Toxic Wastewater from Coal Plants

EPA's New Rule Should Cut Toxic Discharges by 90%, but Could be Derailed by Permit Backlogs and Monitoring Loopholes.

ENVIRONMENTAL INTEGRITY PROJECT

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Executive Summary

Coal-fired power plants account for almost a third of the toxic pollution discharged to our rivers and streams from all industrial sources, according to the U.S. Environmental Protection Agency (EPA), far more than any other industry. The 1972 Clean Water Act required EPA to set standards based on the "best available treatment" systems for reducing toxic pollution, and Congress eventually gave electric generators and other industries until March 31, 1989 to comply.[1] On November 3, 2015, EPA finally published the first standards limiting toxic discharges from the mountains of ash and scrubber sludge that coal plants pile up every year, after environmental groups took action to enforce the deadline.[2]

The new "Effluent Guidelines" for steam electric power plants prohibit the discharge of ash wastewater and set new restrictions on the concentration of arsenic, mercury, selenium, and nitrates in the wastewater from air pollution scrubbers. Arsenic, mercury and selenium are byproducts of coal burning that are toxic to humans as well as to fish and wildlife in very small concentrations, while nitrates trigger algae blooms that lead to low oxygen "dead zones" in rivers, lakes, and coastal waters. EPA expects the new standards to eliminate over 90 percent of these and other toxins like cadmium, chromium, and lead that coal-fired generators pour into our waterways every year.

The rule directs state agencies to revise Clean Water Act permits to incorporate the new standards, determine monitoring requirements, and specify deadlines for meeting the limits "as soon as possible" after November 3, 2018 but no later than December 31, 2023. But a backlog of expired state permits and weaknesses in monitoring requirements could delay or derail implementation of these important protections for public health.

Our analysis focused on 216 coal plants that discharged wastewater to rivers, lakes, or tidal waters in 2015, after we excluded 57 expected to close or switch to natural gas before the end of 2018, when the rule first takes effect.[3] We evaluated publicly available monitoring records and a federal database called the Toxics Release Inventory to determine how much arsenic, mercury, and selenium these plants discharged to waterways in 2015, and how far those with wet scrubbers will have to go to meet the new limits. (For a list of the "Top 10" worst polluters, see Appendix F). We also looked for gaps or errors in monitoring that could make it impossible to know whether these limits are actually being met. Finally, we identified Clean Water Act permits that have expired and need to be renewed promptly if EPA is serious about requiring compliance "as soon as possible."

Based on our review, EPA, states, and power companies have a lot to do to close monitoring gaps, upgrade wastewater treatment, and revise permits to get the new standards in place.

Key Findings and Recommendations

- Coal plants with wet scrubbers will have to upgrade their wastewater treatment to meet the new limits for arsenic, mercury, selenium, and nitrates, based on the few plants that currently monitor these pollutants. For example, all of the 28 plants that monitored scrubber wastewater for selenium in 2015 reported levels well above new

standards – the maximum daily concentration from these plants was nearly 20 times higher than the limit that takes effect between 2018 and 2023. Seventeen of twenty plants also reported monthly average arsenic levels higher than the new standard will allow. The monitoring data was more encouraging for mercury, where 12 of 21 plants reported monthly average concentrations below the new limit.

- The standards will mean little without accurate and reliable monitoring, which is supposed to be defined on a case-by-case basis in each permit. As of 2015, nearly three quarters of the 216 coal plants we identified did not monitor and report arsenic levels in their wastewater flows, either because their Clean Water Act permits did not require such monitoring or because they failed to do so. About 60 percent did not monitor or report mercury levels, while nearly two thirds provided no such data for selenium.

- Even those plants with some monitoring data often did not collect it frequently enough to obtain meaningful results. For example, arsenic and selenium levels were checked less than once a month at more than half the outfalls (or discharge points) where those pollutants were monitored, and sometimes only once a year. Mercury concentrations were measured even less often. The data indicate that pollution levels can fluctuate widely from one month to the next, so sampling only one or two times annually (as some plants do now) will not accurately represent a plant's discharges throughout the year. For example, where plants did monitor at least once a month, the highest concentrations of arsenic, mercury or selenium were typically two to three times greater than the lowest concentrations reported in 2015.

- The Discharge Monitoring Reports filed by coal plants with state agencies and displayed on EPA's Enforcement and Compliance History Online (ECHO) website are too often incomplete and inaccurate. For example, contaminant concentrations are often reported in the wrong measurement units, data are transcribed incorrectly by industry or state agencies, and concentrations that are below the measurement detection limit are flagged inconsistently. Additionally, some outfalls and monitoring points are improperly categorized, so it is difficult to determine which outfalls discharge to waterways and which route wastewater elsewhere inside the plant.

- Incomplete and inaccurate monitoring make it hard to determine just how much arsenic, mercury, or selenium each coal plant releases to public waterways. Quantifying these toxic loadings helps determine their impact on water quality and ensure that treatment systems have enough capacity to handle that load. Based on data from the coal plants that disclose to EPA's Toxics Release Inventory (TRI) how much arsenic, mercury, or selenium they dump in surface waters every year, some of the biggest loads come from plants without permits that require actual monitoring of these deadly toxins. For example, the Ghent power station in Kentucky estimated releasing 9,922 pounds of selenium to surface waters in its TRI report for 2015 –more than any other facility – but its discharge permit does not require monitoring for this pollutant.

- Large power companies have long used the TRI to measure and report their progress in reducing toxic pollution. But most coal plants do not have to disclose arsenic or selenium releases to air or water because reporting is required only where coal

burning generates at least 25,000 pounds per year of either of these toxins. EPA has appropriately lowered the reporting threshold for lead, requiring TRI disclosure if combustion byproducts include more than 100 pounds of this contaminant. It should do the same for arsenic, which EPA has ranked as more toxic than lead, and consider similar action for selenium, which becomes increasingly toxic to fish as it moves up the food chain.

- Coal plants have lost their economic advantage, as the price of natural gas and renewables keeps dropping while increased energy efficiency has reduced the demand for electricity. Fifty-six coal-burning power stations that discharged wastewater in 2015 have either closed already or will do so before the end of 2018. But many of these retirement decisions are voluntary and can be reversed if market conditions change. Also, plants that shut down before the compliance deadline are exempt from the rule, which means they can drain any large ash ponds on site into our waterways without federal permit limits or even monitoring their discharges. EPA and state agencies should take care that shutdown schedules are not manipulated to further delay cleanup requirements.

- Clean Water Act permits are required to be reopened and renewed at least once every five years to incorporate new requirements like those established in the new wastewater rule. These renewal deadlines are frequently missed. Permits have already expired for 113 of the 216 plants we reviewed, and 79 of those lapsed more than two years ago. These permits need to be updated to set specific deadlines for meeting the new wastewater standards and to specify the monitoring needed to measure compliance.

To make matters worse, the limits on toxic discharges from coal plants are already nearly 30 years overdue. Unless EPA and states move promptly to clear permit backlogs and monitoring and reporting requirements, the delay will stretch well into a fourth decade – and our streams, lakes and rivers will continue to be a dumping ground for some of the deadliest toxins known to man.

I. What the Coal Plant Wastewater Rule Requires

Prohibits Discharge of Most Coal Ash Wastewaters

A power plant will generate from 100 to more than 300 pounds of ash for every ton of coal it burns, or 150,000 to 450,000 tons from a large generator burning about three million tons of coal annually.[4] That residue is often flushed with water out of boilers and the pollution control equipment that removes particulates from smokestacks and into settling ponds that must regularly discharge wastewater to keep from over-filling. This high-volume waste stream (called "bottom ash transport water" in the rule) typically has very high concentrations of the toxic metals that accumulate in coal ash because they cannot be destroyed, even in the high temperatures of power plant boilers.

