CRONUS
INVESTMENT BANKING

Coal Combustion Residuals:
The Source, Issue, Remedy And Opportunity

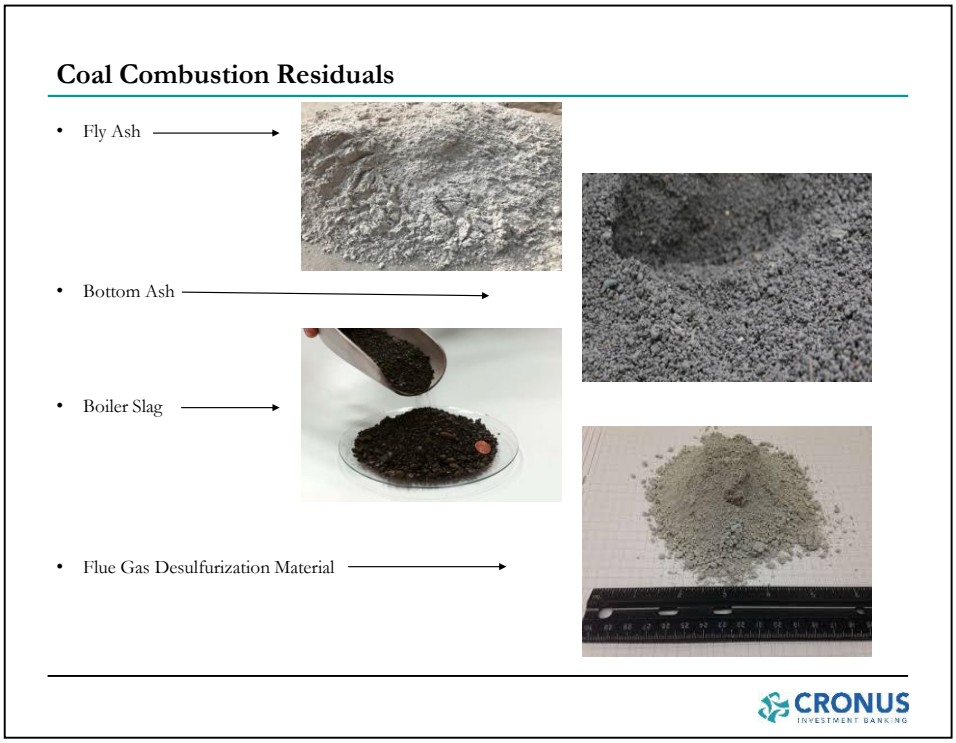
September 2019

Presentation by:
Kenneth Leung
Managing Director

The Source

What are Coal Combustion Residuals?

CRONUS
INVESTMENT BANKING



Coal Combustion Residuals, or CCRs represent the second largest industrial waste stream generated in the U.S. by volume. In broad terms, CCRs include a variety of coal combustion by-products.

Fly Ash is mostly a silica-based fine powder produced from the burning of fine ground coal in a boiler.

Bottom Ash is a heavy angular waste formed at the bottom of the coal furnace.

Boiler Slag is the molten bottom ash from the slag tap and cyclone furnace that turns into pellets with a glassy appearance after being water quenched.

Flue Gas Desulfurization Material or FGD is a wet sludge-like residual consisting of calcium sulfite or calcium sulfate coming out of a wet scrubber or a dry powered mix of sulfites and sulfates coming out of a dry scrubber for acid gas: both are by-products from the emission control process where the flue gas is scrubbed or cleaned after coal burning.

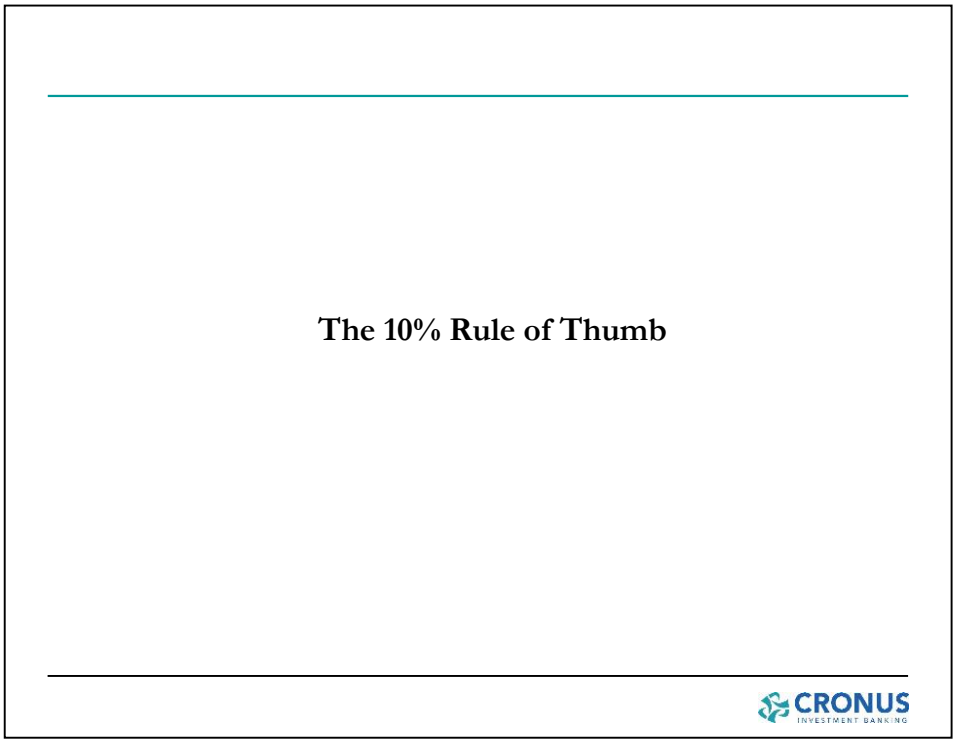
There is more on the types of CCRs later, under beneficial reuse.

