrecovered in buildings. • International Aluminium Institute – Global Mass Flow Model (2021) – notes high "hibernation" and "not collected" shares in electrical infrastructure. • EPA C&D and E-waste reports – show low collection of wiring/electronics, implying abandonment or dissipation. • Graedel et al., Yale MFA studies – explicitly categorize "hibernating stocks"
Machinery & equipment	Large, fixed installations: aluminium components in turbines, presses, or heavy machinery foundations sometimes remain in-situ when plants are dismantled. • Embedded machinery in factories/mines: equipment may be buried, sealed, or abandoned underground rather than dismantled. • Military/industrial stockpiles: some specialised machinery is mothballed rather than recycled. Sources: • USGS Circular 1196 (2002) – notes low recovery efficiency in machinery due to "dispersed and inaccessible stocks." • IAI Global Mass Flow Model (2021) – shows higher "not collected / abandoned" share for machinery than for transport or packaging. • Graedel et al. (Yale MFA, 2011, PNAS: Metal Stocks in Society) – highlights "hibernating" industrial equipment stock as a distinct category. • EPA Industrial Waste & Abandoned Sites reports – confirm machinery often left at brownfield sites. A large share of aluminium in U.S. industrial machinery ends up landfilled/dissipated because dismantling is costly, alloys are heterogeneous and contaminated, and demolition often treats machinery as rubble, so only the most obvious and valuable metals (steel, copper) are recovered. • Complexity of Machinery Scrap: Heterogeneous alloys & composites: Machinery contains cast aluminium, wrought parts, fasteners, coatings, greases, plastics that are difficult to separate economically. Many components are light castings, heat sinks, housings, or mixed alloy chips → they are either lost with mixed shredder residue or too costly to recover. • Demolition & Decommissioning Practices: Mechanical demolition (plants, workshops, mines) often treats machinery as bulk rubble. Aluminium gets mixed with concrete, insulation, and steel, much of it is landfilled as C&D debris. Industrial site abandonment: Equipment may be bulldozed, buried, or scrapped in situ, especially at brownfield sites where environmental remediation focuses on hazards, not metals. • Economics Lower material value vs. copper/steel: Dismantlers prioritize copper (wiring, motors) and bulk steel; aluminium in machinery is often low-return. • Systemic Gaps in U.S. Recycling Brownfield exemptions: Old machinery at industrial sites can be buried or capped during site closure instead of dismantled for recycling.

Consumer goods and other applications	Consumer goods: 5–8% of EoL aluminium left in place/hoarded/abandoned., Other applications: 30–40%. Consumer Goods (appliances, tools, household items, small durables): • Large appliances (refrigerators, washers, stoves): Usually dismantled/shredded and low % "left in place." • Small durables (toasters, lamps, utensils, lawn furniture): Often discarded with MSW mainly landfilled, not left in place. • Hoarding / storage: A small share of small consumer goods (old laptops, broken appliances, aluminum ladders/chairs) sits in households or garages for years before disposal. Other Applications (coins, military, art, miscellaneous) • Coins: Billions of aluminum coins/tokens remain in circulation or drawers indefinitely, effectively "hibernating stock." • Military / aerospace stockpiles: Decommissioned aircraft, vehicles, and weapons frequently mothballed or stored long-term rather than dismantled. • Art/architecture: Rarely dismantled, often persists in situ. Sources • USGS Circular 1196 – Flow Studies for Recycling Metal Commodities in the U.S. (2002) • USGS MCS (annual, aluminum): recycling vs. disposition flows. • IAI Global Mass Flow Model (2021): sectoral collection efficiencies, identifies "hibernating stocks." • Graedel et al., Yale MFA (PNAS 2011 "Metal Stocks in Society"): quantifies hibernating/abandoned stocks across categories. • EPA MSW data: appliance and durable goods recycling vs disposal flows.

Not exhaustive.

1. **USGS – Minerals Yearbook (Aluminum chapters):** Annual reporting of U.S. aluminum apparent consumption by end-use category. "Consumer durables" is often listed as a separate line item in historical yearbooks; "Miscellaneous" or "Other" can also include non-durable consumer goods.

2. **The Aluminum Association** – End Use Market Reports track aluminum usage in consumer goods categories: appliances, cookware, furniture, sporting goods, etc. International Aluminium Institute (IAI) – Global Aluminium Flow Data provides regional breakdowns including "Consumer durables" for North America.

3. I**nternal Aluminum Institute** projections suggest small increases post-2030 if circular economy models extend product life.

4. **Liu, G. & Müller, D.B. (2013) – Mapping the Global Journey of Aluminium:** From Mining to Recycling, Modaresi, R., et al. (2014).

5. **The Role of Postconsumer Scrap in the Aluminium Cycle**, Graedel, T. E., et al. (2011) – What Do We Know About Metal Recycling Rates? (Journal of Industrial Ecology).

6. **EPA – Advancing Sustainable Materials Management Small Electronics** (phones, cameras, gadgets), Studies by the Consumer Technology Association (CTA) and EPA e-waste reports.

7. Furniture, cookware, bicycles- **Trade association reports and product warranty data**, Fashion accessories (bags, watches, eyewear): Market research from Euromonitor.

8. 2020–2040 projections: Based on circular economy policies (**Ellen MacArthur Foundation, IAI scenarios)** and early signs of longer product lifespans in premium markets and under right-to-repair legislation.