The rule generally prohibits the discharge of any water used to flush out the ash that accumulates in boilers or in the pollution control devices that remove particulates from

smoke stacks. EPA expects the prohibition to encourage plants to switch to dry ash handling systems.[5] That should accelerate the closure of ash ponds that too often leak a witches' brew of pollutants into groundwater and occasionally burst their banks and flood rivers with toxic sludge, as happened at the Tennessee Valley Authority (TVA) Kingston plant in Tennessee and Duke Energy's Dan River plant in North Carolina.[6] The rule does allow ash transport water to be recycled for use in wet scrubbers, so long as the scrubber wastewater limits are met (see discussion below and Table A, below. The prohibition on bottom ash transport water does not apply to water used to quench (i.e., cool) bottom ash that is drained off before the ash is moved away from the boiler.[7]

Relationship to Ash Disposal Regulations

After more than six years of deliberation, EPA established the first national disposal standards for coal combustion wastes on April 17, 2015 under Subtitle D of the federal Solid Waste Disposal Act.[8] The Subtitle D standards are primarily designed to protect groundwater from leaking dumpsites and to assure that ash ponds are structurally sound enough to avoid the kind of collapse that cause the TVA Kingtson and Duke Dan River spills in 2008 and 2014, respectively. By 2019, power companies must stop using any pond in a wetland, geologically unstable area, or with a base within five feet of an underground aquifer. As soon as 2018, leaking ponds can no longer be used if they have contaminated groundwater enough to fail drinking water standards. The bill establishes cleanup standards for contamination from landfills as well as ponds and requires safe closure of contaminated sites. While the toxic wastewater rule is primarily designed to protect rivers, streams, and lakes, it also encourages the phase-out of ash ponds by prohibiting the discharge of untreated wastewater from these impoundments.

Appendix A lists the amount of arsenic, chromium, lead, mercury, lead and selenium that power plants released to surface water or dumped into ash ponds in 2015, according to their annual disclosures to the Toxics Release Inventory (TRI). The Appendix also includes the total volume of of all toxic metals discharged or sent to ponds that year, including antimony, barium, manganese, nickel, thallium, and other pollutants hazardous in very small concentrations. The data does not include ongoing discharges from plants that have already shut down, or those that will shut down before the end of 2018. And as explained further in Section III, TRI reporting rules exempt many coal plants with very large wastewater loads, so Appendix D does not provide a full accounting of industry-wide pollution levels. But even this partial inventory is staggering. For example:

- The Pirkey power plant in (county) Texas, discharged more than a quarter of a million pounds of toxic metals to the (insert river) in 2015, almost a sixth of the total reported to TRI by all companies.

- Just 20 power plants reported dumping more than 36 million tons of toxic metals into ponds, which are prone to leaks and may need to be shut down and cleaned up under new waste disposal rules. That included the 48 *tons* of arsenic that TVA's Paradise plant in Kentucky added to its ponds, along with more than 43 tons of chromium and 60 tons of lead.

Scrubber Wastewater Must Meet Limits for Arsenic, Mercury, Selenium, and Nitrates

Clean Air Act regulations restrict the amount of sulfur dioxide and acid gas that can be released from power plant smokestacks, as these pollutants contribute to asthma attacks and lung and heart disease. To meet these air pollution limits, many coal plants use wet scrubbers that inject a wet lime- or limestone-based slurry into the exhaust gases from coal plants to bind with and remove acid gases and sulfur dioxide. Because these scrubber residues also have high concentrations of toxic metals and other pollutants, EPA's new rule requires existing coal-burning generators to meet limits before discharging scrubber wastewater (Table A)

Table A. Scrubber Wastewater Limits for Existing Coal Plants[9]

Pollutant	Daily Maximum	Monthly Average
Arsenic (µg/L)	11	8
Selenium (µg/L)	23	12
Mercury (µg/L)	0.788	0.356
Nitrate/Nitrite as N (mg/L)	17	4.4

EPA expects that the pollutant levels measured over a year will be even lower if the chemical and biological treatment systems installed to meet the short-term limits are well operated, averaging no more than 5.98 µg/L (arsenic), 7.50 µg/L (selenium), 0.16 µg/L (mercury), and 1.3 mg/L (nitrate/nitrite).[10]

The limits in Table A also apply to any ash transport water used in air pollution scrubbers.[11] The standards are more stringent for new power plants (built after November 17, 2015), while the three coal gasification plants face tighter limits for arsenic and mercury and much more lenient standards for selenium.[12] Existing plants that agree to meet the tougher limits that apply to new facilities do not have to comply until the end of 2023 (as explained earlier, plants otherwise must meet the standard "as soon as possible" after November 3, 2018, with more specific deadlines to be established in permits). For more details, see: https://www.epa.gov/eg/steam-electric-power-generating-effluent-guidelines-2015-final-rule.

Arsenic, mercury, and selenium are hazardous to human health and to fish and other aquatic life in very high concentrations, while nitrates feed the algae blooms that lead to low-oxygen "dead zones." EPA expects to eliminate more than 90 percent of coal plant discharges of these pollutants, along with other toxins like cadmium, chromium, and lead, through the treatment systems required to meet the limits in Table A and the ban on dumping ash transport water discussed earlier.

Loopholes for Stormwater and Landfill Discharges

Unfortunately, the rule does not cover toxic metals in stormwater runoff from coal piles or coal yards, which can contain high concentrations of selenium and other toxic metals. Nor does it cover the liquid "leachate" collected under so-called "dry" landfills and periodically discharged, or the leaks from surface impoundments that seep into surface water.[13] While leachate is usually discharged in low volumes, it can include very high percentages of toxic metals that percolate through ash or sludge that is saturated by rain or snow. Seeps from many surface impoundments are chronic and can sometimes be as large as small creeks.

The rule does limit the concentration of total suspended solids (TSS) in leachate or seeps to no more than 100 mg/L on any given day, and no more than 30 mg/L as a monthly average. Also, TSS concentrations in any runoff from coal piles at plants built after November 19, 1982 are not supposed to exceed 50 milligrams per liter at any time.[14] But complying with limits on suspended solids does little to reduce the discharge of toxic metals from coal plants, which are usually in their dissolved form.

Case-by-Case Monitoring

States are left to define monitoring requirements under the new rule on a case-by-case basis, so long as they are consistent with the existing federal standards that apply to all Clean Water Act permits. Those generic standards provide specific direction regarding which methods and protocols should be used to accurately determine the concentration of specific pollutants in wastewater. But the rules do not say how often this data should be collected, only that permits should specify the "type, interval and frequency sufficient to yield data which are representative of the monitored activity."[15]

EPA makes clear that the limits cannot be avoided by hiding or diluting wastestreams, e.g., by mixing ash transport or scrubber wastes into the much larger volumes of cooling water that power plants routinely discharge.[16] But the rule does not specify internal monitoring procedures to prevent this from happening, leaving those to be defined by permit writers. Those permits will need to be written and reviewed carefully to ensure they do not create loopholes that encourage dilution instead of the treatment and removal of toxins.

Timetable for Compliance

Power plants must comply with the new standards "as soon as possible" after November 3, 2018, but no later than December 31, 2023.[17] State agencies are supposed to establish more specific deadlines for each facility within that five year span, taking into account the time needed to design, install, and optimize the necessary treatment systems, the potential impact of other new standards, and "other factors as appropriate."[18]

Significantly, the new limits apply *only* to wastewater that is generated after the deadline for compliance.[19] That means, for example, that ash or scrubber wastewater that accumulates in ponds until at least November 3, 2018, and as late as December 31, 2023, is exempt from the rule. This so-called "legacy" wastewater can be a major source of toxins years after coal

plants shut down. For example, the Willow Island coal plant in West Virginia closed in 2012, but monitoring reports show that it discharged 756 pounds of selenium in 2015, which is more than many coal plants still in business. Dominion's Possum Point Power Station in Virginia stopped generating electricity from coal in 2003, but the plant began draining over 150 million gallons of coal ash wastewater from its old coal ash ponds to Quantico Creek, which leads to the Potomac River, on May 9, 2016.[20]

Effect of Coal Plant Retirements

Burning coal is no longer the cheapest way to generate electricity, as the price of natural gas and renewable sources continues to fall, greater energy efficiency reduces the demand for power, and long-delayed environmental standards finally take effect. Faced with these economic and regulatory realities, many power companies are choosing to retire coal-fired units rather than investing in the pollution controls that should have been installed decades earlier.

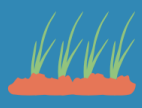
As explained earlier, our analysis did not cover 56 plants that discharged wastewater in 2015 but are expected to shut down or switch to natural gas before the end of 2018, when the rule first takes effect. Thirty of those had already closed before the end of 2015. Power companies have proposed or announced retirements for another 14 plants that fall between between 2019 and the end of 2023, which is the final deadline for meeting the wastewater treatment standards for those plants not required to comply earlier.[21]

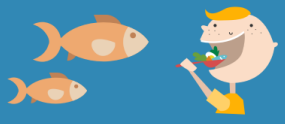
While some of the announced retirements are mandatory, e.g., required by consent decrees, most are voluntary decisions that can be reversed to keep plants operating if market conditions favor coal's return. EPA and state agencies will need to make sure that these shutdown schedule decisions are not manipulated to avoid compliance with the new wastewater treatment rule.

