Managing Coal Combustion Waste (CCW): Issues with Disposal and Use

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Summary

In 2008, coal-fired power plants accounted for almost half of the United States' electric power, resulting in as much as 136 millions tons of coal combustion waste (CCW). On December 22, 2008, national attention was turned to issues regarding the waste when a breach in an impoundment pond at the Tennessee Valley Authority's (TVA's) Kingston, Tennessee, plant released 1.1 billion gallons of coal ash slurry. The estimated cleanup cost will likely reach $1.2 billion.

The characteristics of CCW vary, but it generally contains a range of heavy metals such as arsenic, beryllium, chromium, lead, and mercury. While the incident at Kingston drew national attention to the potential for a sudden catastrophic release of waste, the primary concern regarding the management of CCW usually relates to the potential for hazardous constituents to leach into surface or groundwater, and hence contaminate drinking water, surface water, or living organisms. The presence of hazardous constituents in the waste does not, by itself, mean that they will contaminate the surrounding air, ground, groundwater, or surface water. There are many complex physical and biogeochemical factors that influence the degree to which heavy metals can dissolve and migrate offsite—such as the mass of toxins in the waste and the degree to which water is able to flow through it. The Environmental Protection Agency (EPA) has determined that arsenic and lead and other carcinogens have leached into groundwater and exceeded safe limits when CCW is disposed of in unlined disposal units.

In addition to discussions regarding the potential harm to human health and the environment, the Kingston release brought attention to the fact that the management of CCW is essentially exempt from federal regulation. Instead, it is regulated in accordance with requirements established by individual states. State requirements generally apply to two broad categories of actions—the *disposal* of CCW (in landfills, surface impoundment, or mines) and its *beneficial use* (e.g., as a component in concrete, cement, or gypsum wallboard, or as structural or embankment fill).

In May 2000, partly as a result of inconsistencies in state requirements, EPA determined that national regulations regarding CCW disposal were needed. To date, regulations have not been proposed. However, on March 9, 2009, EPA stated that regulations to address CCW disposal in landfills and surface impoundments would be proposed by the end of 2009. Also, in March 2007, an advance notice of proposed rulemaking regarding the disposal of CCW in mines was released by the Department of the Interior's Office of Surface Mining (OSM). Draft rules have not yet been proposed. With regard to potential uses of CCW, EPA has stated that there have been few studies that would definitively prove that certain uses of CCW are safe, but that its use should include certain precautions to ensure adequate groundwater protection. It is unknown whether regulations regarding beneficial uses of CCW will be included in the upcoming rulemaking.

Some Members of Congress and other stakeholders have expressed concern regarding how CCW will ultimately be regulated. Among other issues, there is concern that the upcoming regulations will be either too far-reaching, and hence costly, or not far-reaching enough—meaning that they will not establish consistent, enforceable, minimal federal requirements applicable to CCW disposal units. On December 17, 2009, EPA issued a statement that its pending decision on regulating CCW would be delayed for a "short period due to the complexity of the analysis the agency is currently finishing."

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Coal fired power plants account for almost 45% of electric power generated in the United States. The coal combustion process at those facilities generates a tremendous amount of waste. In 2008, industry estimates indicate that 136 million tons of coal combustion waste (CCW) was generated.[1] That would make CCW the second largest waste stream in the United States, second to municipal solid waste, or common household garbage. How CCW is managed and how those management methods are regulated have come under increased scrutiny in the last year.

Coal combustion waste is managed in two ways: It may be *disposed of* in landfills or surface impoundment ponds, or in mines as minefill, or it may be *used* in some capacity (commonly referred to as "beneficial use")—for example, as a component in concrete, cement, or gypsum wallboard, or as structural or embankment fill. These management methods are largely unregulated at the federal level. Instead, they are regulated according to state requirements that vary from state to state.

On December 22, 2008, national attention was turned to potential risks associated with CCW management when a breach in an impoundment pond at the Tennessee Valley Authority's (TVA's) Kingston, Tennessee, plant released 1.1 billion gallons of coal fly ash slurry. The release covered more than 300 acres and damaged or destroyed homes and property. The sludge discharged into the nearby Emory and Clinch rivers, filling large areas of the rivers and resulting in fish kills. Sampling at the site in January 2009 found arsenic levels that exceeded the Environmental Protection Agency's (EPA's) Removal Action Level (contaminant levels at which time-critical response actions may be required).[2]

According to TVA, the estimated cleanup cost will likely reach $1.2 billion.[3] TVA recognized that this estimate could change significantly depending on the method of containment or the amount of ash ultimately disposed of as well as the impact of new coal ash laws and regulations that may be implemented at the state or federal level. Further, TVA's estimate does not include the potential costs associated with future regulatory actions, litigation, fines or penalties that may be assessed, final remediation activities, or other settlements. EPA and TVA have estimated that the cleanup may take two to three years.

In addition to the Kingston release, other events related to CCW management have attracted national media attention, as well as the attention of various stakeholders and some Members of Congress. For example, on December 30, 2008, a $54 million class action settlement was approved between Constellation Energy and Maryland residents after CCW that had been disposed of in a Gambrills, Maryland, quarry contaminated the owners' drinking water. Wells were determined to be contaminated with arsenic, lead, cadmium, and sulphates at levels above EPA drinking water standards.

[1] In this report, waste *management* generally refers to any method of handling waste after it has been generated. With regard to CCW, it refers to the *disposal* (in landfills, surface impoundment, or mines) or *use* of the waste (e.g., as a component in cement or concrete).

[2] See "EPA's Response to the TVA Kingston Fossil Plant Fly Ash Release," regarding January 6, 2009, sampling activity at http://www.epa.gov/region4/kingston/index.html.

[3] TVA "Form 10-Q" financial report for the quarterly period ended June 30, 2009, filed with the U.S. Securities and Exchange Commission on July 31, 2009, p. 45, available at http://investor.shareholder.com/tva/sec.cfm.

Concern for a potential accidental release or contamination associated with CCW management is not new. However, the recent high-profile incidents have brought increased attention to the issue. Concerns about CCW management generally center around the following issues:

- The waste is generated in tremendous volumes and has been accumulating at some sites for decades. Individual power plants may generate thousands to hundreds of thousands of tons of the waste each year—the majority of which is disposed of onsite. Some plants have been in operation for decades (the site of the Kingston release has accumulated ash sludge since 1954), resulting in the disposal of millions of tons of CCW at individual plants across the United States.
- The waste likely contains certain hazardous constituents that EPA has determined pose a risk to human health and the environment. Those constituents include heavy metals such as arsenic, beryllium, boron, cadmium, chromium, lead, and mercury, and certain toxic organic materials such as dioxins and polycyclic aromatic hydrocarbon (PAH) compounds.
- Under certain conditions, hazardous constituents in CCW migrate and can contaminate groundwater or surface water, and hence living organisms. For example, EPA determined that the potential risk of human exposure to arsenic and other metals in CCW (via the groundwater-to-drinking-water pathway) increased significantly when CCW was disposed of in unlined landfills. That risk criterion was slightly higher for unlined surface impoundments.[4]
- According to EPA, the majority of new landfills and surface impoundments are constructed with liners and have groundwater monitoring systems. However, it is difficult to determine how many older units that may be operational do not have liners or groundwater monitoring.
- Although CCW contains hazardous constituents, it has been specifically exempt from federal hazardous waste management regulations. Instead, it is regulated in accordance with requirements established by the states. In 1999, EPA determined that national regulations regarding CCW disposal were needed, in part due to inconsistencies in state requirements. Since then, various surveys have been conducted and data gathered, but EPA has not proposed regulations.

Members of the public, particularly those near utility plants, have expressed concern that their health or property values may be affected by either a sudden release of waste, as in Kingston, or the gradual release of contaminants. Industry organizations insist that the waste is generally safe and does not pose a significant risk that would warrant the increased cost of more stringent management—costs that would be ultimately borne by rate payers. They also argue that being required to manage the waste according to hazardous waste regulations would limit its potential for use—thereby increasing the amount that must be disposed of. Environmental organizations argue that the Kingston spill was a warning sign of spills to come and that there is currently inadequate oversight and monitoring of either existing or closed disposal sites.

Some Members of Congress have also expressed concern over these issues, both before and after the Kingston release. Like other stakeholders, their concerns have stretched across various areas

[4] EPA's Office of Solid Waste, "Human and Ecological Risk Assessment of Coal Combustion Wastes," August 6, 2007.

including the role that coal mining plays in our economy, the role that coal-fired utilities play as a major source of domestic energy, the federal role in the regulation of CCW, as well as the potential risks posed to their constituents if CCW is managed improperly.[5]

EPA has been studying how best to regulate CCW since at least 1980. Waste management is regulated under provisions of the Resource Conservation and Recovery Act (RCRA, 42 U.S.C. §6901 *et seq*.). In May 2000, EPA determined that CCW did not warrant regulation under subtitle C of RCRA (the federal *hazardous* waste requirements). EPA did, however, determine that national regulations under subtitle D of RCRA (the *solid* waste management requirements) were warranted for CCW when it is disposed in landfills or surface impoundments. EPA also found that CCW used to fill surface or underground mines warranted regulation under RCRA's solid waste requirements or possibly under modifications to existing regulations established under authority of the Surface Mining Control and Reclamation Act (SMCRA).[6] Since then, various surveys have been conducted, reports issued, and data gathered, but no federal regulations have been proposed.

