Recycling Cannot Precede Production

written by Jack Lifton | August 1, 2026

Whenever a chemical element suddenly becomes “critical,” it is only a matter of time before someone announces a recycling company dedicated to recovering it. Governments applaud. Investors become intrigued. Consultants produce optimistic market forecasts. Before long, there are conferences devoted to the “circular economy” for that element. The one question that is rarely asked is the simplest: **What exactly are you going to recycle?**

Recycling is not mining. It is not manufacturing. It is a supply chain that depends entirely upon the existence of an earlier supply chain. Before recycling can occur, there must first be production. Before there can be scrap, there must first have been products. Before there can be end-of-life material, there must first have been a generation of equipment that has reached the end of its useful life. These are not semantic distinctions. They are economic realities.

Consider almost any newly promoted critical mineral. The first announcements are almost always accompanied by a parallel wave of recycling proposals. Yet almost none of those proposals answer the questions that determine whether a recycling business can ever become commercially successful. First, where will the feedstock come from? Industrial recycling lives or dies on feedstock. A recycling plant without a predictable stream of scrap is simply another chemical plant without raw materials.

Second, who owns that scrap? Manufacturers, distributors, repair facilities, demolition contractors, automobile dismantlers, municipal waste systems, and consumers all occupy different

positions in the chain. Every transfer has a cost. Every transfer requires collection, sorting, transportation, and often regulatory compliance.

Third, what will it cost to prepare the material? Very little industrial scrap consists of pure metal. Permanent magnets are embedded in motors. Battery materials are mixed with plastics, steel, aluminum, copper, adhesives, and electronics. Catalysts are attached to ceramic structures. The desired element is often only a small fraction of the total mass. Before any chemical recovery can even begin, the material must be identified, collected, disassembled, separated, cleaned, concentrated, and transported. Those costs frequently exceed the value of the recoverable element unless the process has been optimized over many years.

Fourth, when will enough scrap actually exist? This may be the most neglected question of all. If a new technology is just beginning widespread adoption, there is almost no end-of-life material available for recycling. The very success of the technology delays the appearance of recyclable feedstock because the products remain in service for years—sometimes decades. Wind turbines remain in operation for twenty years or more. Electric vehicle motors may remain in service for fifteen years. Industrial automation equipment often operates for decades.

In other words, the greater the success of a new technology, the longer investors must wait before meaningful quantities of recyclable material become available. This creates a paradox. The greatest enthusiasm for recycling appears precisely when the least recyclable material exists.

Finally comes the financing question. Every investment ultimately depends upon one calculation: when does the investor begin receiving a return? A recycling company must demonstrate

not only that its chemistry works, but also that its feedstock will exist in sufficient volume, at predictable quality, and at an acceptable cost for decades. That is an extraordinarily difficult proposition when the underlying products have only recently entered commercial production.

Investors are therefore being asked to finance businesses whose principal raw material may not become abundant for ten, fifteen, or even twenty years. That is not impossible. It is simply a different type of investment than is often portrayed.

None of this argues against recycling. Quite the contrary. A mature critical minerals industry should recycle aggressively. Recovering valuable materials from products that have reached the end of their useful lives is economically sensible and environmentally responsible. But recycling is the final stage of an industrial ecosystem—not the first.

The history of metals demonstrates this repeatedly. Steel recycling became significant only after generations of steel production. Copper recycling followed the creation of enormous installed inventories. Aluminum recycling became economical only after aluminum became ubiquitous. The same pattern will almost certainly hold for rare earths, lithium, gallium, scandium, hafnium, and every other emerging critical material.

The lesson for policymakers and investors is straightforward. Do not confuse future recycling potential with present-day supply. A recycling company should be evaluated first by the quality, quantity, ownership, and economics of its feedstock—not merely by the elegance of its chemistry. As I have argued repeatedly, governments and financial markets cannot suspend economic reality.

Recycling is indispensable.

But it cannot recycle materials that have not yet been produced.