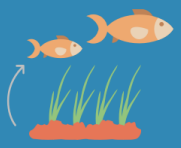
Key Toxins in Coal Plant Wastewater

Federal drinking & aquatic life water quality standards

	Arsenic	Mercury	Selenium
Drinking Water Standard	**10 ppb** Long-term exposure can cause skin damage or problems with the human circulatory system. It can also increase the risk of cancer, and has been linked to neurotoxicity in low doses.	**2 ppb** Can cause kidney, eye, and lung damage, and it is toxic to the nervous, digestive, and immune systems.	**5 ppb** Can cause hair or fingernail loss, numbness in fingers or toes, and circulatory problems.
Freshwater Aquatic Life Criteria (Chronic Exposure)	**150 ppb** At levels above 150 ppb, arsenic reduces algae and biomass growth in freshwater, and shortens the lives of aquatic invertebrates and certain amphibians. Amphibians can also develop physical deformities.	**0.77 ppb** Freshwater organisms exposed to levels above 0.77 ppb for relatively long periods of time can have trouble with reproduction, growth, behavior, metabolism, oxygen exchange, blood chemistry, and osmoregulation. EPA has also set limits based on concentrations in fish tissue.	**1.5 ppb** *Lakes/Ponds* **3.1 ppb** *Rivers/Streams* Fish and aquatic invertebrates exposed for 30 days can have trouble reproducing. Young fish and aquatic invertebrates do not grow as well and live shorter lives. It is also toxic to birds that eat aquatic organisms. EPA has also set limits based on concentrations in fish tissue.
Environmental Persistence	Arsenic accumulates within aquatic plant life and sediments. It does not accumulate in aquatic animal life, but it is difficult to remove from an aquatic ecosystem.	Mercury (especially methylmercury) biomagnifies within the food chain. What may start as small concentrations at the bottom of the food chain can grow to toxic levels in predators. Mercury persists and readily changes forms in the air, soil, and aquatic environment.	Selenium bioaccumulates within the aquatic food chain and can negatively impact ecosystems for decades.







Source: U.S. Environmental Protection Agency, www.epa.gov

II. Analysis of Discharge Monitoring Reports

Coal-fired power plants that discharge wastewater have to file discharge monitoring reports (also called DMRs) with EPA or state agencies that oversee Clean Water Act National Pollutant Discharge Elimination System (NPDES) permitting programs.[22] The content of these reports mirrors the monitoring and reporting requirements in each facility's discharge permit, which require plants to monitor and report information like flow, concentration, and (occasionally) mass load for outfalls covered by the permit. EPA makes this data available through its Enforcement and Compliance History Online (ECHO) database, where the public can download data in an electronic format through ECHO's effluent charts.[23] The following analyses are based on the publicly available discharge monitoring data available through ECHO as of April 2016. For a detailed discussion of our methods, see Appendix B. Appendix C contains a list of all plants and additional information including permit expiration dates, pollutants monitored, and projected retirements.

Scrubber Wastewater: Coal Plants Have Far to Go to Meet Limits

At least 116 of the 216 active coal fired power plants included in our survey had wet scrubbers in 2015, according to EPA's Clean Air Markets database.[24] These scrubber systems inject a liquid slurry into exhaust stacks to react with and remove sulfur dioxide and acid gases, typically generating between 200,000 and 300,000 gallons of wastewater a day. Because scrubber wastewater includes high concentrations of arsenic, mercury, nitrates, and selenium, EPA's new rule sets numerical limits for each that can be met through a combination of biological treatment and chemical precipitation designed to remove these pollutants.

Based on a review of permits, permit applications, and discharge monitoring reports, only 30 of the 216 coal plants in our survey monitored at least one of these four pollutants in scrubber wastewater in 2015 and only nine monitored all four (Appendix D).[25] Table B shows that almost all of those plants reported higher arsenic and selenium levels in scrubber wastewater than will be allowed under the rules that kick in after November 3, 2018. More than half the plants with monitoring data did report mercury concentrations low enough to meet the new standards.

Table B also shows that plants not yet meeting the new limits in 2015 will need significant wastewater treatment upgrades to comply. For example, the average monthly or maximum daily arsenic, mercury, and nitrate levels for those plants were several times higher than the new standards will allow, while selenium concentrations were more than twenty times higher. And some of the worst performers reported pollutant levels from 5 to more than 55 times the new limits, based on the median values reported by the 30 plants.

Table B. Average and highest concentrations reported by plants exceeding the new scrubber wastewater limits, 2015

Pollutant	Plants exceeding limit/total monitored	Limit after 11/3/2018	Median concentration for plants not meeting limit*	Median of highest concentrations for plants not meeting limit*
Monthly Average				
Arsenic (µg/L)	17/20	8	20.5	38.4
Mercury (µg/L)	12/21	0. 356	1.1	1.9
Selenium (µg/L)	24/24	12	291.8	690
Nitrates (mg/L)	7/9	4.4	41	58.5
Daily Maximum				
Arsenic (µg/L)	17/24	11	44.7	84.4
Mercury (µg/L)	13/29	0.788	2.45	3
Selenium (µg/L)	28/28	23	432.5	990
Nitrates (mg/L)	6/9	17	42.8	58.9

Note: Median and median of highest concentrations above limits were calculated across all plants that monitored scrubber wastewater, based on 2015 Discharge Monitoring Report data.

Current Monitoring of Deadliest Toxins is Infrequent and Haphazard

Arsenic, mercury, and selenium that accumulate in ash and scrubber sludge are often released to rivers and streams from settling ponds or wastewater treatment systems. Our review of publicly available monitoring data found that most of the 216 coal plants that discharged wastewater in 2015 are not even required to measure and report both pollutant concentrations and wastewater flow at their outfalls. Both parameters are important since the concentration of a toxin is multiplied by the flow rate to determine how much is being discharged to a waterway. Only 67 (31 percent) of the 216 coal plants we surveyed reported monitoring arsenic levels and flow rates in their 2015 Discharge Monitoring Reports, while 92 (43 percent) reported both mercury levels and flow rates, and 83 (38 percent) reported both selenium and flow rates. Plants may be required to monitor at more than one outfall, and monitoring frequency can vary between outfalls and by pollutant at the same plant. Table C summarizes the monitoring frequency of each pollutant. The reported concentrations of arsenic and other toxins can vary widely from one sample to the next, so infrequent monitoring is unlikely to accurately represent how much each plant actually discharges over the course of a year.

Table C. Number of Coal Plants and Outfalls Monitored for Flow and Arsenic, Mercury, or Selenium in 2015

	Arsenic	Mercury	Selenium
Coal plants:			
Number of plants (out of 216) that monitored	67	92	83
Number of plants (out of 216) that did not monitor	149	124	133
Outfalls:			
Number of outfalls monitored	114	180	155
Number of outfalls monitored less than 4 times per year	35	44	45
Number of outfalls monitored 4-6 times per year	26	74	36
Number of outfalls monitored monthly	53	62	74

Source: 2015 Discharge monitoring report data from ECHO as of April 2016.