Coal-fired Power Plants

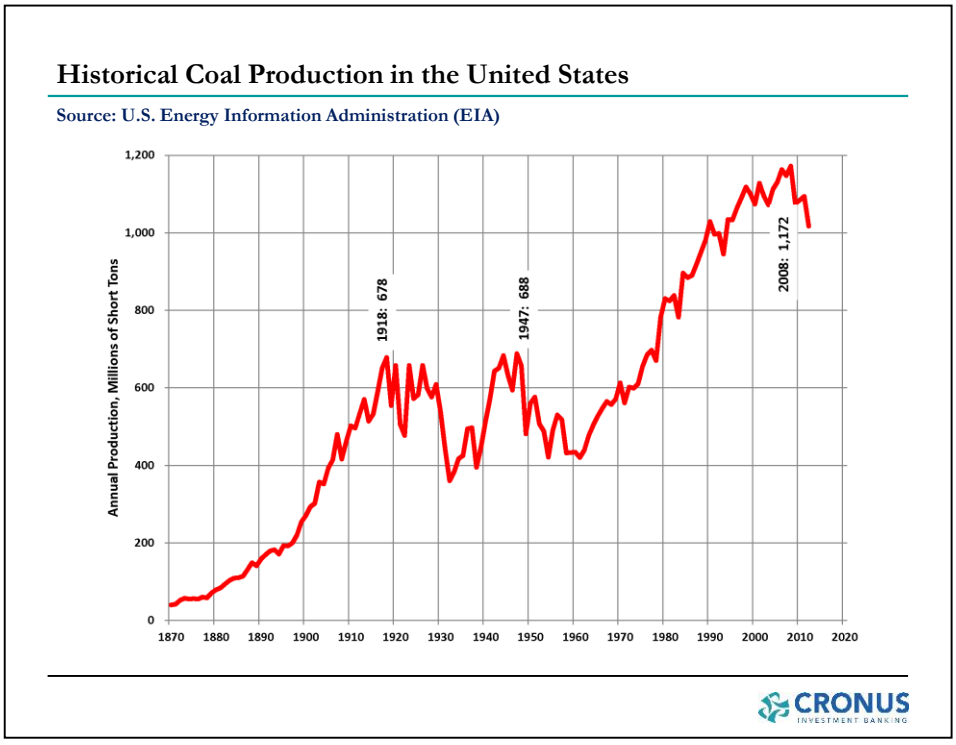
Independent Coal-fired Power Producers

CRONUS
INVESTMENT BANKING

Coal-fired Power Plants and Independent Coal-fired Power Plants are the primary source of CCRs.



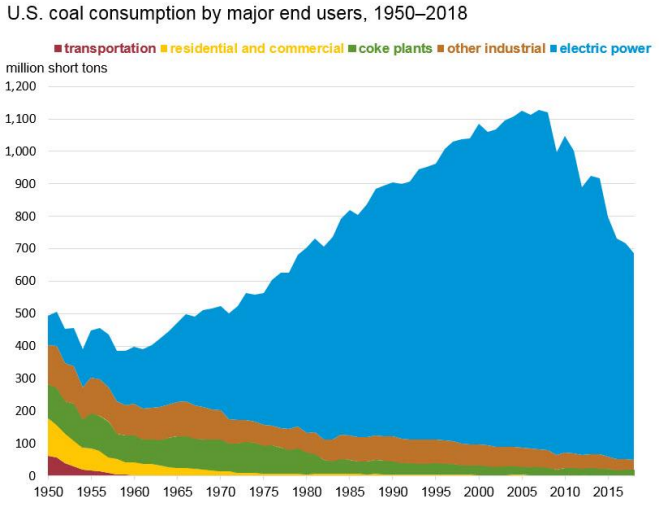
The amount of CCRs produced depends upon the type of coal burned. For instance, lignite has a high ash content and the CCR yield can range 12%-14%. But, after all the various types of coal burned for power generation are considered, bituminous, sub-bituminous, and lignite, the general rule of thumb is 200 lbs. of CCR per 2,000 lbs. of coal burned, or roughly 10%.



As this chart indicates, coal production reached its peak in 2008 at 1.2 billion tons but has been declining ever since.

Historical Coal Usage

Source: U.S. Energy Information Administration (EIA)

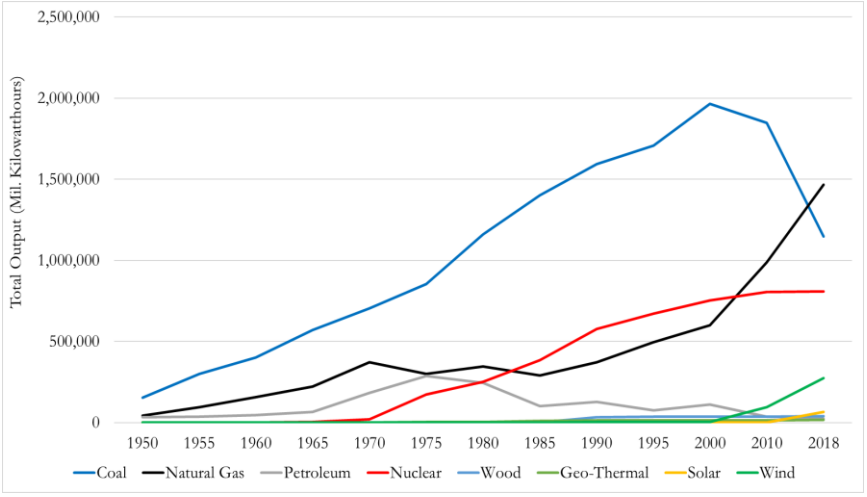


CRONUS INVESTMENT BANKING

With the exception of power plant production, all other coal burning categories have been declining, and as stated before, power plant usage of coal started dropping in 2008.

Historical Power Generation by Type of Energy

Source: U.S. Energy Information Administration (EIA)

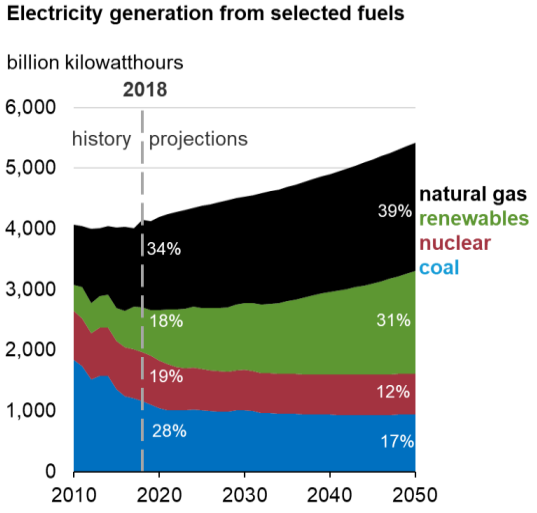


CRONUS INVESTMENT BANKING

While coal usage for power generation continued rising through 2008, it was the concurrent increase in natural gas that actually began coal's demise, being a cleaner fuel to burn and economic to use in small power plants. Although there has been much talk about alternative energy or renewables, it should be noted that only geothermal had actually been much of factor through 2008, whereas solar and wind had not, but that would change, as the foregoing tables indicate.

Projected Power Generation by Type of Energy

Source: U.S. Energy Information Administration (EIA)

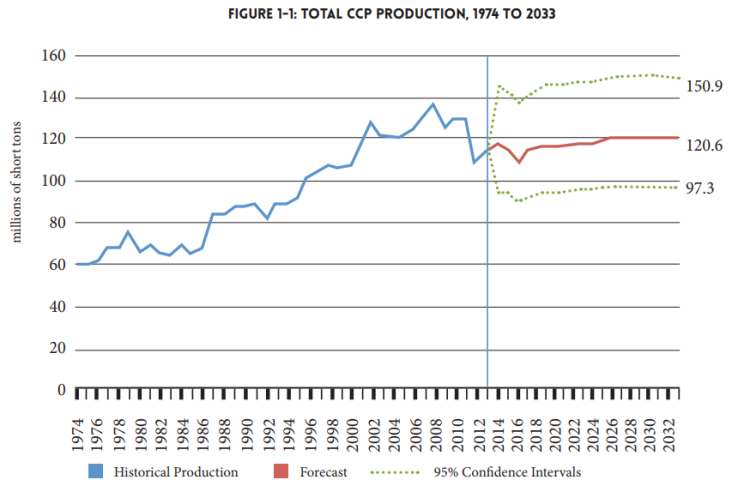


CRONUS INVESTMENT BANKING

Going forward, renewables become a growing energy factor in power generation along with natural gas. It is interesting to note that both coal and nuclear are expected to maintain their share of power generation well into 2050. In the case of coal, many of the older, small coal-fired power plants will have been decommissioned through 2020, leaving the larger, more efficient units running.