On March 9, 2009, in the wake of the Kingston release, EPA declared its intent to move forward with CCW regulations to address the management of coal combustion residuals. EPA stated that regulations would be proposed for public comment by the end of 2009.

Since EPA's statement, industry and environmental groups, state government representatives, and some Members of Congress have expressed concerns regarding how the waste will ultimately be regulated. Generally those concerns center around whether CCW will be regulated as a solid or hazardous waste. Subsequently, representatives with EPA have declared that, although they felt that regulating CCW under RCRA's solid waste management requirements (e.g., subtitle D's landfill criteria and permitting requirements) would provide sufficient protection, the agency had no authority to do so. Instead, their only existing authority was to regulate the waste under RCRA's hazardous waste management requirements (for more information, see "The Current Rulemaking"). On December 17, 2009, EPA issued a statement that its pending decision on regulating CCW would be delayed for a "short period due to the complexity of the analysis the agency is currently finishing."[7]

Regardless of the ultimate choice of waste management, the amounts of CCW generated each year are tremendous. As power plant emission standards become more stringent and air emission control devices capture more contaminants, both the total waste generated and the amount of toxins in the waste can be expected to increase.

[5] See the House Committee on Natural Resources, Subcommittee on Energy and Mineral Resources hearing, "How Should The Federal Government Address The Health And Environmental Risks Of Coal Combustion Waste?," June 10, 2008. Also, on February 12, 2009, the subcommittee held a legislative hearing regarding H.R. 493, the "Coal Ash Reclamation, Environment, and Safety Act of 2009." On March 31, 2009, the House Committee on Transportation and Infrastructure, Subcommittee on Water Resources and Environment, held a hearing, "The Tennessee Valley Authority's Kingston Ash Slide: Potential Water Quality Impacts of Coal Combustion Waste Storage."

[6] Environmental Protection Agency, "Regulatory Determination on Wastes from the Combustion of Fossil Fuels; Final Rule," 65 *Federal Register* 32214-32237.

[7] See EPA's "Statement From EPA On Coal Ash," issued December 17, 2009. EPA's press releases are available, by date, at http://www.epa.gov/newsroom/.

To provide information and context on this issue, this report discusses the nature of the waste itself; potential risks associated with its management; the regulatory history of CCW management requirements, including why CCW is exempt from federal regulations and issues associated with the current rulemaking; and CCW management options (e.g., landfill and surface impoundment disposal) and the likely state and federal requirements associated with those management methods.

This report does not provide risk analysis regarding the disposal or use of CCW, or information regarding the potential fate and transport of hazardous constituents. It also does not discuss details regarding the Kingston release, such as determinations regarding the cause of the release or details of the cleanup. Numerous studies on those topics have been conducted, findings from which are cited or summarized where appropriate. This report focuses primarily on the issues associated with CCW disposal in landfills and surface impoundments, but also provides summary information on issues associated with its disposal in mines and its "beneficial use."[8]

The Nature of Coal Combustion Waste

Each step of the coal combustion process results in different types of waste. The characteristics and potential risks associated with that waste vary according to many factors. To minimize the potential negative impacts associated with CCW management, it is necessary to understand the characteristics of the specific type of CCW being handled as well as the physical environment in which it is placed.

Types of Coal Combustion Waste

Coal combustion waste consists of inorganic residues that remain after pulverized coal is burned. At various stages of the coal combustion process, different types are generated. These residues include both coarse particles that settle to the bottom of the combustion chamber and fine particles that are removed from the flue gas by electrostatic precipitators, scrubbers, or fabric filters. Factors such as the source of the coal burned at a plant and the technology used (both to burn the coal and to filter the ash) have bearing on CCW's characteristics and potential toxicity. **Table 1** describes the different types of CCW generated.

[8] The term "beneficial use" is not specifically defined by EPA (although it may be defined in individual state regulations). It is generally meant to include uses of CCW that would provide some environmental, economic, or performance benefit, when compared to direct disposal of the waste.

Table 1. Types of Coal Combustion Waste

Waste Type	Description	Percentage of Total Generated
Fly Ash	A product of burning finely ground coal in a boiler to produce electricity. It is generally captured in the plant's chimney or stack through a particulate control device (e.g., electrostatic precipitators or fabric filters). It consists mostly of silt-sized and clay-sized glassy spheres, giving it a consistency somewhat like talcum powder.	57%
Flue Gas Desulfurization (FGD) Material	Flue gas desulfurization (FGD) is a chemical process implemented in order to meet emission requirements in the Clean Air Act applicable to sulfur dioxide (an emission associated with acid rain). The goal of the process is to chemically combine the sulfur gases released in coal combustion by reacting them with a sorbent, such as limestone (calcium carbonate), lime (calcium oxide), or ammonia. Depending on the FGD process used at the plant, the material may be a wet sludge or a dry powder. The wet sludge is likely predominantly calcium sulfite or calcium sulfate. The dry material generally consists of a mixture of sulfites and sulfates.	24%
Bottom Ash	A coarse, gritty material, these agglomerated ash particles are those that are too large to be carried in flue gases. They impinge on the furnace walls or fall through open grates to an ash hopper at the bottom of the furnace. The material is taken from the bottom of the boiler furnace either in its dry form or as a slurry (via the addition of water). It has a porous surface structure and is coarse, with grain sizes spanning from fine sand to fine gravel.	17%
Boiler Slag	This type of ash collects at the base of certain furnaces that are quenched with water. When molten slag comes in contact with quenching water, it fractures, crystallizes, and forms pellets. This boiler slag material is made up of hard, black, angular particles that have a smooth, glassy appearance. The particles are uniform in size, hard, and durable, with a resistance to surface wear.	<2%

Source: Table generated by the Congressional Research Service (CRS) using information from the Environmental Protection Agency's "Wastes - Resource Conservation - Reduce, Reuse, Recycle - Industrial Materials Recycling" Web page regarding Coal Combustion Products, at http://www.epa.gov/osw/conserve/rrr/imr/ccps/index.htm and the U.S. Geological Survey, Fact Sheet 076-01, "Coal Combustion Products," available at http://pubs.usgs.gov/fs/fs076-01/fs076-01.html.

Notes: The approximate percentage of total CCW generated was determined using data from American Coal Ash Association (ACAA), "2007 Coal Combustion Product (CCP) Production & Use Survey Results (Revised)," available at http://www.acaa-usa.org/displaycommon.cfm?an=1&subarticlenbr=3.

Waste Characteristics

The physical and chemical characteristics of each type of CCW have bearing on both its potential for use (e.g., as a component in concrete or gypsum wallboard) and its potential to present some level of risk to human health or the environment. In 2006, a study by the National Research Council (NRC) identified several factors that influence the physical and chemical characteristics of CCW.[9] Included among the factors are:

[9] The National Research Council (NRC), *Managing Coal Combustion Residues in Mines*, March 2006, pp. 27-57.

- **The chemical characteristics of the source coal.** The waste itself represents noncombustible constituents in coal. Therefore, its characteristics are strongly influenced by the source coal itself (e.g. lignite, bituminous).
- **The chemical characteristics of any co-fired materials.** Some coal-fired boilers, especially at non-utilities (e.g., boilers at industrial, commercial, or chemical facilities), may be co-fired with materials such as wood, biomass, plastics, petroleum coke, tire-derived fuel, refuse-derived fuel, or manufactured gas plant wastes.
- **The processes or technology used at individual utility plants.** Waste characteristics are affected by the particular combustion technology, air emission control devices used to capture regulated contaminants (e.g., sulfur dioxide, nitrogen oxide, mercury), and residue-handling technology (collection systems result in either dry or wet residues) used at the plant.

While the components of each type of ash vary, depending on these factors, all CCW will likely include certain amounts of toxic constituents, primarily heavy metals such as arsenic, beryllium, boron, cadmium, chromium, cobalt, lead, manganese, mercury, molybdenum, selenium, strontium, thallium, and vanadium. The waste will also likely include a certain level of toxic organic materials such as dioxins and polycyclic aromatic hydrocarbon (PAH) compounds.

With regard to the source coal, the U.S Geological Survey (USGS) maintains a database of coal quality characteristics of coal basins in the United States.[10] The three types of coal most often used in utility boilers, bituminous, subbituminous, and lignite, vary in terms of their chemical composition, ash content, and geological origin. Some of the principal components in the fly ash from these types of coal are silica, alumina, iron oxide, potassium, calcium, and magnesium. These same components can make CCW usable as an ingredient in Portland cement or as a soil amendment.