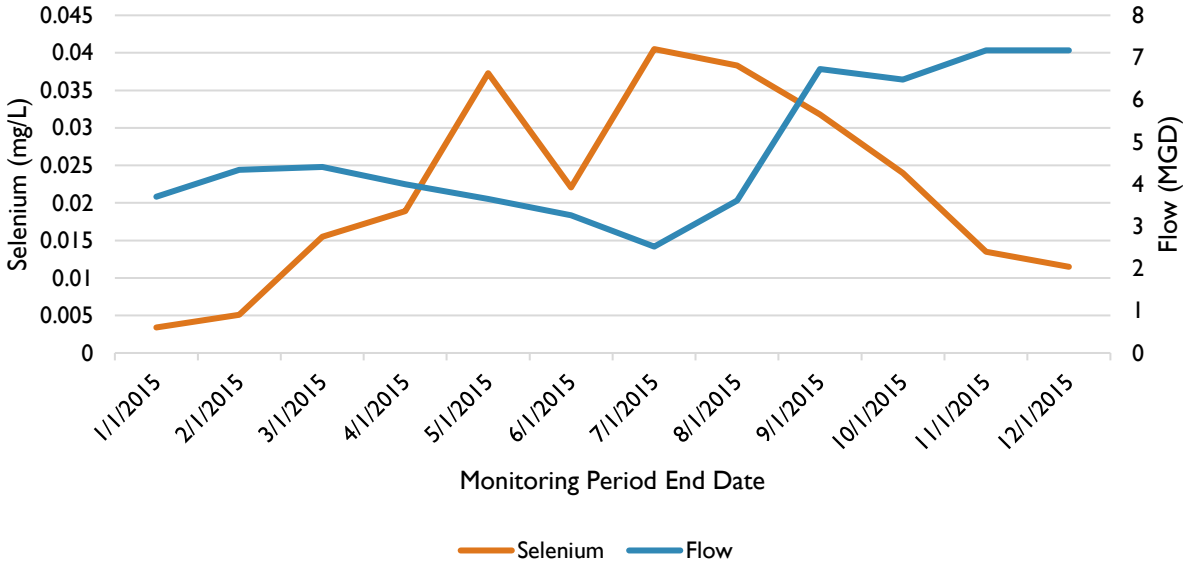
In some states, including Georgia, Iowa, Kentucky, and Missouri, most or all of the coal plants did not monitor for arsenic, mercury, or selenium. Data available from other sources, like the Toxics Release Inventory, indicate that some of the plants in those states release significant amounts of these pollutants to surface water.

For example, the Kentucky Utilities Ghent Power plant in Carroll County, Kentucky disclosed to the EPA's Toxics Release Inventory (TRI) that it released 9,922 pounds of selenium to the Ohio River in 2015, based on its own internal sampling data. Yet Ghent's Clean Water Act permit does not require any monitoring and reporting of selenium, which is toxic to aquatic life in fresh water at concentrations as low as 1.5 parts per billion in lakes, ponds, and other slow-moving waterbodies.[26] Only a handful of coal plants quantify the amount of arsenic, mercury, or selenium they discharge to surface waters in their annual reports to the TRI, possibly because some have determined they do not meet the threshold for reporting. This issue is discussed further in Section III.

Even where their permits require monitoring, some plants collect the data too infrequently to provide the "representative" results that federal rules require. For example, permits frequently allow power plants to sample just once a month to demonstrate compliance with maximum *daily* pollution limit.

Yet pollutant concentrations may fluctuate widely from one day or month to the next based on changes in plant output and wastewater flow rates, the type of coal burned, and other operational variations. For example, the Cayuga coal plant in Indiana reported monthly average selenium concentrations of 3.4 µg/L in wastewater discharges in January and 40.5 µg/L in July of 2015 from a single outfall.[27] Changing flow rates do not explain the widely varying results. Cayuga discharged 3.2 pounds of selenium in January and 35.3 pounds in May, although wastewater volumes were virtually identical for both months (see Figure 1). The data suggest that other operating variables, e.g., variations in the toxicity of ash or scrubber sludge, are responsible for these month to month fluctuations in selenium levels.

Figure 1. Monthly average selenium concentrations from Cayuga (IN), outfall 002



Source: ECHO Effluent Charts, available at: https://echo.epa.gov/effluent-charts#IN0002763.

This variability is typical of other plants that report monthly monitoring of arsenic, mercury, or selenium. Table D shows that the highest monthly concentrations were were typically two to three times higher than the lowest results reported, even *after* removing "outliers" that were astronomically low or high. Measuring toxins less frequently, e.g., once every three to six months, is much less likely to yield results that accurately represent a plant's discharge throughout the year.

Table D. Difference between highest and lowest monthly pollutant levels in 2015

Pollutant	Number of plants	Number of outfalls	Median Difference between Highest and Lowest Concentration: All Plants	Greatest Difference between Highest and Lowest Concentration: Any Plant
Arsenic	33	44	263%	1,900%
Mercury	37	51	371%	2,250%
Selenium	50	62	215%	1,091%

Note: This analysis is based on a subset of plants that reported concentrations and flow on a monthly basis. Concentrations represent monthly averages unless plants only reported a maximum or other alternative concentration (30-day average, daily average, etc.) on a monthly basis. Excludes statistical outliers to reflect variation at the typical plant.

Pollution Loads

While EPA's new coal wastewater rule includes standards that limit the concentration of specific pollutants in scrubber wastewater, it is also important to be able to quantify the amount of arsenic and other toxins discharged to waterways. Estimating these pollutant loadings is critical to determining their impact on the waters that receive these wastes. The amounts, e.g., in pounds per year, are usually calculated by multiplying the concentration of a given contaminant in micrograms or milligrams per liter by the total volume of wastewater that is discharged.

To provide reliable estimates of the most toxic pollutants, monitoring needs to be sensitive enough to measure very low concentrations, e.g., in parts per trillion for mercury, and frequent enough to account for operational variations that can change pollutant levels from one month to the next. Where plants do track one or more of these pollutants, their discharge monitoring reports sometimes indicate only that the results were too low to be measured, without disclosing what detection limits they use in sampling. In other cases, the data includes obvious errors, e.g., when concentrations in one month are a thousand times higher than normal. And as discussed earlier, monitoring is often too infrequent to cover variations in the operation of a plant that can affect the level of pollution.

With these limitations in mind, we reviewed the handful of Discharge Monitoring Reports for 2015 that contained data reliable enough to calculate how much arsenic, mercury, or selenium was being released to our waterways. More specifically, we confined our analysis to plants that reported pollutant concentrations at least quarterly that could be multiplied by flow rates to quantify annual loads, while excluding likely data errors and any values reported as below detection limits. Table E presents the ten facilities that discharged the largest amounts of each toxin in 2015 from the relatively small group of plants that met our monitoring criteria.

These are not necessarily the largest sources. We excluded several plants with monitoring reports that suggested larger discharges of arsenic, mercury, or selenium, because the data were inconsistent or the plant only reported once or twice a year. Also, some of the many coal plants that do not monitor for these pollutants at all have reported much larger wastewater releases to the Toxics Release Inventory.

Table E. Arsenic, Mercury and Selenium in Coal Plant Wastewater: Discharge Monitoring Reports v. Toxics Release Inventory, 2015.

	Plant	Permit No.	State	DMR (lbs)	TRI (lbs)
Arsenic	Asheville	NC0000396	NC	1,079.42	(not available)
	AES Petersburg	IN0002887	IN	1,009.53	1,326
	James E. Rogers Energy Complex	NC0005088	NC	987.81	830
	Cardinal	OH0012581	OH	848.26	790
	F B Culley	IN0002259	IN	746.31	(not available)
	Gallatin	TN0005428	TN	478.25	(not available)
	Miami Fort	OH0009873	OH	423.43	430
	Wateree	SC002038	SC	340.16	317
	Bull Run	TN0005410	TN	290.27	(not available)
	Winyah	SC0022471	SC	288.52	430
Mercury	Monroe	MI0001848	MI	10.61	27.51
	Cayuga	IN0002763	IN	8.05	(not available)
	Northside Generating Station	FL0001031	FL	6.83	1
	Cross	SC0037401	SC	2.16	1.8
	Crist	FL0002275	FL	1.56	(not available)
	Bull Run	TN0005410	TN	1.29	(not available)
	Conesville	OH0005371	OH	1.23	5.4
	AES Petersburg	IN0002887	IN	1.18	1.21
	Seminole	FL0036498	FL	0.66	1.1
	Genoa	WI0003239	WI	0.6	(not available)
Selenium	Northside Generating Station	FL0001031	FL	6,135.88	(not available)
	Cumberland	TN0005789	TN	6,019.31	6,000
	AES Petersburg	IN0002887	IN	3,552.94	4,398
	Merom	IN0050296	IN	3,315.12	(not available)
	Gallatin	TN0005428	TN	1,184.60	(not available)
	Cardinal	OH0012581	OH	979.43	940
	Big Bend	FL0000817	FL	924.39	(not available)
	Pleasants Power Station	WV0079171, WV0023248	WV	840.35	(not available)
	F B Culley	IN0002259	IN	840.24	(not available)
	R.M. Schahfer	IN0053201	IN	579.53	(not available)

Note: Limited to plants that reported pollutant concentrations at least quarterly that could be multiplied by flow rates to quantify annual loads, while excluding likely data errors and any values reported as below detection limits.

