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INDIANA UTILITY
REGULATORY COMMISSION

United States Court of Appeals
FOR THE DISTRICT OF COLUMBIA CIRCUIT

Argued November 20, 2017 Decided August 21, 2018

No.15-1219

UTILITY SOLID WASTE ACTIVITIES GROUP, ET AL.,
PETITIONERS

v.

ENVIRONMENTAL PROTECTION AGENCY,
RESPONDENT

WATERKEEPER ALLIANCE, ET AL.,
INTERVENORS

Consolidated with 15-1221, 15-1222, 15-1223, 15-1227,
15-1228, 15-1229

On Petitions for Review of Administrative Action
of the United States Environmental Protection Agency

Douglas H. Green and Paul J. Zidlicky argued the causes for Industry petitioners. With them on the joint briefs were John F. Cooney, Margaret K. Kuhn, Samuel B. Boxerman, Eric Murdock, Makram B. Jaber, Joshua R. More, Raghav Murali, Richard G. Stoll, Lori A. Rubin, and Thomas J. Grever. Stephen J. Bonebrake, Brian H. Potts, and Aaron J. Wallisch entered appearances.

Thomas Cmar argued the cause for Environmental petitioners. With him on the briefs were *Matthew E. Gerhart*, *Mary M. Whittle*, and *Lisa Evans*.

Perry M. Rosen, Attorney, U.S. Department of Justice, argued the cause for respondents. With him on the briefs were *Jeffrey H. Wood*, Acting Assistant Attorney General, *Jonathan Skinner-Thompson*, Attorney, and *Laurel Celeste*, Attorney, U.S. Environmental Protection Agency.

Douglas H. Green, *John F. Cooney*, and *Margaret K. Kuhn* were on the brief for Industry intervenor-respondents.

Matthew E. Gerhart, *Mary M. Whittle*, and *Lisa Evans* were on the brief for Environmental intervenor-respondents.

Before: HENDERSON, MILLETT and PILLARD, *Circuit Judges*.

Opinion filed *PER CURIAM*.

Opinion concurring in part and concurring in the judgment in part filed by *Circuit Judge HENDERSON*.

PER CURIAM: These consolidated petitions challenge the Environmental Protection Agency's 2015 Final Rule governing the disposal of coal combustion residuals ("Coal Residuals") produced by electric utilities and independent power plants. See Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities ("Final Rule"), 80 Fed. Reg. 21,302 (April 17, 2015). Coal Residuals make up "one of the largest industrial waste streams generated in the U.S." *Id.* at 21,303. Coal-fired power plants in the United States burned upwards of 800 million tons of coal in 2012 alone and produced approximately

110 million tons of solid waste as Coal Residuals. *Id.* That waste contains myriad carcinogens and neurotoxins. *See* Hazardous and Solid Waste Management System; Identification and Listing of Special Wastes; Disposal of Coal Combustion Residuals from Electric Utilities (“Proposed Rule”), 75 Fed. Reg. 35,128, 35,153, 35,168 (June 21, 2010). Power plants generally store it on site in aging piles or pools that are at varying degrees of risk of protracted leakage and catastrophic structural failure. *See* 80 Fed. Reg. 21,327–21,328. The Final Rule sets criteria designed to ensure that human health and the environment face “no reasonable probability” of harm from Coal Residuals spilling, leaking, or seeping from their storage units and harming humans and the environment. *Id.* at 21,338–21,339; 42 U.S.C. § 6944(a).

The statutory framework calling for regulation of solid waste generation, storage, and disposal has been in place since 1976, when Congress enacted the Resource Conservation and Recovery Act (“RCRA”), 42 U.S.C. § 6901 *et seq.*, but regulations implementing RCRA have been long in the making. The EPA has long studied the Coal Residuals disposal problem and struggled over how to address its scale, complexity, and gravity. The agency has been goaded by public outrage over catastrophic failures at sites storing toxic Coal Residuals, *see* 75 Fed. Reg. at 35,132, 35,137, and was directed by a federal court to devise a schedule to comply with its obligation to regulate under RCRA, *see Appalachian Voices v. McCarthy*, 989 F. Supp. 2d 30, 56 (D.D.C. 2013). Nearly four decades after Congress enacted RCRA, the EPA finally promulgated its first Final Rule regulating Coal Residuals in 2015.

These consolidated petitions—one on behalf of environmental organizations (“Environmental Petitioners”) and several others (collectively, “Industry Petition”) for a

consortium of power companies and their trade associations (“Industry Petitioners”)—challenge various provisions of that Final Rule under the Administrative Procedure Act and RCRA. RCRA Subtitle D calls on the EPA to promulgate criteria distinguishing “sanitary landfills,” which are permissible under the statute, from “open dumps,” which are prohibited. 42 U.S.C. § 6944(a); *see id.* § 6903(14), (28). The statutory baseline for the EPA’s criteria for sanitary landfills is that, at a minimum, they “shall provide that a facility may be classified as a sanitary landfill and not an open dump only if there is no reasonable probability of adverse effects on health or the environment from disposal of solid waste at such facility.” *Id.* § 6944(a). Each claim here relates to what a utility operating one or more Coal Residuals disposal site(s) must do to qualify such site as a sanitary landfill that may lawfully operate under RCRA.

