

ISSUE 1 • 2022

# ASH **at work**

Applications, Science, and Sustainability of Coal Ash

## HOW COAL ASH IS HELPING DIAL DOWN INDUSTRY'S GREENHOUSE GAS EMISSIONS

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# The Green Attributes of FGD Gypsum

By Eric Effinger

While fly ash used in the production of concrete is the most common and largest use of recycled coal combustion products (CCPs), gypsum is not far behind in the overall recycled use and sustainability story. Today, flue gas desulfurization (FGD) gypsum represents the second-highest volume of recycled CCP in the U.S. (trailing only fly ash), with the second-highest beneficial use rate (trailing only FBC ash).

According to the ACAA’s 2020 Production and Use Survey, the rate of coal ash recycling overall in the U.S. increased in 2020, reversing two years of declines. During 2020, 59 percent of the CCPs produced across the country were recycled, up from 52 percent in 2019. 2020 represented the sixth consecutive year that more than half of all the coal ash produced was beneficially used rather than disposed. 40.8 million tons of CCPs were beneficially used in 2020, nearly the same as the previous year, but production of new CCPs declined from 78.6 million tons in 2019 to 69.2 million tons in 2020.

Approximately 18 million tons of FGD gypsum were produced in the U.S. in 2020, of which over 74 percent was beneficially used. Nearly 10 million tons were used by the wallboard manufacturing industry and approximately 848,000 tons were used by the agriculture industry, up 3 percent and 34 percent from the previous year, respectively.

## About Synthetic Gypsum

While natural gypsum is mined, synthetic gypsum is a routine product of flue gas desulfurization (FGD) and sulfur dioxide

(SO<sub>2</sub>) compliance operations at coal-fueled power plants. Synthetic gypsum is a byproduct generated by removing sulfur from the combustion gases via emissions control devices known as scrubbers. Using high-calcium sorbents, such as lime or limestone, scrubbers absorb sulfur and other elements from flue gases, creating these non-ash byproducts that are managed and regulated as CCPs. FGD gypsum has the same chemical formulation—calcium sulfate dihydrate—as mined gypsum and is often more pure than natural gypsum, with a purity rate above 90 percent.

Over 50 years ago, the 1970 Clean Air Act and its policies related to sulfur dioxide (SO<sub>2</sub>) emission standards set the stage for the beneficial use of FGD gypsum. Additional Clean Air Act amendments in 1990 relating to acid rain further established the goal of reducing SO<sub>2</sub> emissions by 10 million tons annually by 2010, or roughly 50 percent below 1980 levels. As a result, coal-fueled utilities installed emission-control technologies, including FGD systems, in order to comply. Many of these technologies operated at 97 percent efficiency, creating a continuous supply of FGD, or synthetic, gypsum and established a market for this important and high-quality sustainable product.

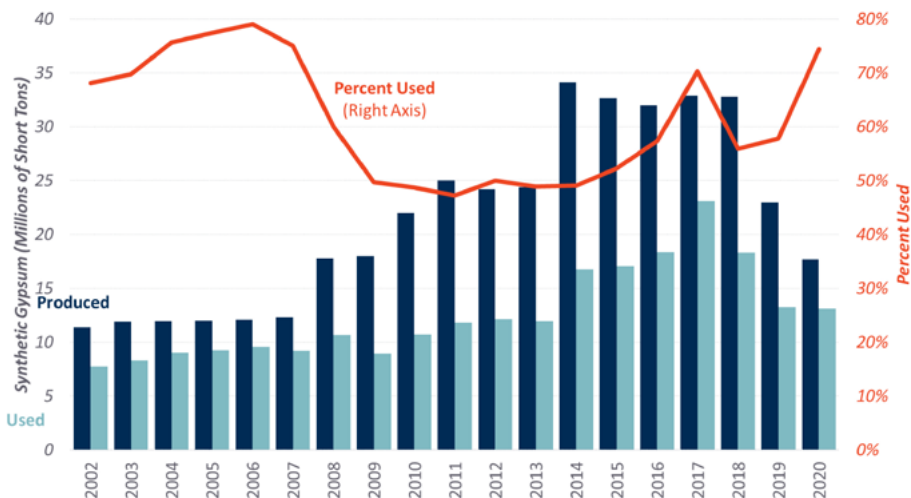
Today it is most widely used in the manufacture of gypsum panel products, or wallboard, which are predominantly used in the construction of interior walls and ceilings. More than half of the gypsum wallboard produced in the U.S. uses recycled synthetic gypsum. Synthetic gypsum is also increasingly applied to agricultural fields to improve soil condition and performance while preventing fertilizer, pesticide, phosphorous, and other runoff. The recently