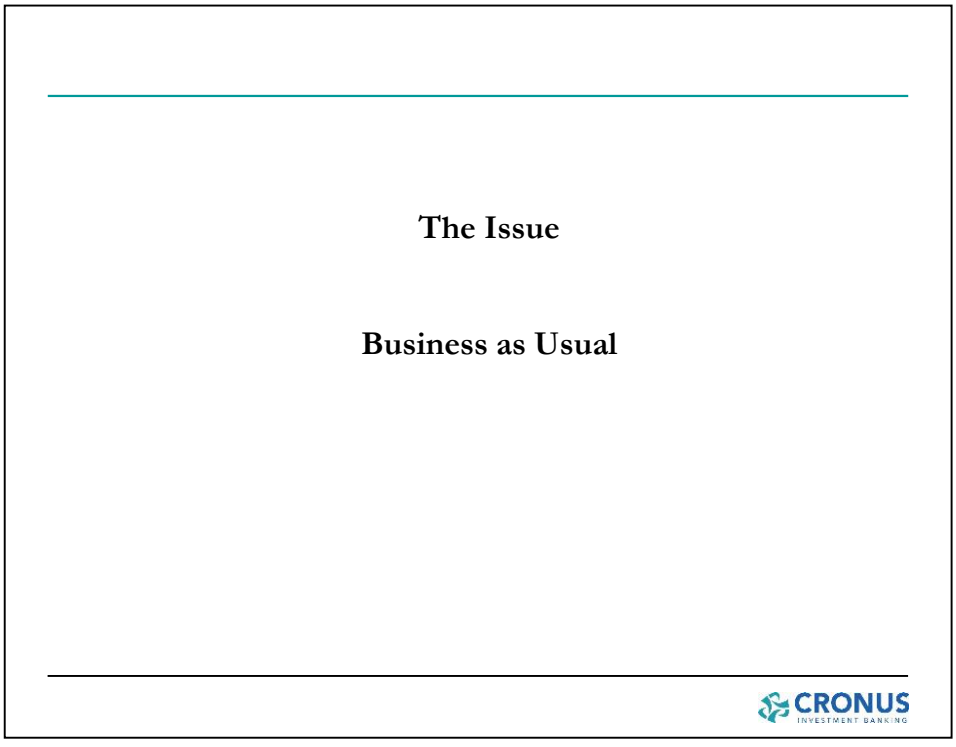
Projected CCR Generation

Source: American Coal Ash Association (ACAA)



CRONUS INVESTMENT BANKING

It is projected that the amount of CCR that will be generated remains relatively steady, with the high- and low-volume projections reflecting of the amount of coal expected to be burned. It is probably safe to say that given that most projections have coal usage declining at power plants, at least through the mid 2020's, that CCR generation will trend somewhere in the mid-to-low range of this projection.



Historically, the utility industry managed its generated CCRs in surface impoundments or ash ponds and landfills.

Surface impoundments are natural depressions, man-made excavations or diked areas, primarily of earthen materials that are used to manage slurry, a mixture of coal ash and water. While most impoundments do not have synthetic liners, use of a compacted clay barriers are sometimes employed to safeguard liquid seepage into surrounding soil and waterways.

Landfills are dry excavations filled with CCR which may, or may not be lined with a geosynthetic plastic on top of a compacted clay barrier.

When surface impoundments and landfills reach capacity, both can be sealed and/or capped with a synthetic material to control or limit moisture infiltration.

The efficacy of these legacy containment practices came under scrutiny following several high-profile environmental incidents.

Tennessee Valley Authority - December 22, 2008

CRONUS
INVESTMENT BANKING

In December, 2008, an ash dike ruptured at the TVA's 84-acre solid waste containment area at its Kingston Fossil Plant in Roane County, Tennessee. More than one billion gallons of fly ash slurry spilled into the Emory River and its Swan Pond recess, covering up to 300 acres of surrounding land. The stored waste also traveled up and down stream in nearby waterways, damaging some 42 houses. As of April, 2015, TVA estimated that the total clean up cost amounted to $1.2 billion, though there are still outstanding potential costs related to illnesses in workers who did the cleanup.

In total, it is estimated that the volume of waste released was 100 times greater than the Exxon Valdez oil spill in 1989. This dike break drew intense scrutiny into the containment methods employed at the facility, and the EPA subsequently found that the 84-acre above ground ash fill was unlined and located 74 feet from the Emory River. Additionally, the cell containing the CCR, which was surrounded by 60-foot earthen walls, had twice developed leaks since 2002.

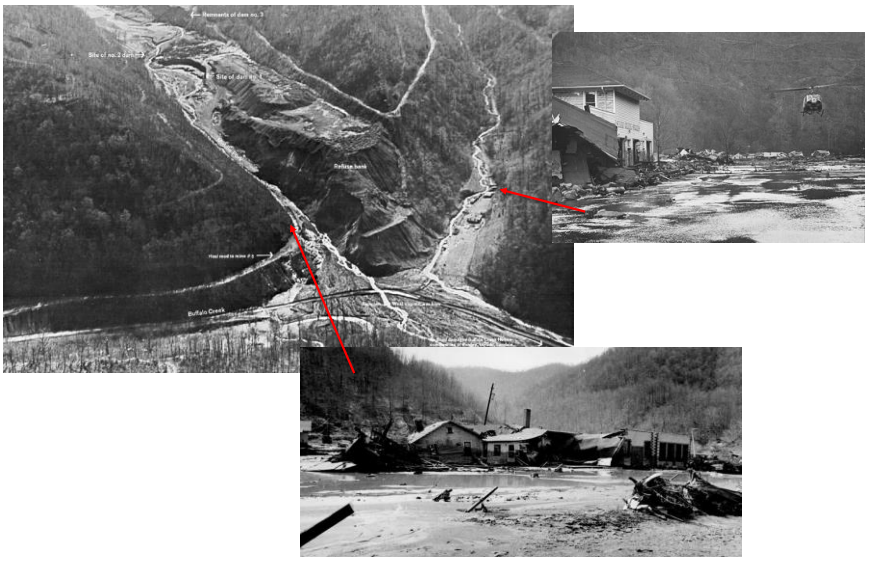
Duke Energy - February 2, 2014

CRONUS
INVESTMENT BANKING

In February, 2014, a drainage pipe burst at a coal ash containment pond at Duke Energy's retired Dan River Steam Station facility in Eden, North Carolina. Up to 39,000 tons of coal ash plus 27 million gallons of wastewater spilled into the Dan River. The ash was deposited up to 70 miles from the spill site.

