Circular Economy for building materials

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USG
USG Corporation is an industry-leading manufacturer of building products and innovative solutions

For more than 115 years, we have expanded the boundaries of building science with products and systems that are safer, lighter, stronger and more sustainable.

Our products have been used to build some of the world’s most iconic structures, such as the Freedom Tower in New York, Burj Khalifa in Dubai, and Lotte Tower in Seoul.

SUSTAINABILITY
Sustainable practices have been core to USG’s business and choices for more than 100 years. It’s how we build a better world for our customers, employees and communities while caring for our business and the world around us.

USG is the only wallboard manufacturer to join in the Architecture 2030 Challenge for Products, where we voluntarily work to lower our carbon footprint in sourcing, manufacturing and transportation by 2030. This is part of a larger effort to design, build and operate carbon-neutral buildings by 2050.
Our Second Century
In Sustainability

- USG develops modern wallboard manufacturing
- Moved to natural gas from heavy oil as primary fuel
- Development of ceiling tile using slag wool from post-industrial waste
- Sheetrock® Panels use 100% recycled paper
- USG Paper Mill generates its own electricity
- First user of synthetic gypsum, a byproduct of coal fired power plants
- USG Diversity and Inclusion Strategy Council formed
- USG paper mills recycle nearly 100% of wastewater
- Life cycle assessment conducted for major product lines
- First USG Sustainability Goals announced
- Ceilings Recycling Program was launched
- Patented wallboard manufacturing water reduction additives
- USG Rainier, OR plant started a jobsite reclaim take back program for wallboard
- USG Sustainability Tool released to help customers with green building documentation submission
- USG Sustainability Tool received for wallboard products
- USG published Declare Labels
- USG published EPDs (Environmental Product Declarations) for ceiling products
- Participation in the Architecture 2030 Challenge for Products for 30 ceilings portfolio
- USG Design Studio LEED® Reporting Tool launched
- Development of Health Product Declarations® (HPD) for ceiling and wallboard products
- USG publishes EPDs (Environmental Product Declarations) for wallboard products
- USG announces 2030 Sustainability Goals

USG SUSTAINABILITY
Along with climate change, waste generation is one of the most challenging problems that humanity faces today and in the future. USG is improving our recycling practices in the communities where we operate. We’ll continue to invest in partnerships with companies that will help us reach our targets.

- Become the recognized leader in construction job site reclaim for gypsum board and ceiling tile recycling
- Achieve zero manufacturing waste to landfill
Urban recycling to build a circular economy in USA

10-11 million tons of dry wall scrap estimated to be co-mingled with C&D debris and other waste

13 million tons/year of gypsum dry wall scrap is landfilled annually

2-3 million tons is estimated to be clean job site construction dry wall waste

Gypsum Mineral Commodity Summary, 2021, USGS
Construction and Demolition Debris Generation in the United States, US EPA, 2018, Table 6, p. 18
How is dry wall made?

The dehydration of natural gypsum or synthetic gypsum (specifically known as calcination) is between 120 to 150°C (250 to 300°F) and the heat energy delivered to the gypsum (the heat of hydration) goes into driving off water and not into increasing the temperature of the mineral as shown below:

\[ \text{CaSO}_4\cdot2\text{H}_2\text{O} + \text{heat} \rightarrow \text{CaSO}_4\cdot\frac{1}{2}\text{H}_2\text{O} + 1\frac{1}{2}\text{H}_2\text{O} \text{ (steam)} \]

The partially dehydrated mineral is called calcium sulfate hemihydrate or calcined gypsum (though more commonly known as plaster of Paris) and has the chemical formula \(\text{CaSO}_4\cdot\frac{1}{2}\text{H}_2\text{O}\). (Exterior plaster or Stucco).

Calcined gypsum has an unusual property: when mixed with water at normal (ambient) temperatures, it recombines with the water that was driven off during calcination, and sets to form a strong gypsum crystal lattice: (e.g. at mixer followed by kiln)

\[ \text{CaSO}_4\cdot\frac{1}{2}\text{H}_2\text{O} + 1\frac{1}{2}\text{H}_2\text{O} \rightarrow \text{CaSO}_4\cdot2\text{H}_2\text{O} \]
Extract gypsum from clean construction dry wall scrap

Clean job site construction dry wall gypsum waste

Ground gypsum from clean job site construction dry wall gypsum waste
Building a circular economy for gypsum contractor waste

Challenges:
Ability to implement construction job site separation of dry wall scrap from other construction debris.
(https://vimeo.com/135889925/cbb111116b)

Requirements of construction job site haulers:
- Dry wall that has NOT been previously installed (i.e., no demolition scraps)
- Scraps have no paint on them
- Scraps have no nails or screws
- No metal trims
- No garbage

Above: Closed Loop Wallboard — Collaborative — Building Product Ecosystems LLC
Additional challenges to building a circular economy

Litigation risk from potential contamination.

Material product safety concerns:
- Exposure during service life (e.g. lead paint.)
- Unknown source (e.g. “Chinese drywall.”)
- Asbestos contamination.
- Additives that are carried over into post-consumer recycled (PCR) dry wall waste

Consistent supply:
- PCR dry wall waste collection and processing continues to be erratic and varies according to job site

Separation of paper from gypsum
- Even with paper “removed” a significant amount% of paper is carried with the gypsum, which is mechanically and chemically bonded to gypsum slurry during manufacturing.
Summary to building a circular economy

Can these obstacles be overcome?
Yes, but not easily or quickly.

What will it take?
Significant investment in R&D, potential process adjustments, material handling and feeding adjustments, etc.