III. Toxics Release Inventory: Some Coal Plants Report Total Annual Releases of Arsenic and Other Toxins

Like other industries, coal-fired generating stations are required to report the annual amount of certain toxins released to water, air, or land that are manufactured, processed, or used above certain threshold quantities. Power plants are considered to "manufacture" arsenic compounds and other toxic metals that are generated as unwanted byproducts of coal burning that are released through smokestacks or accumulate as combustion residue in ash, sludge, or wastewater. These annual disclosures, which are submitted to EPA's Toxics Release Inventory (TRI) and available online at https://www.epa.gov/toxics-release-inventory-tri-program must quantify the toxins released to surface water from all sources within a facility, whether or not Clean Water Act permits require monitoring and reporting.

The TRI provides useful data about annual wastewater loads from coal plants, but too many are exempt from these disclosure requirements. Electric generators are generally required to report releases of toxic metals like arsenic and selenium when the fuel they burn generates more than 25,000 pounds a year of each pollutant as a byproduct. Coal plants can fall below this threshold (or claim to) and be exempt from TRI disclosure while still releasing thousands of pounds of highly toxic metals to the air or water. For example, only 6 of the 10 plants in Table E that monitored and reported high volume arsenic discharges under their Clean Water Act permits in 2015 also disclosed to the TRI how much arsenic they released to surface waters in the same year. Although the threshold for mercury is much lower at 100 pounds, relatively few coal plants reported discharging this pollutant to surface water to the TRI.

Where the TRI reporting requirements are triggered for a specific pollutant, e.g., arsenic, electric generators have to quantify and report the total amount released to waterways from all sources within the power plant, whether or not those discharges are monitored. TRI reports have to indicate whether or not the amounts disclosed were based on estimates or actual measurements, but do not require further detail or justification. Appendix A shows releases of arsenic, mercury, selenium, chromium, lead, and total metals to surface water and surface impoundments from the plants that reported to the TRI in 2015. Appendix F ranks the "Top 10" worst polluters for each of the toxic metals.

Table F. Arsenic, Mercury and Selenium in Coal Plant Wastewater: TRI Surface Water Releases v. DMRs, 2015

	Plant	Permit No.	State	TRI (lbs)	DMR (lbs)
Arsenic	Monroe Power Plant	MI0001848	MI	1,800	(not available)
	HW Pirkey Power Plant	TX0087726	TX	1,800	(not available)
	AES Petersburg	IN0002887	IN	1,326	1009.53
	Killen Station	OH0060046	OH	1,231	(not available)
	Kingston Fossil Plant	TN0080870, TN0005452	TN	870	0.001*
	Rogers Energy Complex	NC0005088	NC	830	987.81
	Cardinal Plant	OH0012581	OH	790	848.26
	Ghent Station	KY0002038	KY	736	(not available)
	Morgantown Generating Station	MD0002647	MD	703	24.5
	Conesville Plant	OH0005371	OH	690	(not available)
Mercury	Cumberland (TN)	TN0005789	TN	120	0.12
	Ghent	KY0002038	KY	60.2	(not available)
	Asheville	NC0000396	NC	51.4	0.24
	Kyger Creek	OH0005282	OH	50.2	0.12
	Marshall (NC)	NC004987	NC	43	(not available)
	Baldwin Energy Complex	IL0000043	IL	33.8	0.038
	Williams	SC0003883	SC	28.3	145.6**
	Kammer/Mitchell (WV)	WV0005304	WV	28.1	0.46
	Monroe (MI)	MI0001848	MI	27.51	10.61
	Clifty Creek	IN0001759	IN	18.6	0.025
Selenium	Ghent	KY0002038	KY	9,922	(not available)
	Cumberland (TN)	TN0005789	TN	6,000	5,862.54
	AES Petersburg	IN0002887	IN	4,398	3,552.94
	Cross	SC0037401	SC	3,892	(not available)
	Monroe (MI)	MI0001848	MI	3,200	(not available)
	Paradise	KY0004201	KY	2,500	(not available)
	Cardinal	OH0012581	OH	940	979.43
	Pirkey	TX0087726	TX	723	(not available)
	John E Amos	WV0001074	WV	542	631
	FirstEnergy Fort Martin Power Station	WV0004731	WV	440	393.31

*Note: DMR loads are limited to plants that reported pollutant concentrations at least quarterly (one exception noted below**) that could be multiplied by flow rates to quantify annual loads, while excluding likely data errors and any values reported as below detection limits.*

**TVA Kingston only reported one month with an arsenic concentration above the detection limit from a single outfall monitored under permit number TN0080870.*

*** Includes outfall 006. ECHO only had flow rates and mercury levels for June and December 2015 for this outfall. We assumed the plant discharged from this outfall during the other 10 months of the year, with a similar flow rate and concentration.*

Only 58 coal plants reported releasing arsenic to surface waters in 2015.[28] Table F identifies the ten facilities reporting the largest discharges of arsenic, mercury, and selenium to the TRI and compares that data to the loads that could be calculated from their Discharge Monitoring Reports. Not unexpectedly, the totals from these two sources do not match. Using arsenic as an example:

- Five of the coal plants reporting the 10 largest arsenic surface water discharges to the TRI in 2015 did not monitor and report these releases in their Discharge Monitoring Reports for the same year, presumably because no such monitoring was required by their Clean Water Act permits. Those facilities included the Monroe (MI), HW Pirkey (TX), Ghent (KY), Killen (OH), and Conesville (OH) power stations. A fourth, the TVA Kingston plant in Tennessee, disclosed discharging 870 pounds of arsenic to TRI in 2015, but less than a tenth of a pound from one insignificant outfall in its Clean Water Act Discharge Monitoring Report.

- The Petersbug plant in Indiana discharged 1,009 pounds of arsenic in 2015 from several outfalls, based on discharge monitoring reports required by its Clean Water Act permit. But the plant also reported total arsenic discharges of 1,326 pounds in the same year in its TRI report. The data show that even when permits provide for some monitoring of toxic discharges, they do not cover some of the larger sources of this pollution.

- Conversely, the discharge monitoring reports for the Cardinal coal plant in Ohio indicate that outfall 19 released 848 pounds of arsenic to the Ohio River in 2015. Yet on its 2015 TRI report, Cardinal estimated discharging no more than 790 pounds of arsenic from the entire plant that year. TRI reports must disclose the total amount of pollution from all sources within a plant, which should not be less than the discharge from a single outfall.

Too many coal plants fall between the gaps left by their Clean Water Act permits and the Toxics Release Inventory. TRI reports show that some of the coal plants dumping the largest loads of arsenic or selenium into our waterways have never had to actually monitor their discharges, which is critical to obtaining accurate data. In other cases, TRI disclosures demonstrate that for some coal plants, the few outfalls that are monitored represent only a fraction of the total toxic discharge. These gaps need to be closed when state agencies specify the monitoring required to implement the Steam Electric Rule.

At the same time, some of the heaviest toxic loads from power plants are never disclosed to the TRI, because many coal plants do not meet reporting thresholds, e.g., they do not generate (or "manufacture") 25,000 or more pounds of arsenic, selenium, or other highly toxic metals like antimony, cadmium, or chromium.[29] The monitoring required by some Clean Water Act permits shows that coal plants can release hundreds or even thousands of pounds of one or more of these pollutants without having to disclose the amount to TRI.

That defeats the purpose of a program meant to provide the public with an easy to understand summary of the annual toxic releases from each facility, which is why large power companies like Duke Energy and American Electric Power have long used TRI data to measure and advertise their environmental performance.[30] Public disclosure inspires corporate accountability and voluntary action to reduce pollution. These benefits are undermined by TRI thresholds that require some coal plants to report while exempting others that discharge even larger quantities of arsenic or selenium.

EPA has already determined that minute concentrations of arsenic and selenium, measured in parts per billion, can threaten and endanger human health, water quality, and wildlife. Selenium can also bioaccumulate and persist in aquatic ecosystems. Unlike benzene and other organic toxins, these toxic metals are not destroyed in the hot temperatures of coal boilers, but are released to the air or transferred to ash, scrubber sludge and wastewater. In other words, almost all of the toxic metal byproducts of coal combustion will end up as air pollution or (for those residues that cannot be recycled in cement, wallboard, or other products) as wastes that must be managed to minimize the contamination of underground aquifers or surface waters.

EPA can and should exercise its authority to reduce reporting thresholds for the most dangerous pollutants, and has already done so for pollutants like lead and mercury. Power plants and other facilities that manufacture or process more than 10 pounds of mercury or 100 pounds of lead must disclose any environmental releases of these pollutants in their annual TRI reports. Arsenic is nearly twice as hazardous as lead according to EPA's ranking of the relative toxicity of chemical pollutants, which considers both health and environmental impacts.[31] Based on the same ranking system, the relative toxicity of selenium is half that of lead but far above most of the pollutants that must be reported to TRI.