It is estimated that Duke Energy has spent $260 million to excavate all the coal ash at the site and transport it offsite or into a new lined landfill on the same property. Additionally, some tonnage was recycled for beneficial reuse in a Virginia cement kiln.

Buffalo Creek - February 26, 1972

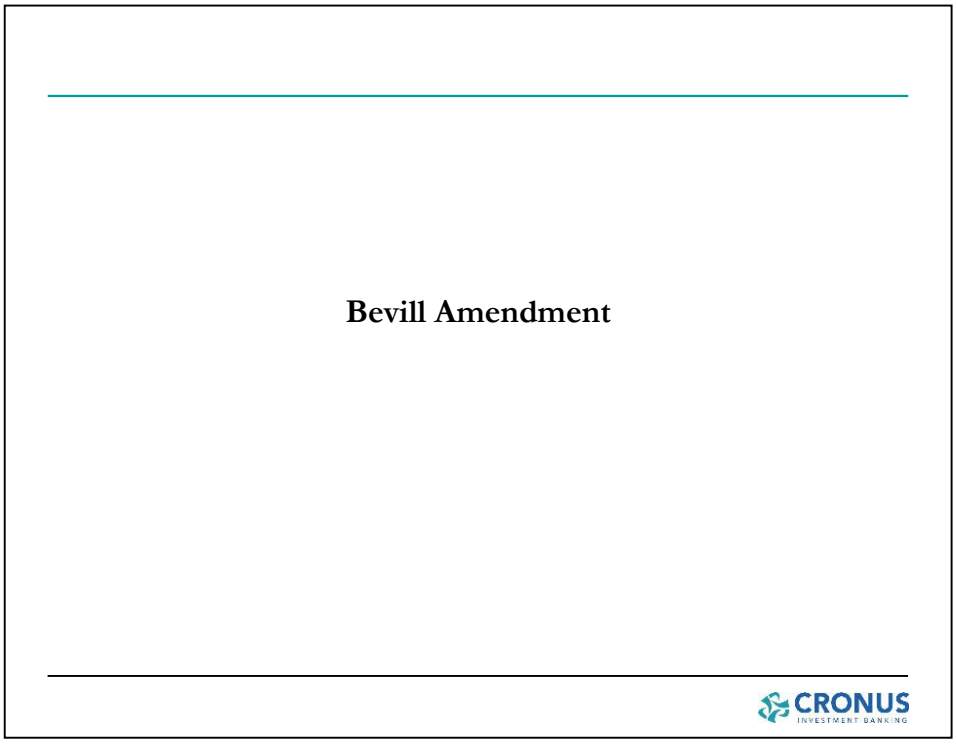


CRONUS INVESTMENT BANKING

Both the TVA and Duke Energy spills are regarded as the primary impetus for passage of the Federal Coal Combustion Residual Rule of 2015. But neither situations were the first nor will they be the last to cause concern over power plant coal burning and the adequate handling of the residual wastes.

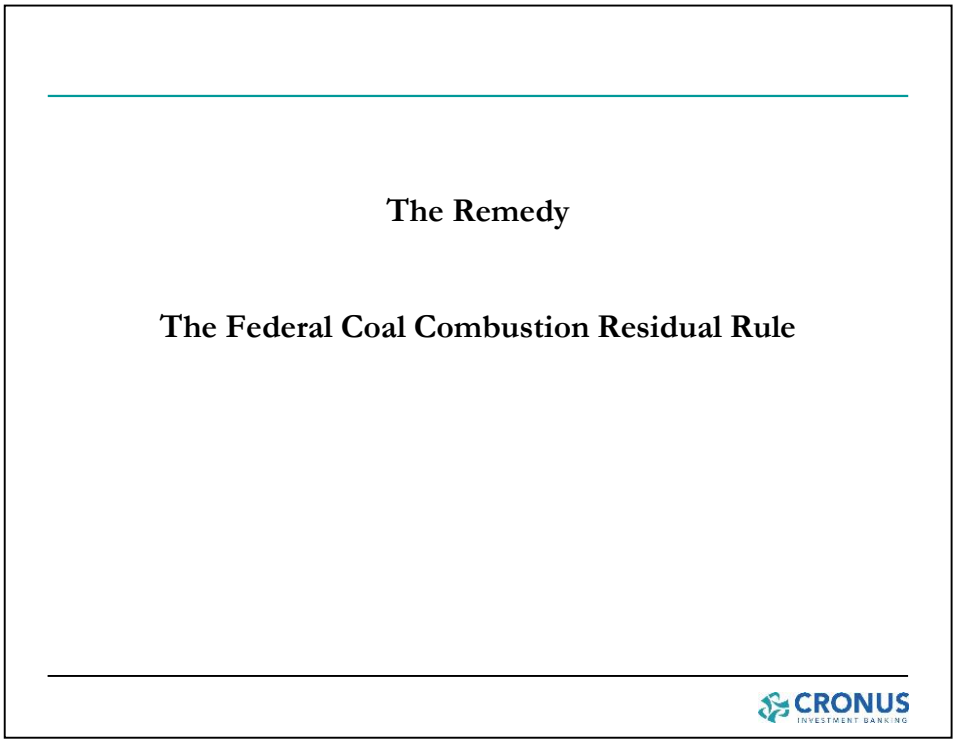
Though not directly related to CCR, in February, 1972, a coal slurry impoundment at Pittston Coal Company's Buffalo Creek coal mine in Logan County, West Virginia gave way as a result of heavy rainfall and flooding, sending millions of gallons of water and millions of cubic yards of coal slurry down the Buffalo Creek: 11 communities were affected with over 500 homes demolished leaving 4,000 homeless, 1,100 injured and 125 dead. In the aftermath of the spill, it was found that coal slurry impoundment and other impoundments on the site were not well engineered.

More recently, in September, 2018, as result of Hurricane Florence, a coal ash impoundment at Duke Energy's HF Lee plant in Goldsboro, North Carolina spilled 2,000 cubic yards of CCR into the Neuse River



In 1980, the Bevill Amendment was passed, covering certain coal combustion wastes, such as CCRs and other ore mining wastes, together with its companion bill, the Bentsen Amendment, which covered certain hydrocarbon wastes, such as drilling fluids and production waters, associated with crude oil, natural gas and geothermal energy production. Collectively, these wastes were categorized as exempt or special wastes. Both amendments had the fortuitous consequence of shielding these wastes from being regulated under the Resource and Conservation Recovery Act or RCRA of 1976, while the EPA evaluated whether they should be regulated under Subtitle C regulations for hazardous waste or Subtitle D regulations for solid waste. In essence, and perhaps for this reason, CCRs assumed a "phantom waste" status, despite being the second largest generated waste in the U.S. by volume.

EPA ruled 20 years later in 2000 that CCR regulation under Subtitle C was not warranted, thus these wastes fell under Subtitle D as a solid waste, and avoiding the much higher cost of disposal levied on hazardous wastes.