Knowledge of coal chemistry—as well as the technology used to fire, filter, and collect it—is important to determine which mitigation procedure will be most efficient in reducing the amount of hazardous material potentially generated as waste.

Potential Risks Associated with CCW Management

Generally, there are two potential risks associated with the disposal or use of CCW. Disposal or use that involves direct applications of the waste to the ground may allow hazardous constituents in the waste to leach from the material, migrate, and contaminate groundwater or surface water and, ultimately, living organisms. Also, the land disposal of high volumes of liquid waste could result in a sudden release, as occurred at Kingston.

[10] See U.S. Geological Survey, Energy Resources Program, available at http://energy.er.usgs.gov/coal_quality/coal_databases.html.

Surface or Groundwater Contamination

Although the possibility exists that hazardous constituents in CCW could become airborne, the primary concern regarding the management of the waste usually relates to the potential for hazardous constituents to leach into surface or groundwater, and hence contaminate drinking water, surface water, or biota. The presence of hazardous constituents in the waste does not, by itself, mean that they will contaminate the surrounding air, ground, groundwater, or surface water. The 2006 NRC report stated that there are many complex physical and biogeochemical factors that influence the degree to which heavy metals can essentially dissolve and migrate offsite. Those factors include:[11]

- **The volume and degree to which water is able to flow through the waste.** Water, such as precipitation or groundwater flow, is the primary mechanism for the transport of hazardous constituents through the waste. EPA has found that contaminants have a significantly higher likelihood of migrating away from the disposal site (i.e., landfill or surface impoundment) if they are disposed of in an unlined disposal unit (i.e., a scenario in which water is able to flow through the waste).
- **The chemistry, particularly the pH, of the water that flows through or contacts the waste.** Different metals commonly found in CCW are soluble in acidic (high pH), alkaline (low pH), or neutral environments. Many types of CCW are themselves alkaline and capable of neutralizing acidity. This is one reason why certain types of CCW are placed in mines to treat acid mine drainage.
- **The leachable mass of toxic constituents present in the waste.**

While general factors that contribute to contamination migration are known, it is difficult to determine the degree to which actual or potential contamination is being monitored at CCW disposal sites or sites where it has been placed directly on soil (e.g., as structural or embankment fill). EPA has documented selected cases of damages associated with disposal in landfills and surface impoundments.[12] However, there is little data regarding contamination associated with its disposal in mines or the "beneficial use" of CCW when it is place directly on land—such as when used as embankment or structural fill. That does not mean that contamination *has* occurred in those uses—only that it is known that CCW has been managed in a way that contamination could be anticipated. The degree to which such data may be tracked in individual states is difficult to determine.

A Sudden of Release of Liquid Waste

Surface impoundment ponds hold liquid waste that has been sluiced from the power plant to the disposal area. It is generally held within the pond by depositing it in a natural depression in the ground or through the use of a dike of some sort (see discussion regarding the use and regulation of surface impoundments in "Landfill and Surface Impoundment Disposal"). The Kingston release resulted from a rupture in an impoundment dike.

[11] For more information, see the NRC report, *Managing Coal Combustion Residues in Mines*, pp. 59-76.

[12] EPA, Office of Solid Waste, "Coal Combustion Waste Damage Case Assessment," July 9, 2007.

On March 9, 2009, in an attempt to avoid catastrophic releases such as that in Kingston, EPA sent a request for information to the owners and operators of CCW impoundment units.[13] The information-gathering was intended to assist in prioritizing surface impoundment ponds for inspection, and, ultimately, to assess the structural integrity of the units. EPA regional offices were asked to assist in identifying facilities that they considered priorities.

EPA sent the assessment survey to 61 utility headquarters and 162 individual facilities, requesting information regarding, among other factors, the stability of liquid-holding surface impoundment units. Responses to EPA's survey request identified 584 impoundment units (almost 300 more than EPA originally thought were operating). Survey responses also indicated that 49 units at 30 different locations were deemed "high hazard units." Such a rating is not an indication of the structural integrity of a unit or an assessment of its potential for failure. Rather, the rating allows dam safety and other officials to determine where significant damage or loss of life may occur if there is a structural failure of the unit.[14] EPA's intent in determining the dam safety rating was to assist in prioritizing inspections at individual facilities.

Regulatory History and Current Rulemaking

The Resource Conservation and Recovery Act (RCRA, 42 U.S.C. §6901 *et seq.*)[15] provides the general guidelines under which all waste is managed. It also includes a congressional mandate to EPA to develop a comprehensive set of regulations to implement the law (also commonly referred to as RCRA). Enacted in 1976, RCRA was intended, in part, to protect human health and the environment from the potential hazards of waste disposal and to ensure that wastes are managed in an environmentally sound manner.

The evolution of CCW regulation involves a long and somewhat complicated history. To understand issues associated with CCW disposal regulations and the current rulemaking process, it is useful to understand EPA's current authority under RCRA to regulate solid and hazardous waste; the terms of the "Bevill amendment," which excluded CCW from regulation under RCRA's hazardous waste requirements; EPA's actions in response to Bevill amendment directives; and issues associated with the current rulemaking process—particularly questions regarding EPA's potential to regulate CCW as solid or hazardous waste.

[13] EPA requested this information pursuant to its authority under § 104(e) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, 42 U.S.C. § 9604(e)), which provides that when the agency has reason to believe that there may be a release or threat of a release of a pollutant or contaminant, it may require any person who has or may have information about the release to furnish information relating to the matter to EPA. For more information about EPA's request for information, and the response from utilities, see EPA's "March 9, 2009 Coal Ash Information Request Letter," at http://www.epa.gov/osw/nonhaz/industrial/special/fossil/coalashletter.htm.

[14] For more information, see EPA's "Fact Sheet: Coal Combustion Residues (CCR) - Surface Impoundments with High Hazard Potential Ratings," document EPA530-F-09-006, available at http://www.epa.gov/osw/nonhaz/industrial/special/fossil/ccrs-fs/index.htm.

[15] RCRA actually amends earlier legislation, the Solid Waste Disposal Act of 1965, but the amendments were so comprehensive that the act is commonly referred to as RCRA rather than by its official title.

Waste Management Requirements Potentially Related to CCW

Broadly, industrial waste is regulated pursuant to standards applicable to "solid waste" and "hazardous waste." The current debate regarding CCW management centers around determining under which of those categories CCW belongs. To understand some of the challenges associated with the current rulemaking, it is useful to understand how a waste is identified as a solid waste or a hazardous waste (under the regulatory definition), and EPA's current authority to regulate each category of waste.

Identifying Solid and Hazardous Waste

RCRA regulations define solid waste broadly as any discarded material.[16] The regulations specify that a *solid* waste becomes a *hazardous* waste[17] by exhibiting one or more of the following characteristics—toxicity, reactivity, ignitability, or corrosivity. If CCW were to be characterized as hazardous, it would likely be because hazardous constituents in the waste exceed regulatory *toxicity* levels. EPA requires that toxicity characteristics be determined using the Toxicity Characteristic Leaching Procedure (TCLP).[18] The TCLP test is intended to simulate conditions that would likely occur in a landfill, and measures the potential for toxic constituents to seep or "leach" into groundwater.

Generally, CCW does not "fail" TCLP (that is, a given sample of waste generally does not exceed toxicity levels for certain contaminants like lead, arsenic, selenium, or other heavy metals). However, the nature of CCW is unique, relative to other hazardous waste. That is, it is generated in huge volumes, with large amounts of inert, benign materials that effectively dilute what may be an overall significant amount of hazardous constituents in an entire CCW landfill or surface impoundment.

Another means by which a waste may be identified as hazardous is by EPA specifically listing it as such (hence commonly referred to as "listed wastes").[19] One category of listed waste is "source specific waste." This list of waste includes wastes from specific industries, such as petroleum refining or pesticide manufacturing. If CCW were determined to be a hazardous waste it would likely be a specifically listed waste.

In addition to specifically listing wastes as hazardous, certain wastes may be specifically *excluded* from the definition of hazardous waste or solid waste. Materials may be excluded for various reasons, including public policy, economic impacts, prior regulation, lack of data, or the waste's high volume and low toxicity. The decision to exclude these materials from the solid waste definition is a result of either congressional action (embodied in the statute) or EPA policy making (embodied in the regulations). For example, Congress excluded CCW from the definition

[16] Solid waste is defined in more detail at 40 C.F.R. 261.2.

[17] Hazardous waste is a subset of solid waste. A waste must first be determined to be a solid waste before it can meet the definition of hazardous waste.

[18] Other test methods may also be acceptable. For more information, see EPA's website regarding various test methods for evaluating solid waste, at http://www.epa.gov/waste/hazard/testmethods/index.htm.