Yet most coal plants are exempt from having to disclose the amount of arsenic, cadmium, or selenium they release to air or water because they do not "manufacture" or "process" more than 25,000 pounds of these pollutants in a single year. Given their extreme toxicity, EPA should adopt the lower thresholds for reporting these pollutants that it already has in place for lead.

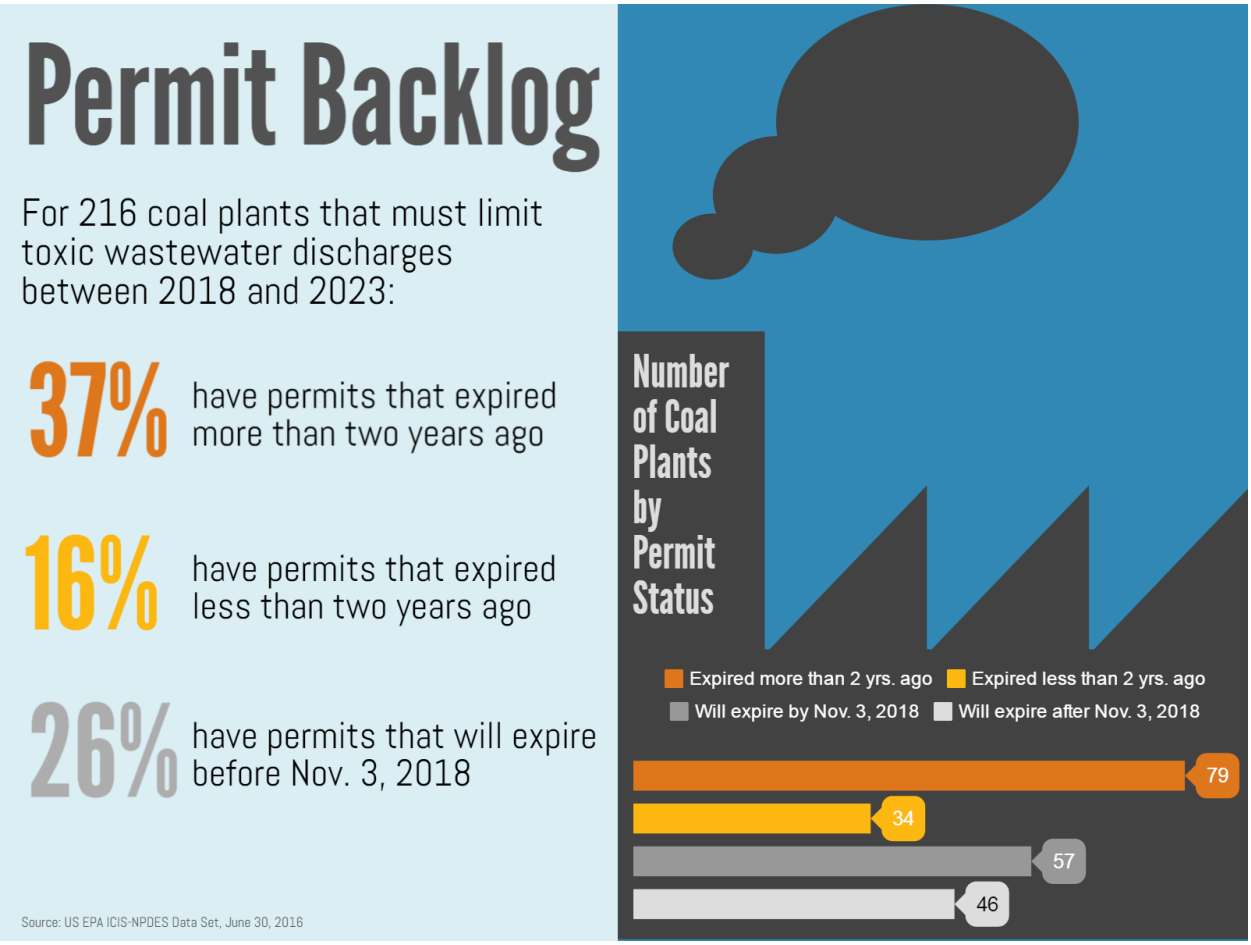
IV. Permit Backlog Could Delay Implementation of Standards Already Decades Late

EPA's new rule anticipates that the new Clean Water Act standards will be rolled into permits as they are reopened for renewal, which is supposed to happen at least once every five years. These decisions will determine exactly when each coal plant has to comply with standards that must take effect as soon as possible after November 18, 2018 but no later than December 31, 2023. Permit language will also define the type and frequency of monitoring needed to prevent circumvention of the standards (e.g., by diluting instead of treating waste to meet numerical standards for scrubber wastewater) and to ensure that results accurately represent a plant's discharges under varying operating conditions. While most states are

authorized to issue and renew federal Clean Water Act permits, EPA retains that authority in Massachusetts, New Hampshire, and New Mexico.

Unfortunately, states often fail to meet the five-year deadline for permit renewals, and instead administratively extend existing permits that do not include new requirements established since that permit was issued. For example, 113 out of 216 coal-fired generators are holding Clean Water Act permits that have already expired, and permits for 79 of those expired more than two years ago.[32] And while state agencies are responsible for issuing and renewing Clean Water Act permits in most states, EPA is not setting a good example in the few cases where it retains that responsibility, such as New Mexico and New Hampshire. For example, the permits for the Four Corners Coal plant in New Mexico was last issued in 2001, and for the Merrimack coal plant in New Hampshire in 1992.[33]

The EPA has proposed new regulations that will allow the agency to object to permits that significantly impact the environment and have been administratively extended for two to five years or more. But, the agency has stated that it will use this authority "only in very limited circumstances."[34] Absent public pressure, there is a real risk that permit backlogs will delay implementation of toxic limits for coal plant wastewater that are already nearly 30 years overdue.



V. Conclusion and Recommendations

The Clean Water Act recognizes that our lakes, rivers, estuaries, and coastal waters belong to the public and not to private industry. Clean water is used for drinking and household use, provides a safe habitat for aquatic life, supports thriving commercial and recreational fisheries, revitalizes urban waterfronts, and is the bedrock of local tourism. Perhaps more important, our waterways satisfy aesthetic or spiritual needs that cannot be quantified or even explained without the help of artists like Mark Twain, who said this about the Mississipi:

> *The face of the river, in time, became a wonderful book… which told its mind to me without reserve, delivering its most cherished secrets as clearly as if it had uttered them with a voice. And it was not a book to be read once and thrown aside, for it had a new story to tell every day.*
>
> *Mark Twain, Life on the Mississipi*

Twain would read a murkier tale in the Mississippi today. Arsenic, mercury, selenium, and other toxic metals are particularly hazardous to our waterways because they can persist in the water column or in sediment for many decades, fouling drinking water sources and poisoning fish and those who eat them. The Clean Water Act required EPA to restrict toxic discharges from coal plants – by far the largest industrial source of these pollutants – no later than 1989. Threatened with a lawsuit in 2009 for failing to meet that deadline, EPA finally issued these standards that require compliance between 2018 and 2023, or 29 to 34 years late. No effort should be spared in making sure that coal plants meet their obligations on time. There are no further excuses for delay.

To meet the deadlines for compliance with the new rule:

- States should propose draft permits for renewal no later than March 3, 2017, which is a full fifteen months after the new requirements were published. As noted earlier, revising permits to list numerical limits and prohibitions that apply to all coal-fired power plants should not be time consuming. The compliance deadlines in draft permits should be reviewed carefully to ensure that states have justified any compliance deadlines beyond November 3, 2018.

- Final permits should be issued before the end of 2017, to ensure that any required construction projects are on schedule and will achieve compliance on time.

- Permit revisions should be accelerated for power plants already known to discharge thousands of pounds per year of arsenic or other highly toxic pollutants.

The revised permits should:

- Require that arsenic, mercury, selenium, and nitrate compounds be monitored daily to determine compliance with the maximum daily and monthly average numerical limts for scrubber wastewater.

- Require regular monitoring of other pollutants, like boron, cadmium, manganese, and lead, which can be just as toxic as the surrogates to which EPA decided to apply limits=.

- Include internal monitoring as needed to ensure that all wastewater limits are met through treatment, and not by dilution, and that all discharges of coal ash transport water are eliminated.