passed (November 2021) Infrastructure Investment and Jobs Act is expected to continue to drive demand for CCPs.

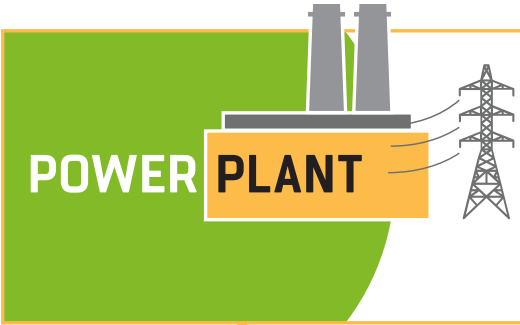
## Beneficial Use of FGD Gypsum

Raw gypsum byproduct is sold to manufacturing plants, where it is beneficially used in residential and commercial construction projects. The beneficial use of gypsum in drywall offers product benefits, including fire resistance, sound control, versatility, quality, convenience, and cost-effectiveness. From an environmental perspective, it eliminates the need for utilities to dispose of FGD material in landfills or ponds while reducing water and energy consumption.

Synthetic Gypsum Production and Use (2002 - 2020)



Graph: ACAA 2020 Production and Use Survey



# POWER PLANT

Coal ash is generated by burning coal in the boiler furnace, which creates bottom ash. The ash then goes into the electrostatic precipitator or fabric filter which creates fly ash; then into the flue gas desulfurization (FGD) creating gypsum - all byproducts which are managed by Charah Solutions and can be beneficially used creating a sustainable process.

## BENEFICIAL USE of CCPs

Charah Solutions manages the coal combustion products (CCPs) including fly ash, bottom ash, conditioned ash, ponded ash, and gypsum, which are collected and beneficially used in products for multiple industries. By beneficially using more than 2.58 million tons of ash and supplementary cementitious materials (SCMs) each year, we dramatically reduce greenhouse gas emissions and the amount of waste sent to landfills.

Fly Ash Ready Mix Concrete	Fly Ash Structural Fill	Ponded Ash Kiln Feed	Bottom Ash Cinder Block
Conditioned Ash Kiln Feed	Gypsum Drywall	Oil Wells	Gypsum Fertilizer