[19] See 40 C.F.R. §§ 261.31, 261.32, and 261.33.

of hazardous waste pending additional study from EPA (see discussion below regarding "CCW's Regulatory Exemption Under "the Bevill Amendment"").[20]

Solid Waste Management Requirements

Subtitle D of RCRA establishes state and local governments as the primary planning, regulating, and implementing entities for the management of non-hazardous solid waste, such as household garbage and non-hazardous industrial solid waste. RCRA specifically requires EPA to regulate solid waste management facilities that accept household hazardous waste or hazardous waste from "small quantity generators." Such a specific directive indicates that EPA *does not* have the authority to regulate other types of disposal facilities, such as those that receive CCW.

Hazardous Waste Management Standards

Subtitle C of RCRA created a hazardous waste management program that, among other elements, directed EPA to develop certain waste management criteria. Under subtitle C, EPA is authorized to establish a system for controlling hazardous waste from the time it is generated until its ultimate disposal (i.e., from "cradle to grave").

Under subtitle C, hazardous waste treatment, storage, and disposal facilities (TSDFs) are required to have permits, to comply with operating standards specified in the permit, to meet financial requirements in case of accidents, and to close their facilities in accordance with EPA regulations. The 1984 amendments imposed a number of new requirements on TSDFs with the intent of minimizing land disposal. Bulk hazardous liquid wastes are prohibited from disposal in any landfill, and severe restrictions are placed on the disposal of containerized hazardous liquids, as well as on the disposal of nonhazardous liquids in hazardous waste landfills. EPA was directed to review all wastes that it defined as hazardous and to make a determination as to the appropriateness of land disposal for them. Minimum technological standards were set for new landfills and surface impoundments, requiring, in general, double liners, a leachate collection system, and groundwater monitoring.

As required under subtitle C, EPA proposed hazardous waste management regulations in 1978.[21] In these proposed regulations, EPA identified six categories of wastes it deemed "special wastes" (including fossil fuel combustion wastes) which would be deferred from hazardous waste management requirements until the completion of further study and assessment to determine their risk to human health and the environment. These special wastes were identified because they typically were generated in large volumes and, at the time, were believed to pose less of a risk to human health and the environment than wastes identified for regulation as hazardous waste.

In 1980, the Solid Waste Disposal Act Amendments of 1980 amended RCRA in several ways, including exempting "special wastes" from regulation under subtitle C until further study and assessment of risk could be performed. This section of the law is frequently referred to as the "Bevill Amendments."

[20] For more information about the identification of solid and hazardous waste and hazardous waste exclusions, see the Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division, "Hazardous Waste Exclusions Guidance," Second Edition, April 2009, available at http://www.cdphe.state.co.us/HM/hwexcl.pdf.

[21] 42 *Federal Register* 58946, December 18, 1978.

Authority to Address an Imminent and Substantial Endangerment

Section 7003 of RCRA (42 U.S.C. § 6973) provides EPA with broad enforcement tools that can be used to abate conditions that may present an imminent and substantial endangerment to health or the environment. Section 7003 allows EPA to address situations where the handling, storage, treatment, transportation, or disposal of any solid or hazardous waste may present such an endangerment. In these situations, EPA can initiate judicial action or issue an administrative order to any person who has contributed or is contributing to such handling, storage, treatment, transportation, or disposal to require the person to refrain from those activities or to take any necessary action.

Section 7003 is available for use in several situations where other enforcement tools may not be available. For example, Section 7003 can be used at sites and facilities that are not subject to subtitle C of RCRA or any other environmental regulation (as may be the case at CCW disposal or use sites).

Action under Section 7003 may be initiated if the following three conditions are met:

1. Conditions may present an imminent and substantial endangerment to health or the environment—such conditions generally require careful documentation and scientific evidence. However, the endangerment standard under RCRA has generally been broadly interpreted.
2. The potential endangerment stems from the past or present handling, storage, treatment, transportation, or disposal of any solid or hazardous waste.
3. The person has contributed or is contributing to such handling, storage, treatment, transportation, or disposal.[22]

Under Section 7003, EPA may take action as deemed necessary, determined on a case-by-case basis. Further, it gives EPA authority to obtain relevant information regarding potential endangerments.

Section 7003 authority has been cited by some industry representatives as one alternative to EPA to regulate CCW management. Proponents argue that such an approach would allow EPA to enforce disposal practices or uses that pose a potential threat. Opponents of this approach argue that it is a resource-intensive method of enforcement—one that would require EPA to gather substantial amounts of information on individual disposal sites, as opposed to implementing a consistent national approach to regulation.

CCW's Regulatory Exemption Under "the Bevill Amendment"

In the months before hazardous waste regulations were finalized in 1980, Congress debated RCRA reauthorization. In February 1980, Representative Tom Bevill introduced an amendment to the Solid Waste Disposal Act Amendments that would require EPA to defer the imposition of hazardous waste regulatory requirements for fossil fuel combustion waste and discarded mining

[22] For details on EPA's Office of Enforcement and Compliance Assurance, see "Guidance on the Use of Section 7003 of RCRA," October 1997, available at http://www.p2pays.org/ref/03/02645.pdf. For information on legal requirements for initiating action under Section 7003, in particular, see pp. 9-19.

waste until data regarding the materials' potential hazard to human health or the environment could be analyzed. Congressman Bevill stated that EPA's intent to regulate such waste as hazardous would discourage the use of coal and constitute an unnecessary burden on the utility industry.[23] In anticipation of the enactment of this legislation, according to EPA, the agency excluded the regulation of fossil fuel combustion waste from its final hazardous waste regulations.[24]

P.L. 96-482, the Solid Waste Disposal Act Amendments of 1980, was enacted on October 12 of that year. The law was intended, in part, to provide EPA with stronger enforcement authority to address illegal dumping of hazardous waste. The final version included Representative Bevill's amendment, which excluded the following large-volume wastes from the definition of hazardous waste under Subtitle C of RCRA:

- Waste generated primarily from the combustion of coal (e.g., fly ash waste, bottom ash waste, slag waste, and flue gas emission control waste) or other fossil fuels.
- Solid waste from the extraction, beneficiation, and processing of ores and minerals, including phosphate rock and overburden from the mining of uranium ore.
- Cement kiln dust waste.

The Bevill amendment specified that the hazardous waste exclusion would be held pending completion of a study and report to Congress by EPA for each waste category. Factors to be addressed in each study were specified under Section 8002 of RCRA. For example, EPA was required to determine the potential danger, if any, posed by each form of waste to human health or the environment; identify documented cases in which danger to human health or the environment had been proved; identify then-current disposal practices, alternatives to those disposal methods, and the costs of such alternatives; and identify then-current uses and potential future uses of coal combustion products.[25] Within six months of each report to Congress, EPA was directed to make a regulatory determination regarding whether the waste in question warranted regulation as a hazardous waste under Subtitle C of RCRA.

EPA Actions from the Bevill Amendment to Kingston

Since 1980, EPA has conducted various studies, submitted reports to Congress, and made regulatory determinations in response to the directives in the Bevill amendment. Those actions primarily address issues associated with landfill and surface impoundment disposal. EPA has also conducted studies into the beneficial use of CCW. In addition, both EPA and the Department of the Interior's Office of Surface Mining (OSM) have conducted various activities related to mine placement of CCW. Selected actions undertaken by both EPA and OSM are summarized in **Table 2**.

[23] *Congressional Record*, February 20, 1980, p. 1087.

[24] 45 *Federal Register* 33084, May 19, 1980.

[25] Section 8002(f), (n) and (p) of RCRA.