To improve disclosure of the highly toxic metals released by electric generators:

- EPA should require power plants that generate more than a hundred pounds per year of arsenic, cadmium, or selenium, to report their releases of these dangerous pollutants ot the Toxics Release Inventory. EPA has already adopted this lower threshold for lead.

To improve the value and transparency of the monitoring publicly available on the "ECHO" website, EPA should:

- Audit Discharge Monitoring Reports on a regular basis for accuracy and completeness, and require prompt correction of errors.

Appendix B: Methods

This report is based on an analysis of discharge monitoring records and data from EPA's Enforcement and Compliance History Online (ECHO), Clean Air Markets database, the 2014 Toxics Release Inventory, and current permit applications and discharge permits issued to coal plants. EPA's 2015 Steam Electric rule establishes new limits on discharges of toxins from coal-fired power plants. The requirements must be rolled into the permits issued by state agencies. These permits will establish the deadlines for meeting the standard between November 3, 2018 and the end of 2023 and define monitoring needed to assure compliance. This report sought to determine a) how much work needs to be done to implement the new rules and b) to identify the obstacles that could undermine or delay implementation.

Identifying Coal Plants and Expired Permits

We identified 293 coal plants that operated in 2015, had Clean Water Act wastewater discharge permits (NPDES permits), and generated over 50 MW of energy from coal on average in 2015 using the Clean Air Markets Database and ECHO.[1] The Clean Air Markets Database contains information about sulfur dioxide controls (scrubbers), primary fuel types, and gross generation. ECHO contains discharge monitoring data from EPA's ICIS-NPDES system, permit numbers, and permit expiration dates.

We limited our analyses to 216 coal plants that will have to limit their toxic wastewater discharges "as soon as possible" after November 3, 2018 and before December 31, 2023, excluding plants that are scheduled to retire before the end of 2018. We identified plants that have retired and plants that are projected to retire using publicly available information from www.SourceWatch.org and company press releases and websites as of July 6, 2016.

The ICIS-NPDES data set available through ECHO contains a list of all permits issued and their expiration dates. We used this data set to identify plants with expired permits as of June 30, 2016, June 30, 2014 (two years ago), and by the time the rule takes effect on November 3, 2018.

Discharge Monitoring Report Data

Coal-fired power plants that discharge wastewater have to file discharge monitoring reports (DMRs) with EPA or state agencies that oversee the Clean Water Act's National Pollutant Discharge Elimination System (NPDES) permitting programs. The reports mirror requirements in each facility's discharge permit to monitor and report concentrations (in milligrams or micrograms per liter) or amount (e.g., in kilograms per day) of specific pollutants, along with the volume of wastewater (usually in gallons or million gallons per

[1] We also included Logansport (IN0041246), Tyrone (KY0001899), Dover (OH0007994), Painesville (OH0039357), Orrville (OH0064025), which were not listed in the Clean Air Markets database, and Edwardsport, Wabash River, and Polk, which are coal gasification plants.

day) discharged through specific outfalls. State agencies submit the DMR data to EPA. EPA processes the data to standardize certain elements (like measurement units) in its ICIS-NPDES database, posts the data online, and updates its database each week as states submit corrections and new data. Members of the public can download DMR data in an electronic format through ECHO's effluent charts and through other downloading features.

We downloaded the 2014 and 2015 DMR data for each plant from ECHO's effluent charts in April 2016.[2] After downloading the data, we used R, a free, open-source statistical program to combine individual plant data files and to identify the subset of data for arsenic, selenium, mercury, nitrates, and flow.[3] EPA's new rule limits the concentrations of arsenic, selenium, mercury, and nitrates in scrubber wastewater. We were also interested in cumulative pollution loads, and so we calculated these loads using concentration data and flow data.

The downloadable DMR data contain many variables, including monitoring values, measurement units, outfall numbers, outfall types, monitoring point descriptions, monitoring period end dates, qualifiers (i.e. "<" for results below method detection limits), and no data indicator codes ("nodi codes") which are reported in lieu of concentrations in a number of circumstances (i.e. "B" for below detection limit, "Q" for non-quantifiable, "9" for conditional monitoring/monitoring not required, and "C" for no discharge). Descriptions of all the variables included in the downloadable DMR data can be found here.[4]

DMR data is not error-free. The most common errors involve incorrect values, either because permit holders submit incorrect information, or because states or EPA transcribe information incorrectly. For example, while we were reviewing DMR data, we noticed several cases where reported mercury concentrations used the wrong measurement units (ug/L or mg/L instead of ng/L). We also noticed that several outfalls listed as 'internal' outfalls in discharge permits were listed as 'external' outfalls in the DMR data, which makes it difficult to determine which outfalls should be used to estimate pollution loads. From May to July 2016, we submitted 23 error reports to EPA and state data custodians requesting clarification or correction. Most of the errors we reported were corrected, and

[2] DMR data downloads can be 'automated' using EPA's REST services and a web browser extension, like Chrono Download Manager for Chrome, that loops through a list URLs and downloads each file. We used the following standard to download DMR data from effluent charts: https://echo.epa.gov/effluent-charts?p_id=*NPDESID*&start_date=01/01/2014&end_date=12/31/2015. For more information about EPA's REST services, see: https://echo.epa.gov/tools/web-services.

[3] We originally reviewed data from 2014 and 2015 and included measurements of another pollutant, boron, which is often found in coal plant wastewater. We narrowed the analysis to data from 2015 and the contaminants limited by EPA's new rule—arsenic, mercury, selenium, and nitrates. Arsenic, mercury and selenium because monitoring they are highly toxic to human health and the environment and the rule limits all three pollutants in any discharge from wastewater scrubbers. The rule also limits nitrate discharges from scrubber wastewater, as this pollutant feeds algal blooms that can create low-oxygen dead zones in waterways. Limiting the analysis to 2015 allowed us to properly account for plant retirements and slight improvements in monitoring that occurred between 2014 and 2015. While boron is one of the key pollutants found in coal plant wastewater, relatively few plants monitored their boron discharges and it is not limited by EPA's new rule.

[4] https://echo.epa.gov/help/reports/effluent-charts-help#data_considerations; https://cfpub.epa.gov/dmr/glossary.cfm#ndi

some companies were asked to resubmit DMRs. We included these corrections in our analysis.

Scrubber Wastewater

We identified 116 plants that used wet scrubbers to control sulfur dioxide emissions according to the Clean Air Markets database. Of those, we identified only 30 that had NPDES permits and monitored for arsenic, mercury, selenium, or nitrates at scrubber wastewater outfalls in 2015. We identified scrubber wastewater outfalls by reviewing NPDES permits, permit applications, and permit fact sheets obtained through public information requests and from state or EPA websites. One of our goals was to measure concentrations of the specific toxins in wastewater that will be limited under the new rule. For that reason, we limited our analysis to those outfalls that appeared to discharge only treated scrubber wastewater that had not been mixed with other waste streams.

We compared monthly average and daily maximum monitoring results from the scrubber wastewater outfalls at the 30 plants to the numerical limits that plants will have to meet between the end of 2018 and 2023 under the new rule. In some cases where plants monitored for something other than a daily maximum or monthly average, like Big Bend, which reported "instantaneous maximums," we only compared the concentrations to the standard if no other data was available.

Some plants reported pollutant concentrations in scrubber wastewater entering the treatment process, but we excluded these values because the rule's limits apply only to the effluent after it has been treated. However, in some instances, monitoring points reported as influent actually represented effluent. We reported these errors to EPA and state data custodians. We also excluded "dissolved" concentrations of pollutants if the plant also reported "total" concentrations.

Monitoring Frequency and Variability in Monthly Monitoring Results

We used the DMR data set (described above) to count the number of plants that monitored for flow and arsenic, selenium, or mercury at any outfall in 2015. If a plant reported a no data indicator code of "9—conditional monitoring (no monitoring required)" in lieu of sampling results for a specific monitoring period, we did not include it as a plant that monitored during that monitoring period.

We also evaluated how often plants reported concentrations of arsenic, mercury, or selenium on their DMRs, e.g., whether sample results were reported every month, quarterly, etc. Our analysis of monitoring frequency included outfalls reporting values below detection limits or "no discharge" in some months (since some outfalls discharge only sporadically). We did not include any outfalls where plant operators reported concentrations without wastewater flow, or no flow for an entire year. Since it is impossible to measure pollutant concentrations at dry outfalls, we were concerned that data for those outfalls could be incorrect.