Following the TVA spill, the EPA formally began a process of drafting regulations to address the treatment and disposal of CCRs, and in June, 2010 initially proposed a set of federal standards to establish minimum national criteria. Perhaps motivated in part by the Duke Energy incident in 2014, together with lawsuits by various environmental groups, the EPA announced regulations regarding structural integrity requirements for coal ash impoundments, groundwater monitoring and corrective action standards, operating criteria for coal ash units, and recordkeeping and public disclosure.

In April, 2015 the Rule was published in the Federal Register, effective October, 2015, with implementation deadlines ranging from 6 to 42 months.

As a side note, and confirmed by Barnes Johnson, Director of the Office of Resource & Recovery at the EPA, CCR regulations are about 90% complete, and are not likely to be rescinded – and notwithstanding the current Administration's position on coal burning, not much effort has been made to alter current regulations.

Subsequent Actions

CRONUS
INVESTMENT BANKING

Water Infrastructure for Improvement to the Nation

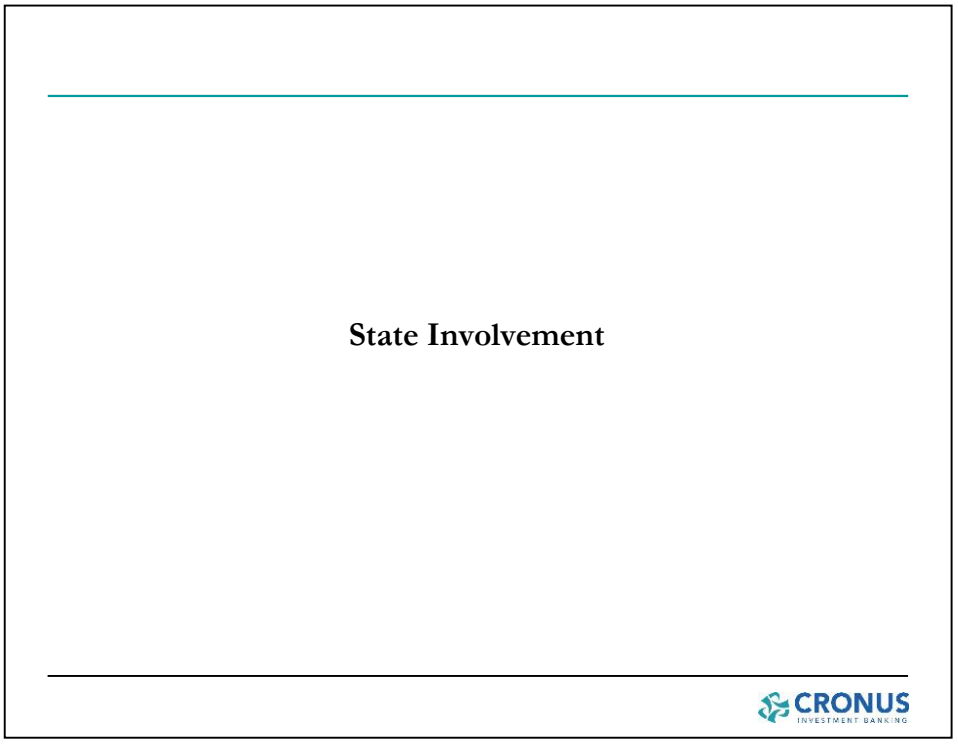
The D.C. Circuit Court of Appeals

CRONUS INVESTMENT BANKING

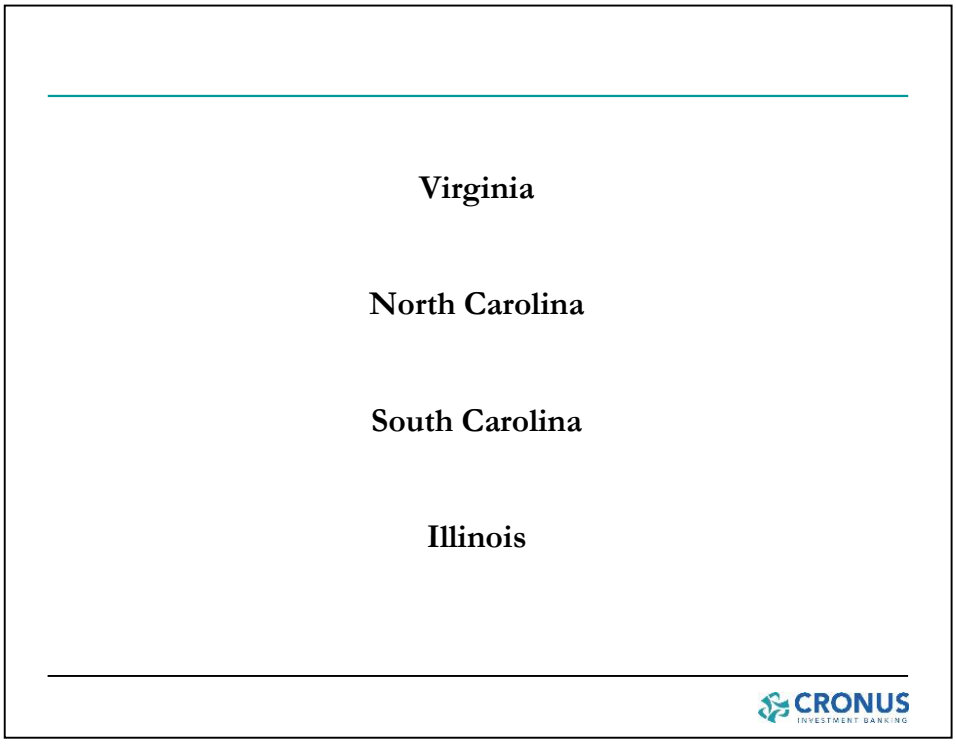
Subsequent to the enactment of the CCR Rule, various industry groups as well as environment groups filed court suits, many of which are still ongoing. Of the various rulings and decisions, the following two are worth highlighting.

On December, 2016 the Water Infrastructure for Improvements to the Nation Act (or WIIN) was enacted which authorized EPA-approved state permitting programs to regulate coal ash disposal. The WIIN Act is significant as the Agency had been limited in its enforcement abilities under RCRA, but could now, in conjunction with states, directly enforce CCR regulations.

On August, 2018, in response to various environmental group suits, the D.C. Circuit Court ruled that the EPA had acted arbitrarily in failing to require the closure of unlined impoundments, in classifying certain clay-lined impoundments as lined, and exempting inactive surface impoundments at inactive power plants from regulation under the CCR rule.