Table 2. EPA and OSM Actions in Response to Bevill Amendment Requirements

Selected Actions and Findings Applicable to Coal Combustion Waste

Date	Document Type	Summary of Findings
Oct. 31, 1982	Deadline	EPA missed its statutory deadline for submitting its fossil fuel combustion waste report to Congress.
Feb. 1988	Report to Congress (RTC)	EPA published its "Report to Congress on Wastes from Combustion of Coal by Electric Utility Power Plants." The RTC found that the four large volume waste streams studied (fly ash, bottom ash, boiler slag, and flue gas emission control waste) were not a major concern. Trace constituents in the wastes, including arsenic, barium, cadmium, chromium, lead, mercury, and selenium, may present risks to human health and the environment. However, the data also indicated that these wastes generally do not exhibit RCRA hazardous waste characteristics. Further, the RTC concluded that current waste management practices appear to be adequate. The RTC also indicated that as of 1988, coal-fired electric utilities spent about $800 million per year for CCW disposal, and that costs would increase to $3.7 billion per year if CCW was regulated as hazardous waste under RCRA's Subtitle C. This report addressed wastes generated from the combustion of coal by electric utility power plants, but did not address co-managed wastes (independent power producing facilities that are co-managed with certain other CCW), other fossil fuel combustion wastes, and wastes from non-utility boilers. Those "remaining wastes" were addressed in a subsequent RTC in 1999.
Aug. 31, 1988	Deadline	EPA missed its statutory deadline for making a regulatory determination regarding wastes studied in its February 1988 RTC.
Aug. 9, 1993	Regulatory determination (58 FR 42466)	EPA concluded that the four waste streams studied in the 1988 RTC did not warrant regulation as hazardous waste under Subtitle C of RCRA. EPA determined that it required more time to research the "remaining wastes" to make an appropriate determination.
March 31, 1999	Report to Congress	EPA published its "Report to Congress on Wastes from the Combustion of Fossil Fuels." This report addresses "remaining wastes" identified in the 1988 RTC and 1993 regulatory determination.
May 22, 2000	Regulatory determination (65 FR 32214)	This determination applied to large-volume CCW generated at electric utility and independent power producing facilities, and non-utilities. EPA concluded that these wastes did not warrant regulation under subtitle C of RCRA, but that national regulations under RCRA's subtitle D (solid waste requirements) were warranted for CCW when it is disposed of in landfills or surface impoundments. Further, to consistently regulate such waste across all waste management scenarios, the agency stated its intent to promulgate such national requirements. The agency also concluded that no additional regulations were warranted for CCW used beneficially. EPA stated that the agency did not wish to place any unnecessary barriers on the beneficial use of fossil fuel combustion wastes so that they can be used in applications that conserve natural resources and reduce disposal costs.
May 2001 - May 2004	Public Meetings	EPA held several meetings with stakeholders regarding the use and disposal of coal combustion byproducts. In the public notice for its March 2004 meetings, EPA stated that the "Agency remains concerned about coal combustion byproducts because of the potential for environmental damage; the lack of ground-water protection via monitoring and/or liners; and widely varying state regulatory programs."
Dec. 2002	Reports	EPA issued two draft reports "Regulation and Policy Concerning Mine Placement of Coal Combustion Waste in Selected States" and "Mine Placement of CCW: State Program Elements Analysis" (final versions do not appear to have been released). The reports review and summarize current state regulations and policies concerning the placement of CCW in surface and underground mines.
March 1, 2006	Report	The National Academy of Sciences' National Research Council (NRC) issued a report, *Managing Coal Combustion Residues in Mines.* Among other recommendations, NAS recommends that the Department of the Interior's Office of Surface Mining (OSM) take the lead in CCW disposal standards under the Surface Mining Control and Reclamation Act of 1977 (SMCRA, the primary federal law that regulates the environmental effects of coal mining). EPA is working with OSM as they amend the SMCRA regulations to better address minefilling in active coal mines as well as federally funded abandoned mines.

Date	Document Type	Summary of Findings
August 2006	Report	EPA and the U.S. Department of Energy issued a joint report *Coal Combustion Waste Management at Landfills and Surface Impoundments, 1994-2004*. The report evaluated CCW disposal practices and state regulatory requirements at landfills and surface impoundments that were permitted, built, or laterally expanded between January 1, 1994, and December 31, 2004. In part, the report concluded that, since the 1988 RTC, a majority of the states reviewed for the study tightened regulation of landfill liners, leachate-collection systems, and groundwater monitoring for new disposal units.
March 6, 2007	Advanced Notice of Proposed Rulemaking (72 FR 12025)	In response to the March 2006 NRC report on managing CCW in coal mines, OSM released an ANPR regarding "Placement of Coal Combustion Byproducts in Active and Abandoned Coal Mines." The ANPR cites various findings and recommendations in the NRC report as the basis for the initiation of the rulemaking process.
July 9, 2007	Report	EPA's Office of Solid Waste issued "Coal Combustion Waste Damage Case Assessment." In that report, EPA determined that there have been 24 cases of proven damage and 43 cases of potential damage associated with CCW landfills and surface impoundments. (Cases of alleged damage were submitted for review to EPA by environmental organizations. EPA also collected information from its own experience and from state agencies.) In each case there has been either proven damage to surface water or to groundwater. In some cases, elevated levels of polychlorinated biphenyls (PCBs), chromium, arsenic, cadmium, nickel, beryllium, selenium, iron, and other metals were found. Potential impacts to human health and the environment that were observed included contaminated well water and fish-kills.
Aug 6, 2007	Report	EPA's Office of Solid Waste issued "Human and Ecological Risk Assessment of Coal Combustion Wastes." The draft risk assessment conducted by EPA sought to quantify human health and ecological risks associated with current disposal practices for high-volume CCW in landfills and surface impoundments. In part, the risk assessment stated that risks from clay-lined liners are lower than unlined units, but that risks were still well above risk criteria for arsenic and thallium for landfills and arsenic, boron, and molybdenum for surface impoundments. Composite liners effectively reduce the risks from all constituents below the risk criteria for both landfills and surface impoundments. Further, although it is likely that new landfills will have some type of liner, it is not known how many unlined units continue to operate in the United States.
Aug. 29, 2007	Notice of Data Availability (NODA)	EPA issued a Notice of Data Availability on "Disposal of Coal Combustion Wastes in Landfills and Surface Impoundments." Documents made available under the NODA were the August 2006 joint EPA/DOE report on report on CCW Management at Landfills and Surface Impoundments; EPA's Aug. 2007 risk assessment; and EPA's July 2007 damage case assessments. EPA made these documents available and sought public comments on how, if at all, the information should affect EPA's decisions as it continued to follow up on its Regulatory Determination for CCW disposed of in landfills and surface impoundments. EPA stated that it would "consider all the information provided through the NODA, the comments and new information submitted on the NODA, as well as the results of a subsequent peer review of the risk assessment, as it continued to follow up on its Regulatory Determination for CCW disposed of in landfills and surface impoundments."
Feb. 5, 2008	NODA	The comment period related to the August 2007 NODA was extended until February 11, 2008.
Feb. 12, 2008	Report	EPA Office of Solid Waste and Emergency Response, Economics, Methods, and Risk Analysis Division issued "Waste and Materials-Flow Benchmark Sector Report: Beneficial Use of Secondary Materials-Coal Combustion Products." Among other information, the report provides an overview of key beneficial uses of CCW and an analysis of its benefits and potential impacts.

Source: This table was prepared by CRS based on a review of the public record. In particular, EPA's "Fossil Fuel Combustion (FFC) Waste Legislative and Regulatory Time Line," available at http://www.epa.gov/osw/nonhaz/industrial/special/fossil/regs.htm.

As discussed above, EPA first stated its intent to develop regulations applicable to CCW management in May 2000. In its regulatory determination, EPA concluded that CCW did not warrant regulation as hazardous waste pursuant to provisions of subtitle C. However, EPA stated that it was convinced that CCW could pose risks to human health and the environment if not properly managed, and there is sufficient evidence that adequate controls may not be in place. The agency cited, for example, that most states can require newer units to include liners and groundwater monitoring, but that 62% of existing utility surface impoundments do not have groundwater monitoring. Further, EPA stated:

> ... [I]n light of the evidence of actual and potential environmental releases of metals from these wastes; the large volume of wastes generated from coal combustion; the proportion of existing and even newer units that do not currently have basic controls in place; and the presence of hazardous constituents in these wastes; we believe, on balance, that the best means of ensuring that adequate controls are imposed where needed is to develop national subtitle D regulations.[26]

EPA stated its decision to establish national regulations under RCRA subtitle D for CCW that is disposed of in landfills or surface impoundments or used to fill surface or underground mines. Since that decision, EPA gathered data, issued various reports, and held public hearings, but did not propose regulations.

The Current Rulemaking

In the wake of the Kingston release, EPA again stated its intent to develop regulations applicable to CCW disposal. On March 9, 2009, EPA announced that it was moving forward on developing regulations to address the management of CCW. The agency stated that it planned to propose regulations by the end of 2009.

In its May 2000 regulatory determination, EPA stated that it would establish national regulations under subtitle D of RCRA, and specifically sited sections 1008(a) and 4004(a)[27] of the law as the basis of its authority to regulate for CCW disposed in landfills or surface impoundments or used to fill surface or underground mines. However, in 2009, statements attributed to an EPA representative indicated that the authority previously cited was not sufficient to regulate CCW under subtitle D.[28] Instead, subtitle D gave EPA only the authority to regulate sanitary landfills (discussed above). Specifically, under subtitle D, Congress requires the "upgrading of open dumps" (42 U.S.C. § 6945) and directs EPA to determine the adequacy of certain guidelines and criteria (42 U.S.C. § 6949a) applicable to certain solid waste management and disposal facilities. Those sections of RCRA apply specifically to facilities that may receive hazardous household wastes or hazardous wastes from small-quantity generators.

[26] Ibid.

[27] 42 U.S.C.§ 6907(a), "Solid Waste Management Information and Guidelines" and §6944(a), "Upgrading of Open Dumps."