Where monthly monitoring data was available, we identified the values (daily maximum, monthly average, etc) reported on a monthly basis for each outfall and monitoring point. We then selected the monthly average values, where available. Facilities commonly report a single value for a month, and often label it a 'daily maximum.' It should be noted that if this single value is the only data available for a month, it is reasonable to treat it as both a daily maximum and a monthly average. For that reason, if a plant did not report a monthly average, we then looked for daily maximum values or other values (30 day average, weekly average, etc). We calculated the percent difference between the minimum and maximum concentrations (((maximum-minimum)/minimum) *100) to quantify variability. We identified statistical outliers and excluded them from our summary of results to provide a conservative estimate and to weed out any remaining measurement unit or remaining data input errors in the DMR data.

Quantifying Pollution Loads

Determining the actual amount of pollution discharged is important to understanding its potential impact on water quality. In this report, we quantify pollution loads using DMR data from 2014 and 2015 and Toxics Release Inventory data from 2014. Our goal was to show examples of how much pollution some plants discharge and illustrate how gaps in reporting requirements set by NPDES permits and the Toxics Release Inventory allow coal plants to understate the amount of pollution they discharge to waterways. Pollution loads from point sources can be calculated using the equations in Figure A1.

Figure A1. Pollution Load Equations

If concentrations (mg/L) are available:

Load (pounds) = Flow (MGD) x Pollutant Concentration (mg/L) x Days in the monitoring period x 8.346 (conversion factor)

If mass quantities (kg/day) are available:

Load (pounds) = Pollutant Mass (kg/day) x Days in the monitoring period x 2.205 (conversion factor)

EPA quantifies pollution loads using data from DMRs and the Toxics Release Inventory using its Discharge Monitoring Report Pollutant Loading Tool ("DMR Loading Tool"). Our methods closely followed EPA's, but we opted to only present loads for the top plants that had complete data instead of filling in data gaps for plants that may have discharged larger amounts of pollution. Detailed information about the DMR Loading Tool can be found here. We did not use the DMR Loading Tool to quantify loads because we wanted to correct errors in underlying DMR data.

We selected the appropriate measurements that represented wastewater discharged to waterways according to the methods used by the DMR Loading Tool, and then used the equations in Figure A1 to calculate loads for each monitoring period (month, quarter, etc), depending on the data available for each plant, outfall, and monitoring point. Calculating loads from mass quantities (kg/day) involves less uncertainty, but relatively few coal plants report quantities on their DMRs. If a plant reported enough information (i.e. at least quarterly results for both flow and concentration, and no missing data or non-detects), we calculated the annual load by adding together the loads from each monitoring period. The pollution loads shown may not represent the entire load from a plant, as many are not required to monitor every outfall for arsenic, selenium, and mercury.

Toxics Release Inventory

We identified coal plants that reported releasing arsenic, selenium, or mercury to surface waters and impoundments to the Toxics Release Inventory (TRI) in 2015 using the preliminary 2015 TRI data release in July 2016. We searched for all plants in the US that reported under industry NAICS code 221112 or 221122 for electric utilities and excluded plants from the results if they were slated to retire before the end of 2018 or generated less than 50 MW per hour on average in 2015 according to data from Clean Air Markets. We used the TRI's definition of "metals and metal compounds" to identify and aggregate metals and metal compounds discharged to surface water and impoundments.[5]

[5] Toxics Release Inventory, List of Metals and Metal Compounds. Available at: https://iaspub.epa.gov/triexplorer/tri_text.list_chemical_metals, accessed 7/27/2016.

NOTES

[1] 33 U.S.C. §1311(2)(C),(D)
[2] 40 CFR Part 423, at 80 FR 67838 (November 3, 2015)
[3] We excluded plants that closed before June 30, 2016. We also excluded plants that are scheduled to retire or convert to natural gas before the end of 2018, according to company press releases issued before June 30, 2016 and SourceWatch.org "Coal Plant Retirements" available at http://www.sourcewatch.org/index.php/Coal_plant_retirements, accessed June 30, 2016.
[4] Cost and Quality of Fuels for Electric Plants 2009, Energy Information Administration, Table ES3, p. 3 (November 2010), at https://www.eia.gov/electricity/cost_quality/pdf/cqa2009.pdf
[5] *Supra, n. 2,* at 80 FR 67862
[6] See, e.g., "EPA Response to Kingston Coal Ash Spill," at https://www.epa.gov/tn/epa-response-kingston-tva-coal-ash-spill, and "EPA's Response to the Duke Energy Spill in Eden, North Carolina, at https://www.epa.gov/dukeenergy-coalash
[7] 40 CFR 423.13(h)(1)(i); 40 FR 67892
[8] 40 CFR 257, 261; 80 FR 21301
[9] 40 CFR 423.13(g)(1)(i)
[10] 80 FR 67870
[11] *Supra, n. 5*
[12] 40 CFR 423.15(b)(13); 423.13(j)(1)
[13] 80 FR 67854
[14] 423.15 (a)(3)
[15] 80 FR 67682; 40 CFR 122.48(b)
[16] 80 FR 67862, 67885. As noted earlier, power plants can "recycle" ash wastewater through the scrubber treatment process, so long as the post-treatment effluent meets the limits that apply to scrubber wastewater. *Supra. n. 7.*
[17] 80 FR 67854; 40 CFR 423.13(g)(1)(i); (h)(1)(i); (j)(1)(i); (k)(1)(i)
[18] 40 CFR 423.11(t)
[19] *Id.*
[20] Possum Point VPDES Permit Fact Sheet, Permit No. VA0002071 issued January 2016, p. 31. http://www.deq.virginia.gov/Portals/0/DEQ/Water/PollutionDischargeElimination/Coal_Ash/VA0002071FactSheetJan2016reduced.pdf
[21] Information on actual or proposed closure of power stations comes primarily from the "SourceWatch" inventory of existing coal plants maintained by Center for Media and Democracy and available online at http://www.sourcewatch.org/index.php/Existing_U.S._Coal_Plants. EIP updated that information for some plants based on a review of online sources and can provide additional references upon request.
[22] 40 CFR 127.11
[23] Environmental Protection Agency, Enforcmeent and Compliance History Online database, available at: https://echo.epa.gov, accessed April 2016.
[24] Environmental Protection Agency, Clean Air Markets Program Data, available at: https://ampd.epa.gov/ampd/, accessed April 2016. Not all plants with wet scrubbers necessarily discharge scrubber wastewater to surface waters. For example, the Crist power plant in Florida disposes of its scrubber wastewater into a Class 1 underground injection well.
[25] We considered an outfall a "scrubber wastewater outfall" if the plant's permit designated it only for scrubber wastewater. Many plants that have wet scrubbers mix their scrubber wastewater with other waste streams. The 31 plants have current NPDES permits that require monitoring before scrubber wastewater mixes with any other waste streams.
[26] USEPA 2016 Aquatic Life Criterion for Selenium in lentic (slow-moving) freshwater. EPA's standards are hierarchical and fish tissue samples take precedent over water column concentrations. Water column concentrations apply when fish tissue measurements are unavailable. See: https://www.epa.gov/wqc/aquatic-life-criterion-selenium
[27] ECHO's Effluent Charts, Cayuga IN0002763, outfall 002, selenium. https://echo.epa.gov/effluent-charts#IN0002763 accessed 7/12/2016.

[28] We searched for coal plants by limiting search results to NAICS 2211, Electric Generation, in EPA's preliminary 2015 TRI dataset, available at: https://www.epa.gov/toxics-release-inventory-tri-program/2015-tri-preliminary-dataset, as of July 13, 2015.
[29] "EPCRA 313 Industry Guidance: Electricity Generating Facilities," Office of Pollution Prevention and Toxics, USEPA, EPA 745-B-00-004 (February 2000), p. 3-10.
[30] *See, e.g.,* "Environmental Performance Metrics," Duke Energy, online at https://www.duke-energy.com/environment/reports/environmental-performance-metrics.asp; "AEP's TRI Releases and Their Potential Impacts," American Electric Power, available online at https://www.aep.com/environment/EmissionsAndCompliance/tri/releasesandpotentialimpact.aspx
[31] See "TRI Chemicals TWF" spreadsheet identifying toxicity weights for specific pollutants at the USEPA's "Discharge Monitoring Tool (DMR) Pollutant Loading Tool, available online at https://cfpub.epa.gov/dmr/technical-support-documents.cfm
[32] Environmental Protection Agency, Enforcmeent and Compliance History Online database, available at: https://echo.epa.gov, accessed April 2016.
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