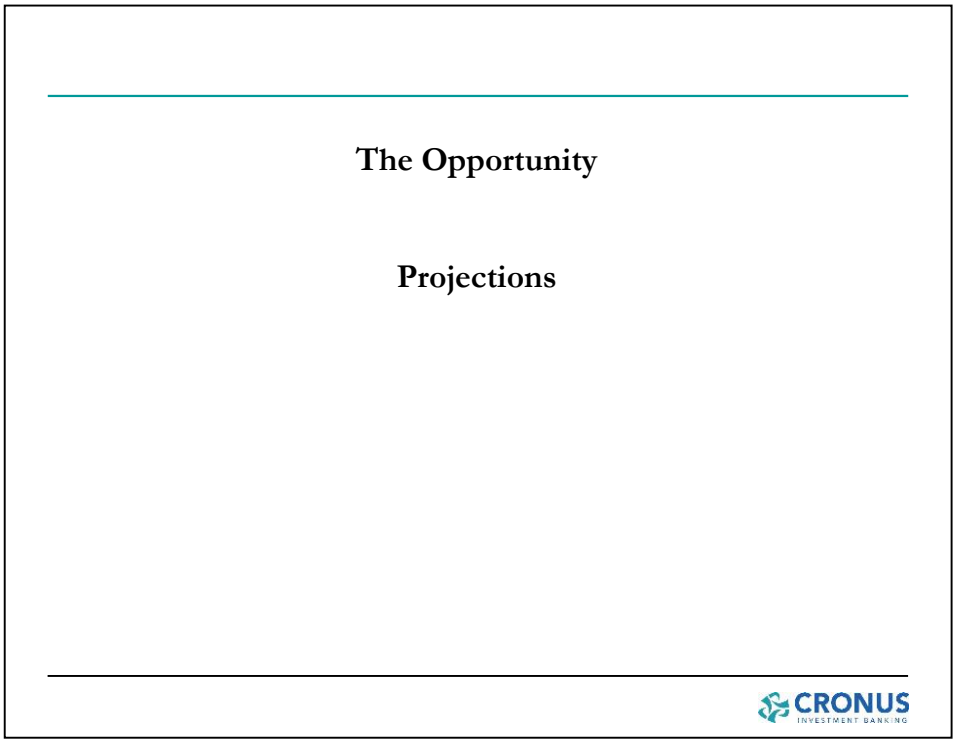
The states jump in.



With the passage of the CCR Rule in 2015 and the WIIN Act in 2016, various states began initiating their own CCR programs. Kansas developed its own program in September, 2015 and Alabama did the same in April, 2018, but neither have been approved by the EPA. Oklahoma submitted its application in January, 2018 which was approved in June of that year. And, Georgia submitted its permit application in June, 2019, which has preliminary approval from the Agency.

But, some states have taken more drastic and direct action in handling CCRs: in March, 2019, Virginia directed Dominion Energy, the state's largest electric utility to clean up all its unlined coal ash pits via excavation, and either recycle the waste or store it in lined landfills; in April, 2019, North Carolina also directed Duke Energy, its largest electric utility to excavate all its unlined coal ash pits, and either recycle or store it in lined landfills; in May, 2019, South Carolina regulators adopted a motion to reduce Duke Energy's proposed rate hike by about 30%, essentially disallowing the recovery of about $333 million in CCR cleanup costs; and in May, 2019, the Illinois legislature passed a bill directing the state's EPA to establish rules on a case-by-case basis for coal ash sites in the state.

What is important to note is that Virginia's and North Carolina's excavate and remove requirements are far more stringent and more costly than federal regulation , which allows in place cap and closure.

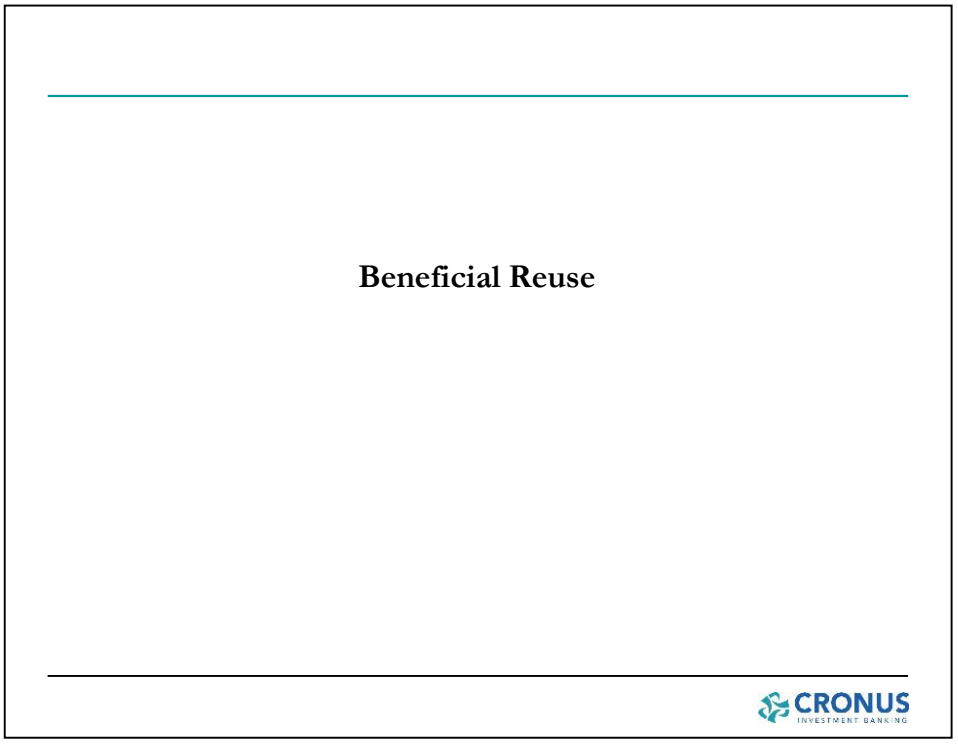


Including a closure-in-place solution, entailing dewatering the CCR, stabilizing and capping the impoundment as well as a closure removal solution, dewatering of the CCR, and excavation and transportation to a landfill, the EPA estimates the projected cost to comply with the CCR Rule could range between **$7 to $23 billion**.

The Utility Solid Waste Activities Group, an informal consortium of approximately 80 utility operating companies, the Edison Electric Institute, the National Rural Electric Cooperative Association, and the American Public Power Association estimates the cost to comply with the CCR Rule could range **$23 to $35 billion**.

But, when considering last year's DC Court of Appeals ruling that all unlined surface impoundments operating or at closed power plant facilities must close, an additional **$39 billion** could be added to the overall cost of CCR cleanup.

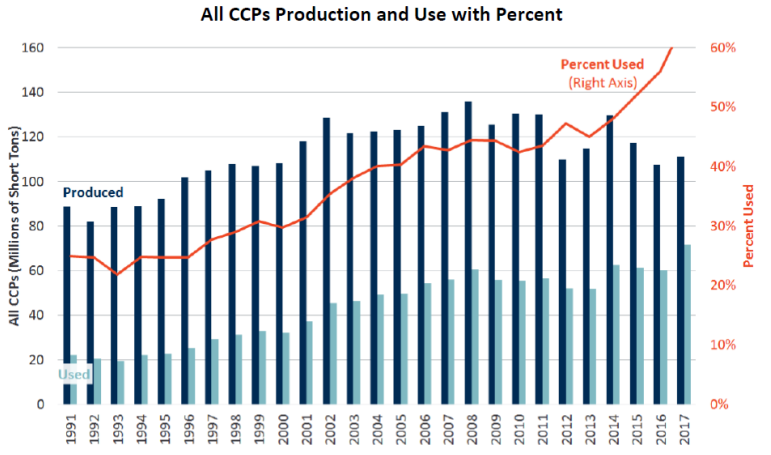
In total, it is a large cleanup bill that is likely to extend some 15-20 years to complete, according to a number of engineering and consulting sources, beginning in earnest starting around 2020-2021.