[28] *InsideEPA*, "Environmental Policy Alert: EPA Lawyers Stymie State, Industry Bid For 'Solid' Waste Coal Ash Rules," October 17, 2009.

Solid waste facilities that receive CCW are not specifically identified in the law. Therefore, according to EPA, the agency is not authorized to promulgate enforceable regulations under subtitle D (e.g., to establish landfill criteria or require states to include CCW disposal units in their solid waste permitting programs.

Considering the recent interpretation of its authority under subtitle D and the current existing authority (described above), it appears that EPA generally has three options for regulating CCW. Those options, as well as selected and pros and cons outlined by various stakeholders, are summarized in **Table 3**.

Table 3. Summary of Potential Regulatory Authorities to Address CCW Management

Selected Stakeholder Arguments "For" and "Against" Potential Regulatory Approaches

Statutory Authority	Description	Proponent Arguments "For"	Opponent Arguments "Against"
RCRA Subtitle C-Hazardous Waste Management Requirements	CCW would be regulated as a hazardous waste. Land disposal of the waste would be prohibited unless certain criteria were met, such as landfills and surface impoundments would be required to have synthetic liners and groundwater monitoring. Further, states would be obliged to apply for federally enforceable permits from EPA. Under this approach, EPA has the option to exclude CCW from the definition of hazardous waste under certain conditions, such as when recycled under specific conditions.	Environmental groups favor this approach because they argue that it is the only option that would ensure that consistent, enforceable, minimum federal standards would be applied to CCW disposal units and its uses. It would also provide EPA with enforcement and inspection authority that is currently lacking.	Industry groups and state agencies argue that this approach is too strict, would result in significant logistical challenges, and would cost billions of dollars. Some industry groups also believe that a "hazardous waste" designation will stigmatize the use of coal ash in construction materials such as cement mix and wallboard, ultimately reducing its beneficial use and increasing the amount that must be disposed of.
RCRA Subtitle D-Solid Waste Management Requirements	CCW would be regulated as solid waste. Essentially, the waste would continue to be regulated pursuant to current requirements. That is, its disposal and use would be regulated in accordance with terms dictated by individual states. EPA could chose to develop landfill criteria or permitting requirements under subtitle D, but those requirements would not be enforceable.	Many states and industry organizations favor this approach. States prefer to regulate the waste as they see fit. Industry groups argue that current solid waste requirements are sufficient.	Environmental groups argue that sufficient protections to human health and the environment must involve restrictions on land disposal and include enforceable requirements. This approach would leave inspection and permitting to states, which could result in inconsistent approaches and make it difficult for EPA to enforce the rules (if EPA chooses to develop disposal criteria).
RCRA Section 7003-Imminent hazard protection	EPA would use its current authority to address potential hazards at individual disposal sites.	Industry groups argue that this approach would allow EPA to address disposal units at power plants as well as uses that were not truly "beneficial" (e.g., land application as fill material as opposed to its use as a component in concrete)	Environmental groups argue that this is a resource intensive approach to addressing the issue. It is not a regulatory approach intended to regulate disposal facilities nation wide, but instead a provision that allows EPA to act in the case of an emergency. CCW should be regulated in a way that prevents an emergency from happening.

Source: Table prepared by CRS based on provisions of RCRA and public statements from various interest groups regarding potential CCW regulation.

Note: There has also been discussion of a potential "hybrid approach" that would involve regulating the waste as a solid waste if it were disposed of under certain conditions (e.g., in a lined landfill), but as a hazardous waste if those conditions were not met. It is unclear if such an approach would be enforceable considering EPA's current authority under RCRA.

On December 17, 2009, EPA issued a statement indicating that the regulatory proposal is on hold.

Requirements Applicable to CCW Management

As discussed previously, CCW is managed in one of two ways—it is either *disposed of* in landfills, surface impoundments, or mines, or it is put to some *beneficial use*. In 2008, 136 million tons of CCW were generated. Industry estimates indicate that 8% was disposed of in mines as minefill and 37% was used in some capacity (e.g., as a component in concrete, cement, or gypsum wallboard, or as structural or embankment fill).[29] The remainder was disposed of in landfills or surface impoundments. Requirements applicable to each of these management methods are determined by individual states. Generally, the only federal role in their management may be that certain state permit programs (e.g., those related to wastewater discharges to surface water) are implemented under the authority of federal law. Other than that, there is little federal role in CCW management.

It is difficult to make any broad statements about regulations applicable to CCW management methods. Regulations do not just vary from state to state, but from unit to unit. For example, a given state likely regulates surface impoundments and landfills under different requirements associated with regulations applicable to solid waste and wastewater management, while mine disposal and beneficial uses may be largely unregulated.

Regulatory requirements within a given state may also vary depending on when a disposal unit went into operation. For example, requirements applicable to older landfills may be grandfathered in, under less stringent requirements than newer units, as new laws are enacted. Also, no industry or federal agency tracks the total number of disposal units or waste usage sites (e.g., locations where waste may have been used as structural fill). That is not to say that the waste is necessarily unregulated or disposed of improperly—only that there are many unknown elements of both current disposal and use practices, and probably even less that is known about sites that have been closed.

Landfill and Surface Impoundment Disposal

Landfilling CCW involves the long-term disposal of generally dry waste that is placed on an area of land or an excavation for permanent disposal. Surface impoundment units hold liquid waste that is generally sluiced directly from a power plant to the impoundment unit, where solids settle out, leaving relatively clear water at the surface (which may be recirculated into the plant or discharged to surface water). The impoundment itself may be a natural or man-made depression or diked area formed of earthen materials used for temporary or permanent storage or treatment of liquid waste. Solids may accumulate until the impoundment unit is full, or they may be dredged periodically and taken to another disposal unit such as a landfill.

[29] See the American Coal Ash Association (ACAA), "2008 Coal Combustion Product (CCP) Production & Use Survey Results (Revised)," available at http://www.acaa-usa.org/displaycommon.cfm?an=1&subarticlenbr=3. The ACAA considers "mining applications" a "use" of CCW. The extent to which such applications are actually minefill is not defined. In this report, the use of CCW as minefill is considered another method of disposal and therefore is not included in statistics regarding "beneficial use."

In 2006, in a joint-agency effort, EPA and the U.S. Department of Energy (DOE) conducted a study to determine state regulatory requirements applicable to CCW landfills and surface impoundments built between 1994 and 2004.[30] At the time, it was estimated that roughly two-thirds of the waste was disposed of in landfills and the remainder in surface impoundments. However, it is unknown how accurate that estimate is. In March 2009, when EPA surveyed power plants to determine the integrity of existing surface impoundments, the agency estimated that there were approximately 300 ponds nationwide. Instead, survey results found that there are 584. There is no comparable data on the number of landfills.

The EPA/DOE study also found that regulations varied for each type of surface disposal unit, and varied significantly from state to state. A common regulatory element was that all disposal units were required to have some type of permit to operate—generally more than one. The most commonly issued state permits were issued in accordance with a state's solid waste requirements, wastewater or water pollution control requirements, or dam safety requirements.

As noted in the EPA/DOE study, these requirements applied to "new" landfills and surface impoundments. It is unknown how many landfills and surface impoundments built before 1994 exist, are still in operation, or may not have been properly closed. Older units may be required to have permits to continue operation, but would not likely have been required to install liners, leachate collection systems, or groundwater monitoring devices.

With regard to surface impoundments, states commonly regulate two elements of a unit—the structure itself (commonly pursuant to the state's dam safety requirements) and any discharges from the unit to surface or groundwater (commonly pursuant to the state wastewater or water pollution control requirements).

Another complicating factor in determining state CCW disposal requirements is states' tendency to allow a certain number of "exceptions" to state regulatory requirements. For example, a state may have specific requirements for landfill and surface impoundment liners or groundwater monitoring systems, but allow an individual plant to implement an alternative means of compliance on a case-by-case basis.

With regard to both surface impoundments and landfills, many states are likely to require groundwater monitoring to detect contamination from a disposal unit, but fewer states are likely to have regulatory requirements intended to *prevent* groundwater contamination from occurring (e.g., they would not likely require a plant to install a liner in an older, unlined landfill). These potential variations within a state's own program make comparison from state to state even more difficult. This variation, in part, was the basis for EPA's 2000 determination that consistent, national regulation regarding CCW disposal under RCRA Subtitle D was needed.

Although details of each state's regulatory requirements vary, there are certain broad requirements that may be similar. For example, a state is likely to regulate new landfills under provisions of the state's solid waste management program. New surface impoundments are likely regulated under provisions of the state's dam safety program and under the terms of a wastewater discharge permit program.

[30] EPA and the U.S. Department of Energy report, *Coal Combustion Waste Management at Landfills and Surface Impoundments, 1994-2004*, August 2006.