**WE BENEFICIALLY RECYCLED MORE THAN 2.58 MILLION TONS OF CCPs IN 2020**

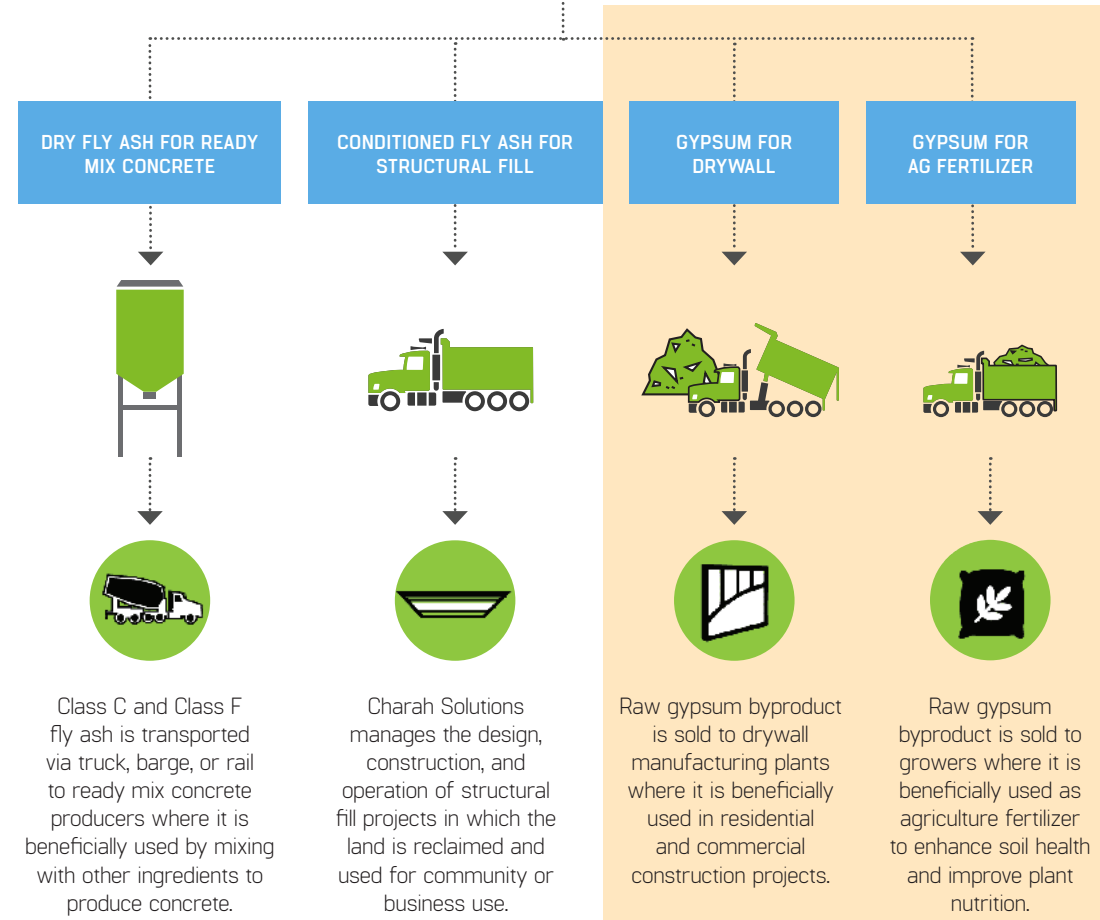




Photo: CC BY-NC-ND 2.0 - Rene De la Garza

Moreover, recycling this CCP reduces the need to mine virgin gypsum and thus preserves natural resources.

In addition, after its use as wallboard, FGD gypsum can be recycled and beneficially used again in other applications—as an additive to concrete, plaster, and stucco. According to the Gypsum Association, the core material can be reused as a soil amendment, as a water treatment to settle suspended clay particles, and as an addition to animal bedding to absorb moisture. Research is also being conducted on incorporating gypsum core into large-scale composting efforts.

Raw gypsum byproduct is also sold to growers, who beneficially use it as agricultural fertilizer to enhance soil health and improve plant nutrition. Farmers have used gypsum (calcium sulfate dihydrate) for centuries as a soil amendment because of its many benefits. It is an excellent source of calcium and sulfur that provides plant nutrition and can increase crop yield. It also improves acid soils and treats aluminum toxicity, resulting in increased root growth. Gypsum improves soil structure, enhances water infiltration, and helps reduce runoff and erosion.