Beneficial reuse or recycling.

Historical CCP Production and Beneficial Reuse Percentage

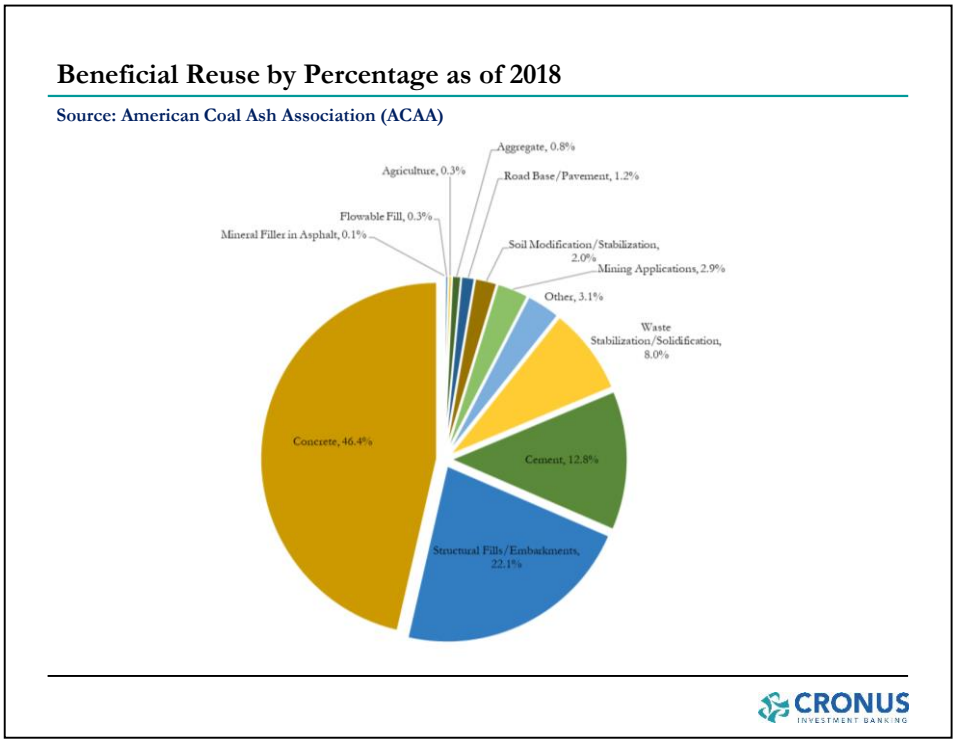
Source: American Coal Ash Association (ACAA)



CRONUS INVESTMENT BANKING

Beneficial reuse of CCRs, or as recyclers term it, CCPs or coal combustion products, have been increasing, and are expected to continue growing in the future. The advantages of beneficial reuse are clear: lower volumes of CCRs needing disposal versus higher volumes of CCPs that can be recycled and provide cost savings.

Additionally, CCPs are being recycled from previously disposed CCRs that are later excavated and sent to cement manufacturers and wallboard manufacturers.



CCP beneficial reuse is mainly in construction and related applications - back to the CCR categories: Fly Ash is used in a wide range of concrete products -- roads, bridges, buildings, and concrete blocks -- and is also used in structural fills and embankments, waste stabilization and solidification, and mine reclamation; Bottom Ash is used as an aggregate and is an ingredient in concrete blocks and can also be used in structural fills and embankments, waste stabilization and solidification, and mine reclamation; Boiler Slag is used as blasting grit and roofing granules; FGD Material can be converted into synthetic gypsum for wallboard, can be used in agriculture to improve soil conditions and prevent fertilizer and pesticide runoff, and can also be used in structure fills and embankments, waste stabilization and solidification, and mine reclamation.

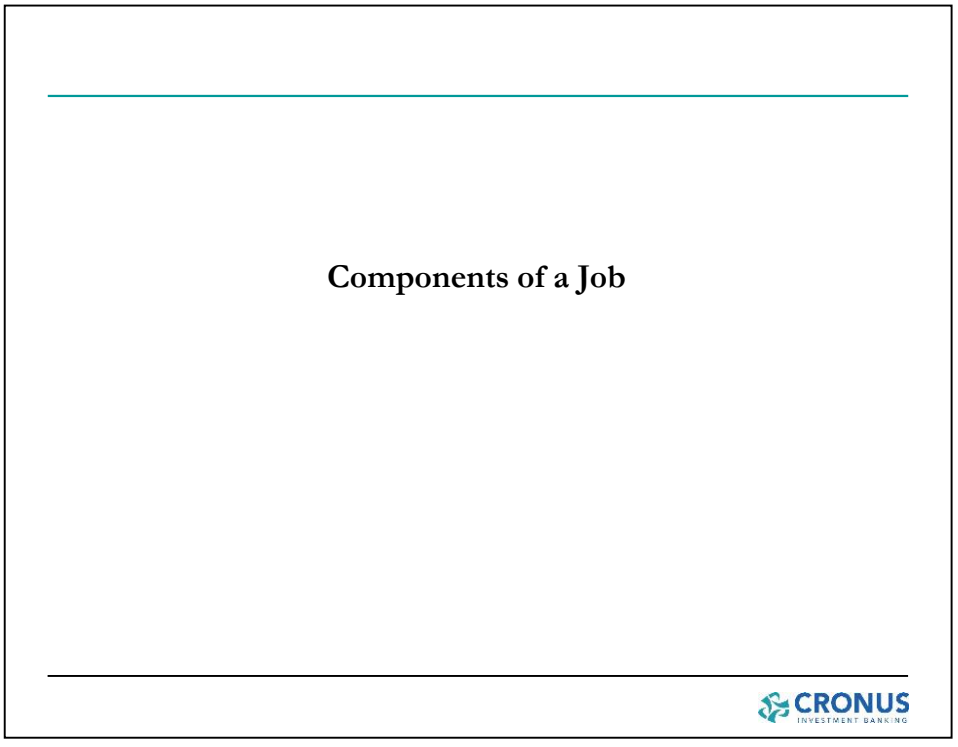
There has also been research in possibly extracting strategic rare earth minerals for reuse in electronic manufacturing.

Finally, there has been much discussion by environmental groups about heavy metal trace elements, arsenic, copper, barium, cadmium, chromium, lead, mercury, nickel, and thallium being found in groundwater leached out of CCR disposal sites. Both the Bevill Amendment and CCR Rule considered the presence of these heavy metals concluding that the levels found did not justify Subtitle C designation. If this ever proves not to be the case in the future, CCP beneficial reuse could become problematic.