Solid Waste Permits

States may regulate CCW landfills in accordance with state solid waste management program requirements. Most state waste management programs specifically exclude CCW from the definition of hazardous waste and instead regulate it as solid waste. States generally regulate solid waste disposal in accordance with a permit program. That is, landfills generally are required to operate in accordance with criteria specified in a permit. If a state regulates CCW landfills under its solid waste permit program, new CCW landfills likely are required to have a liner and groundwater monitoring system. Permits may also require leachate collection systems, closure and post-closure requirements, siting controls, or a financial assurance requirement.

Not all states regulate CCW landfills through a permit program. For example, in the EPA/DOE study, of the 11 state programs analyzed, five adopted laws and regulations that resulted in exemptions from solid waste permitting requirements for certain CCW landfills. That does not necessarily mean that those states exempt CCW landfills from regulation, just that operational requirements established by the state are not met by complying with the terms of a permit.

Dam Safety Requirements

Many states use their dam safety requirements to regulate the construction, operation, and maintenance of surface impoundments. Such requirements would be intended to prevent a breach of a unit (such as the breach that occurred at Kingston). State dam requirements applicable to CCW surface impoundments may be similar to those for *mining waste* surface impoundment requirements found in the Surface Mining Control and Reclamation Act (SMCRA)—specifically requirements applicable to the unit design, construction, inspections, and emergency reporting. For example, West Virginia, a state that generates a significant amount of CCW, has dam safety requirements applicable to CCW surface impoundments. Selected elements of those requirements are:

- Units must have an application on file and a certificate of approval from the state to place, construct, or perform major repairs of a waste disposal dam.
- Plans and specifications of the design and construction must include, among other information, data regarding existing site conditions, subsidence potential, routine inspection and maintenance procedures and schedules, sediment control measures, the placement of spillways, seeding and mulching of the project area, surface drainage structures, installation of reading and monitoring devices, and an inventory of protected sites.[31]
- Units must meet specific design requirements, such as conformance to general hydrological requirements and, like SMCRA, address criteria applicable to foundation stability, structural consideration, and spillways.
- Units must meet construction requirements regarding inspections, operations and safety (including emergency procedures), and maintenance.

[31] A complete list of plan requirements is specified under the West Virginia state regulations at 47 C.S.R., 34 §6.

The presence of strong dam safety requirements is not a guarantee that regulated units will actually *be* operated and maintained according to those requirements. The requirements may be only as strong as a state's ability to enforce them. A state may have hundreds of structures required to meet its dam safety requirements and only a limited number of inspectors to insure that they are operated or maintained in an appropriate manner. In addition, a state may have strict requirements applicable to dam construction and operation, but limited ability to inspect those dams as often as necessary to ensure compliance. This makes it almost impossible to gauge the degree to which states are able to enforce their requirements.

Wastewater Discharge Permits

Disposal units, particularly surface impoundments, may be regulated as water pollution control facilities (as opposed to solid waste management units, such as landfills). In general, water pollution control facilities treat or store wastewater, including industrial wastewater, and discharge it directly or indirectly into the waters of a state, which may encompass both surface water and groundwater located wholly or partly within the state.

A disposal unit that has an outfall that discharges to surface water would be required to meet effluent guidelines specified under requirements of the Clean Water Act (CWA), and to operate in accordance with parameters specified in a National Pollutant Discharge Elimination System (NPDES) permit. As a federal requirement, all states that have been authorized by EPA to administer the NPDES program are required to regulate discharges to surface waters in accordance with certain minimum requirements (e.g., in accordance with federally mandated effluent standards). Specifics regarding how a permit program is implemented may vary (as long as minimum federal requirements are adhered to). For example, state water quality agencies may evaluate facilities on a case-by-case basis to determine the need for groundwater-protection measures such as impoundment liners and groundwater monitoring.

Even facilities that do not discharge wastewater to surface or groundwater may still be regulated in accordance with alternative water pollution control permits. Such facilities may be evaluated on a case-specific basis to determine the need for groundwater protection measures such as liners and groundwater monitoring.

Mine Disposal

The Department of the Interior's Office of Surface Mining (OSM) administers provisions of the Surface Mining Control and Reclamation Act (SMCRA). Among other provisions, SMCRA specifies requirements applicable to mine reclamation. CCW can be used in the reclamation process when it is used as minefill. Potential benefits associated with the use of CCW include its potential to abate acid mine drainage (due to the alkalinity of much of the waste), to improve already-disturbed mine lands, and to avoid increased generation of aboveground landfills and surface impoundments.[32]

[32] Truett Degeare, U.S. Environmental Protection Agency, Office of Solid Waste, presentation, "Overview of U.S. Environmental Protection Agency Coal Combustion Waste (CCW) Mine Fill Issues," available at http://aciddrainage.com/ps/ccb2/5-1.pdf.

As with the disposal of CCW in landfills and surface impoundments, there are no explicit federal requirements specific to the use of CCW as part of the mine reclamation process. However, unlike landfill and surface impoundment disposal, some states define minefill disposal as a beneficial use that is exempt from any regulation or restriction.

In its May 2000 regulatory determination, EPA stated that regulations under Subtitle D of RCRA (and/or possibly modifications to existing regulations established under the authority of the SMCRA) were warranted when these wastes are used to fill surface or underground mines.[33] In 2000, minefill disposal was a relatively new practice that lacked long-term monitoring data regarding its potential risks. In 2003, Congress requested that EPA commission an independent study of the health, safety, and environmental risks associated with the placement of CCW in active and abandoned coal mines in all major U.S. coal basins. As a result, the National Research Council (NRC) established the Committee on Mine Placement of Coal Combustion Wastes in September 2004.

In March 2006, the NRC committee published its study *Managing Coal Combustion Residues in Mines*. In part, it found that placing CCW in coal mines as part of the reclamation process is a viable management option as long as the waste placement is properly planned and carried out in a manner that avoids significant adverse environmental and health impacts, and that the regulatory process for issuing permits includes clear provisions for public involvement.[34]

The NRC committee cautioned that an integrated process of waste characterization, site characterization, management and engineering design of placement activities, and design and implementation of monitoring is required to reduce the risk of contamination moving from a mine site to the ambient environment. It stated further that comparatively little is known about the potential for minefilling to degrade the quality of groundwater and/or surface waters, particularly over longer time periods.

The committee recommended the establishment of enforceable federal standards to govern the placement of CCW in mines. The committee's reasoning for its recommendation, after reviewing the laws and other relevant literature, was that, although SMCRA does not specifically regulate CCW placement at mine sites, its scope is broad enough to encompass such regulation during reclamation activities. Further, while SMCRA and its implementing regulations indirectly establish performance standards that could be used to regulate the manner in which CCW may be placed in coal mines, neither the statute nor those rules explicitly addresses regulation of the use or placement of CCW, and some states have expressed concern that they do not have the authority to impose performance standards specific to CCW. Therefore, the committee recommended that enforceable federal standards be established for disposal of CCW in mines. It proposed that OSM regulations be changed to address CCW specifically, or that joint rules be developed by OSM and EPA under the authority of both SMCRA and RCRA.

[33] EPA's data collection and analysis efforts associated with developing regulations applicable to CCW mine disposal have proceeded on a track separate from the efforts to develop regulations associated with CCW disposal in landfills and surface impoundments.

[34] Sections of the NRC report referenced here are taken largely from the Department of the Interior's Office of Surface Mining Reclamation and Enforcement's March 14, 2007, Advance Notice of Proposed Rulemaking, "Placement of Coal Combustion Byproducts in Active and Abandoned Coal Mines," 72 *Federal Register* 12025-12030.

"Beneficial Use"

In 2008, according to industry, approximately 37% of CCW was used in some capacity—most commonly as a component in concrete products, blended cement, gypsum panel products, and structural fill.[35] Some types of CCW are also used for road-base materials, roofing tiles and shingles, snow and ice control, and soil modification.

In its 1993 and 2000 regulatory determinations, among other factors, EPA looked at:

- Alternatives to current disposal methods.
- The costs of such alternatives.
- The impact of those alternatives on the use of natural resources.
- The current and potential utilization of coal combustion products.

After its analyses, EPA did not identify any environmental harm associated with the beneficial use of coal combustion products, and concluded in each regulatory determination that these materials did not warrant regulation as hazardous waste.

The beneficial use of coal combustion products can include both encapsulated and unencapsulated applications. The potential for contaminants to leach from CCW products largely depends on whether the waste is bound or encapsulated—as it would be in construction materials. According to EPA, unencapsulated uses of CCW require proper hydrogeologic evaluation to ensure adequate groundwater protection.[36] **Table 4** describes the primary encapsulated and unencapsulated uses of CCW.

[35] The ACAA, "2007 Coal Combustion Product (CCP) Production & Use Survey Results." In determining reuse totals, ACAA considers "mining applications" a reuse of CCW. The extent to which such applications are actually minefill is not defined. In this CRS report, the use of CCW as minefill is considered another method of disposal and therefore not included in statistics regarding reuse.