Charah Solutions has years of experience managing FGD operations and marketing wallboard-grade quality gypsum. We provide comprehensive operations and maintenance for FGD plants and processes from limestone delivery management,

***Beneficial use of FGD gypsum reduces the need to mine virgin gypsum (pictured above), thus preserving natural resources.***

to unloading and crushing, to final gypsum loadout. Charah Solutions then provides marketing and management services, including operations support for onsite management or implementing innovative loading, transportation, and marketing solutions to deliver cost savings to our customers and recycle gypsum for the manufacturing of drywall and agricultural fertilizer.

Increasing beneficial use requires marketers to ensure that products are consistent and available when and where customers need them—from drywall manufacturers to the farmers themselves. Over the past five years, Charah Solutions has ramped up efficient distribution of fly ash, gypsum, and other CCPs through expansion of its MultiSource® terminal network. The Charah Solutions MultiSource materials network is a unique distribution system of more than 40 locations nationwide, with international sourcing and distribution and a national network of barge, rail, and truck services that provide a continuous and reliable supply of CCPs, including gypsum, for ready-mix concrete producers, wallboard manufacturers, farmers, and other customers throughout the U.S.



CONSERVES  
VIRGIN  
RESOURCES



DECREASES  
LANDFILL  
DISPOSAL



REDUCES  
GREENHOUSE  
GAS EMISSIONS



CONSERVES  
AND PROTECTS  
WATER



REMEDiates  
LAND  
FOR USE

The MultiSource materials logistics network provides CCPs to markets where they are needed, as well as sufficient storage to level out seasonal supply and demand fluctuations. With terminals and distribution hubs in place nationwide, customers are now able to reliably purchase CCPs, including ash and gypsum, through the MultiSource network in the Midwest, Northeast, and Southern regions. In addition, Charah Solutions continues to strategically expand the network to meet growing customer demand.

### The Green Benefits of Recycling

Today, more than ever, the importance of Environmental, Social, and Governance (ESG) actions and commitments of corporations are driving real environmental and social change across the country to improve our planet and lives. These matters will only continue to increase in relevance for companies of all sizes as regulators look to standardize ESG reporting across the globe and hold all businesses accountable to ensure they are doing their part to improve ESG compliance.

FGD gypsum is a great example of sustainability in action. The beneficial use of FGD gypsum and other CCPs conserves virgin resources and water, reduces greenhouse gases, and decreases landfill disposal, all while providing essential recycled products that contribute to the growth of our economy and land remediation for the community. The beneficial use of synthetic gypsum not only helps conserve natural resources, but dramatically reduces the need for landfill disposal.

Recycling more than 2.58 million tons of ash and other supplementary cementitious materials (SCMs) each year, Charah Solutions is proud of the role it plays in helping dramatically reduce greenhouse gas emissions, conserve water and virgin resources, and lower the volume of materials sent to landfills. We beneficially recycle gypsum to produce drywall

and fertilizer, as well as recycle ash into green concrete and environmentally sound structural fill projects that return thousands of acres of land to the community for recreational or commercial use. In 2020 alone, per the EPA WARM model, Charah Solutions saved 2.24 million tons of CO<sub>2</sub> from entering the atmosphere through the recycling of these CCPs.

As federal and state guidelines around the recycling of CCPs, including gypsum, become more defined and mandated, utilities need to focus beyond the recycling of ash into the concrete industry for their byproduct sales and marketing efforts. With growing demand for construction projects, as well as increased construction material prices, the future of FGD gypsum use in recycled materials, including wallboard

**Today, more than ever, the importance of Environmental, Social, and Governance (ESG) actions and commitments of corporations are driving real environmental and social change across the country to improve our planet and lives.**

and crop fertilizer, will continue to grow. As a result, there is great opportunity for byproduct sales organizations, as well as utilities that look to meet environmental goals as well as state and federal regulations, to recycle more byproducts, lower greenhouse gas emissions, and reduce volumes of landfilled materials. In the end, this increased demand for recycled gypsum will benefit the entire industry, including suppliers, utilities, manufacturers, farmers, and—not the least—the environment.

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