Operational Coal Ash Impoundment

CRONUS
INVESTMENT BANKING

Where the CCR is interned.



The clean up.

Clean Closure

Dewater, Excavate, Remediate, Transport, Landfill

Or

In Place Closure

Dewater, Excavate, Stockpile, Remediate,

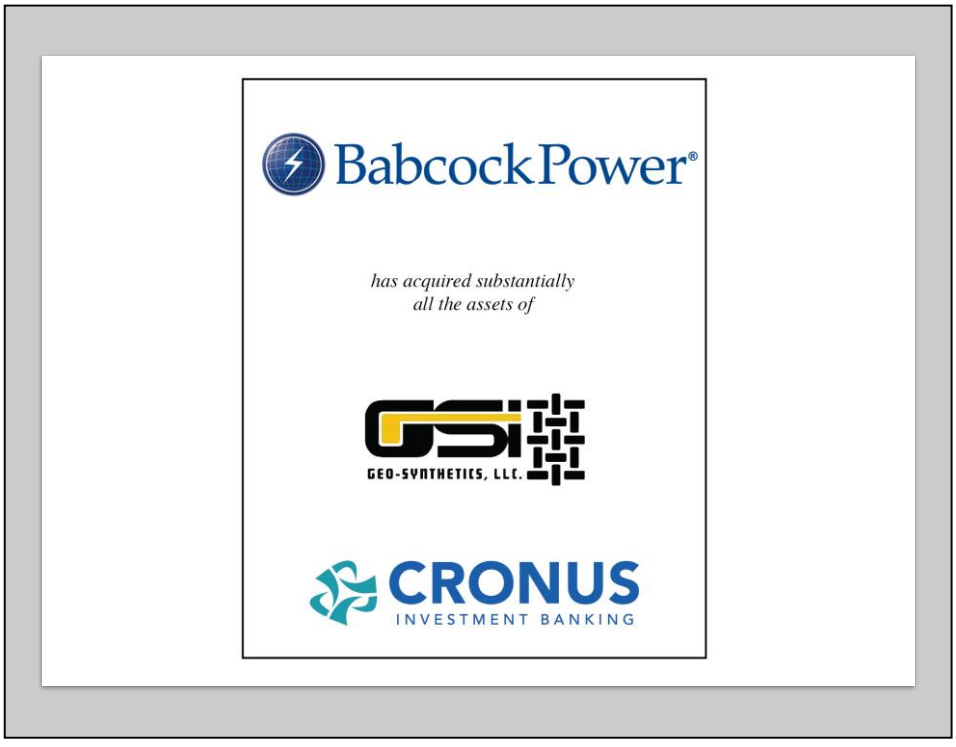
Landfill Construct, Reinternment

CRONUS
INVESTMENT BANKING

There are two basic ways to remediate a coal ash impoundment: Clean Closure or In Place Closure.

Clean Closure or Close by Removal, according to such engineering and consulting firms such as TRC Companies and Arcadis, both specialists in all aspects of coal ash impoundment clean up, involves a multi-phase process: 1) developing and mobilizing a removal program and securing the necessary fill-in material, 2) dewatering and likely enlarging the impoundment footprint as well as installing erosion and sediment control, 3) excavating the CCR while continuing to dewater and begin water treatment of the effluent, 4) removing and transporting the CCR to an offsite Subtitle D landfill, 5) final grading of the fill-in material and installing a synthetic cap and cover plus vegetation, 6) demobilizing, and 7) initiating a 30-year post closure care monitoring program.

In Place Closure involves a similar multi-phase process but in step 4) stockpiling the CCR and constructing a Subtitle D landfill, possibly near the existing impoundment or on an adjacent property, which would entail excavating a new cell and installing a synthetic liner and leachate collection system, 5) final grading of the fill-in material and installing a synthetic cap and cover plus vegetation, while re-disposing the stored CCR in the new landfill, 6) demobilizing, and 7) initiating a 30-year post closure care monitoring program.



In 2018, Babcock Power Environmental, a subsidiary of Babcock Power Inc., announced the acquisition of substantially all of the assets of Geo-Synthetics, LLC. Cronus Partners acted as financial advisor to Babcock in the transaction, identifying the target company, as well as other synthetic liner installers in the industry, initiating contact, intermediating discussions, and advising our client on key deal terms, including valuation. Geo-Synthetics is a distributor, fabricator and installer of geosynthetic materials for containment applications in landfills for coal ash residuals as well as for other wastes, both hazardous and non-hazardous, plus a broad range of erosion control projects.

Currently, we are in the market to sell a fully-permitted, though yet to be constructed coal ash residual landfill in the Midwest, in whole or in part.

In addition, we have been engaged to a sell a majority ownership in another coal ash liner installer in the Midwest.

As a result of our research and transaction experience, we at Cronus Partners believe that we can be of assistance to both buyers and sellers in understanding the coal ash residual marketplace and identifying the many participants providing services in the various sectors of the business. Additionally, we are in constant contact with private equity investors who are interested in participating in this sector. Please contact us.

Cronus Partners Overview

Cronus Partners, a recipient of the ACG Boutique Investment Bank of the Year award, is a middle market focused independent investment bank headquartered in Southport, Connecticut.

Firm Profile

While Cronus works on investment banking mandates for companies across a broad spectrum of industries, we are unrivaled in our knowledge and experience with specific industries. We understand the drivers of change within each industry and nurture relevant and meaningful corporate and private capital market relationships therein. Cronus combines Wall Street expertise with the agility and attentiveness of a boutique firm.

Our investment bankers are highly experienced professionals who combine in-depth industry knowledge with transactional execution skills and an intimate understanding of issues facing middle market companies. Cronus Partners' focused attention and guidance through each step of the process enables each client to accomplish its goals.

Investment Banking Services

- Sales, mergers, divestitures, spinouts
- Mergers and acquisitions
- Bank facilities, senior, subordinated and other debt financing (asset based, cash flow based, transaction oriented)
- Private placements of equity and debt
- Management buyouts
- Fairness opinions
- Corporate finance advisory services

Sector Coverage

- Aerospace & Defense
- Alternative Energy
- Business Services
- Enterprise Software and IT Services
- Environmental
- Maritime Transportation and Logistics
- Oilfield Technology
- Specialty Manufacturing

ACG CHAMPION'S AWARDS WINNER BOUTIQUE INVESTMENT BANK OF THE YEAR

CRONUS INVESTMENT BANKING

Contact Us

Cronus Partners LLC
www.CronusPartners.com

181 Old Post Road
P.O. Box 103
Southport, CT 06890

203.774.9640

John Quirk
Partner
O: 203.774.9643
M: 203.595.1757
jquirk@cronuspartners.com

Ken Leung
Managing Director
O: 203.774.9645
M: 917.841.8186
kleung@cronuspartners.com

Paul Nowak
Managing Director
O: 203.774.9644
M: 917.204.8827
pnowak@cronuspartners.com

Charlie Carson
Senior Advisor
M: 917.833.8881
ccarson@cronuspartners.com

CRONUS
INVESTMENT BANKING