[36] See EPA's Coal Combustion Products-Regulatory Resources webpage: http://www.epa.gov/wastes/conserve/rrr/imr/ccps/resources.htm.

Table 4. Primary Beneficial Uses of Coal Combustion Wastes

Encapsulated and Unencapsulated Uses

	CCW Product Description	Type of CCW Used
Encapsulated Uses		
Concrete	Concrete consists of a mixture of approximately 25% fine aggregate (sand), 45% gravel, 15% Portland cement, and 15% water.	Certain types of fly ash can replace a percentage of the Portland cement component of concrete, and are typically less expensive than Portland cement.
Cement additive	Cement clinker is an intermediary product of the Portland cement manufacturing process. Clinker is formed when a raw mix consisting of limestone, clay, bauxite, iron ore and quartz are heated in a kiln at higher temperatures.	Fly ash can be blended with limestone or shale and fed into the cement kiln to make clinker, which is then ground into Portland cement. FGD gypsum can be used to offset virgin gypsum in cement manufacture.
Gypsum wallboard	Gypsum wallboard (or drywall) is used as an interior finish in the construction of homes and building. Wallboard is composed of a layer of gypsum stucco sandwiched between two sheets of heavy paper.	FGD gypsum can replace 100% of virgin gypsum in wallboard after the excess moisture has been removed.
Road base	A road base is a foundation layer underlying a pavement and overlaying a subgrade of natural soil or embankment fill material. It protects the underlying soil from the detrimental effects of weather conditions and from the stresses and strains induced by traffic loads.	Bottom ash can be used to offset virgin sand or gravel in road base.
Unencapsulated Uses		
Structural fill/ embankments	Structural fill is an engineered material used to raise or change the surface contour of an area and to provide ground support beneath building foundations. It can also be used to form embankments.	Depending on the soil type, fly ash can replace a percentage (generally 50%) of virgin rock, dirt, sand, or gravel in structural fill. Bottom ash can be used to offset virgin sand and gravel in structural fill.
Waste stabilization	CCW can be used in place of Portland cement, cement kiln dust, or lime to solidify and harden wet or liquid waste before it is landfilled.	Certain types of fly ash harden by themselves in contact with moisture; others can be mixed with another hardening agent, such as Portland cement, in order to be used in waste stabilization.
Soil modification/ stabilization/agricultural uses	Gypsum (calcium sulfate dihydrate) can be used as a nutrient source for crops; as a conditioner to improve soil's physical properties and water infiltration and storage; to remediate sodic (high-sodium) soils; and to reduce nutrient and sediment movement to surface waters.	Fly ash and flue gas desulfurization gypsum (a synthetic material of identical chemical structure as natural, mined gypsum) can be used as a soil amendment to neutralize acidic soils.

Source: Table prepared by CRS based on data from EPA's Office of Solid Waste report, "Waste and Materials-Flow Benchmark Sector Report: Beneficial Use of Secondary Materials-Coal Combustion Products," February 12, 2008, pp. 2-5 through 2-6; EPA brochure, "Agricultural Uses for Flue Gas Desulfurization (FGD) Gypsum," EPA530-F-08-009; and ACAA, "2007 Coal Combustion Product (CCP) Production & Use Survey Results."

Under EPA's Resource Conservation Challenge (RCC), CCW is an industrial material targeted for increased use as a building and manufacturing material. As part of that effort, EPA formed the Coal Combustion Products Partnership (C2P2) program with the American Coal Ash Association, Utility Solid Waste Activities Group, DOE, U.S. Department of Agriculture's Agricultural Research Service, Department of Transportation's Federal Highway Administration, and Electric Power Research Institute to help promote the beneficial use of CCW and "the environmental benefits that result from their use."[37]

EPA has been criticized for promoting certain "beneficial uses" of CCW without first determining if such uses are safe. In particular, the safety of agricultural uses or its use as structural or embankment fill has been questioned. National attention[38] was brought to its use as a fill material after developers used at 1.5 million tons of dry fly ash to build a golf course over a shallow aquifer at the Battlefield Golf Course, in Chesapeake, Virginia.

An assessment of groundwater wells and private drinking water wells in close proximity to the golf course found elevated levels of arsenic, barium, chromium, copper, iron, lead, mercury, and zinc.[39] However, from the available data, it has not been determined conclusively that the fly ash placed on the site has impacted nearby residential wells. Monitoring of the site is ongoing.

Issues associated with the Battlefield Gold Course site brought attention to what little is known about certain "beneficial" uses of CCW. In November 2009, the EPA Office of Inspector General issued its findings in an investigation into allegations of a cover-up in the risk assessment for the coal ash rulemaking. The Inspector General found no evidence of wrongdoing, but in that report stated that it has opened an investigation into the EPA's "partnership" with the coal industry to market coal ash and other combustion wastes in consumer, agricultural, and industrial products.[40] The report recommended a new probe of why EPA was promoting coal ash prior to determining whether these commercial applications were prudent or safe. In part, the report stated:

> We identified a potential issue related to EPA's promotion of beneficial use through its Coal Combustion Product Partnership and have referred the question how EPA established a reasonable determination for these endorsements to the appropriate OIG office for evaluation.

Conclusion

Since the regulation of CCW disposal and use is controlled by individual states, it is difficult to determine certain information about the waste. For example, it is difficult to determine the entire amount of CCW that has been disposed of in the United States. It can be estimated (although not known definitively) how many *currently operational* disposal units exist today, but is not likely

[37] For more information, see the C2P2 website at http://www.epa.gov/epawaste/partnerships/c2p2/index.htm.

[38] See *CBS News, 60 Minutes*, "Coal Ash: 130 Million Tons of Waste," originally aired October 4, 2009, available at http://www.cbsnews.com/stories/2009/10/01/60minutes/main5356202.shtml.

[39] See "Draft Site Inspection for Battlefield Golf Club Site, Chesapeake, Virginia," prepared for EPA Region 3 by Tetra Tech EM, Inc., March 30, 2009, p. 10, available at http://www.chesapeake.va.us/SERVICES/citizen_info/battlefieldgolfclub/pdf/Draft-Battlefield-Golf-Club-SI.pdf.

[40] EPA Office of the Inspector General, "Response to EPA Administrator's Request for Investigation into Allegations of a Cover-up in the Risk Assessment for the Coal Ash Rulemaking," Report No. 10-N-0019, November 2, 2009, available at http://www.epa.gov/oig/reports/2010/20091102-10-N-0019.pdf.

possible to determine the total number that have *ever been* in operation—that is, unlined units that may have been closed without a cap or groundwater monitoring system. Also, it is difficult to determine the number of sites that have used unencapsulated CCW that have properly evaluated the site, as recommended by EPA, to ensure adequate groundwater protection.

As power plant emission standards become more stringent, and air emission control devices capture more contaminants, both the total waste generated and the total amount of toxins in them can be expected to increase. As regulations are formulated to address new or expanded landfills, there are still many questions unanswered regarding the controls in place to minimize the potential risks posed by existing facilities—both with regard to a sudden, catastrophic release (as that in Kingston) or a gradual release and migration of contaminants.

Congressional interest in the issue existed before the Kingston release, but increased significantly afterward. On January 14, 2009, the Coal Ash Reclamation, Environment, and Safety Act of 2009 (H.R. 493) was introduced. The bill was intended to establish new standards applicable to surface impoundments. On February 12, 2009, the House Committee on Natural Resources, Subcommittee on Energy and Mineral Resources, held a legislative hearing on the bill. A scheduled markup was canceled when EPA announced that it would soon propose new regulations applicable to landfills and surface impoundments. The House Transportation and Infrastructure Committee, Subcommittee on Water Resources and Environment, held several hearings that looked at different aspects of the Kingston release, such as potential water quality impacts, causes of the release, and cleanup progress.[41] Also, on December 10, 2009, the House Committee on Energy and Commerce, Subcommittee on Energy and the Environment, held a hearing entitled "Drinking Water and Public Health Impacts of Coal Combustion Waste Disposal." Given its interest in this issue, it is unclear how Congress may respond given the current debate regarding EPA's existing authority to regulate CCW and its potential to regulate it as hazardous waste.

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[41] "The Tennessee Valley Authority's Kingston Ash Slide: Potential Water Quality Impacts of Coal Combustion Waste Storage," on March 31, 2009, "Coal Combustion Waste Storage and Water Quality, " on April 30, 2009, "The Tennessee Valley Authority's Kingston Ash Slide: Evaluation of Potential Causes and Updates on Cleanup Efforts," July 28, 2009, and "The One Year Anniversary of the Tennessee Valley Authority's Kingston Ash Slide: Evaluating Current Cleanup Progress and Assessing Future Environmental Goals," on December 9, 2009.