Shortly before oral argument, the EPA announced its intent to reconsider the Final Rule, and moved to hold all proceedings in abeyance. We asked for clarification on the exact provisions of the Rule that would be subject to reconsideration. The EPA then filed a separate motion to remand six specific provisions.

For the reasons that follow, we deny the EPA’s abeyance motion, and partially grant its remand motion. We also grant in part the Environmental Petition and deny the Industry Petition.

I. Background

A.

“Coal Residuals” is a catch-all term for the byproducts of coal combustion that occurs at power plants. It includes “fly

ash,” “bottom ash,” “boiler slag,” and “flue gas desulfurization materials.” *See* 75 Fed. Reg. at 35,137. These residuals vary in their size and texture, but all contain “contaminants of* * * environmental concern.” *Id.* at 35,138. According to the EPA, Coal Residuals contain carcinogens and neurotoxins, including arsenic, boron, cadmium, hexavalent chromium, lead, lithium, mercury, molybdenum, selenium, and thallium. 80 Fed. Reg. at 21,449. The risks to humans associated with exposure to the identified contaminants include elevated probabilities of “cancer in the skin, liver, bladder, and lungs,” as well as non-cancer risks such as “neurological and psychiatric effects,” “cardiovascular effects,” “damage to blood vessels,” and “anemia.” *Id.* at 21,451. Both cancer and non-cancer risks to infants “tend[] to be higher than other childhood cohorts, and also higher than risks to adults.” *Id.* at 21,466. The risks to plant and animal wildlife include “elevated selenium levels in migratory birds, wetland vegetative damage, fish kills, amphibian deformities, * * * [and] plant toxicity.” 75 Fed. Reg. at 35,172.

In developing the Final Rule, the EPA collected data on coal-fired units and their environs, identified hazards for evaluation, and specified benchmarks of toxicity that it determined “generally will be considered to pose a substantial present or potential hazard to human health and the environment and generally will be regulated.” Final Rule, 80 Fed. Reg. at 21,449, 21,451. The EPA analyzed potential pathways of contamination to determine those most likely to pose a reasonable probability of adverse effects on humans or the environment. *Id.* at 21,450–21,451. The EPA concluded that current management practices for Coal Residuals posed risks to human health and the environment at levels justifying uniform national guidelines. *Id.* at 21,303. The main exposure pathways the EPA found were through waste that escapes landfills and surface impoundments and then

contaminates groundwater tapped as drinking water, and contaminates surface water that comes in direct contact with fish and other ecological receptors. *Id.*

Under most circumstances, the operators of coal-fired power plants dispose of the waste either by dumping it in dry landfills or by mixing it with water to channel it to wet surface impoundments. 80 Fed. Reg. at 21,303. These disposal sites are massive. On average, landfills span more than 120 acres and are more than 40 feet deep. *Id.* Surface impoundments average more than 50 acres in size with an average depth of 20 feet. *Id.* As of 2012, there were at least 310 landfills and 735 surface impoundments in the United States currently receiving coal ash. *Id.* The EPA identified at least 111 surface impoundments that are no longer receiving coal ash, but are not fully closed. *See* EPA, Regulatory Impact Analysis: EPA's 2015 RCRA Final Rule Regulating Coal Combustion Residual (CCR) Landfills and Surface Impoundments at Coal-Fired Utility Power Plants, 2-3 (2014), Joint App'x (J.A.) 1096. The record does not specify the number of inactive landfills. *See id.* The Rule also addresses circumstances under which Coal Residuals safely may be "beneficially used"—*e.g.*, to make cement—thereby reducing the total volume that must be managed as waste. *See* 75 Fed. Reg. at 35,212.

Landfills and surface impoundments both pose threats to human health and the environment. 80 Fed. Reg. at 21,327–21,328. The risks generally stem from the fact that "thousands, if not millions, of tons [of coal ash are] placed in a single concentrated location." *Id.* These disposal sites are at risk of structural failure, particularly where they are located in unstable areas such as wetlands or seismic impact zones. *Id.* at 21,304. The sheer volume of Coal Residuals at these sites, moreover, can force contaminants into the underlying soil and groundwater, threatening sources of drinking water. *Id.* at

21,304–21,305. Surface water bodies—*i.e.*, rivers, lakes, and streams, *see* 75 Fed. Reg. at 35,131—are also at risk of contamination through harmful constituents that migrate through groundwater, or flow into surface waters as run-off or wastewater discharge, any of which can lead to environmental harms such as “wetland vegetative damage, fish kills, amphibian deformities, * * * [and] plant toxicity.” *See id.* at 35,172.

Groundwater contamination is more likely to occur at sites that are unlined or lack adequate lining between the coal ash and the soil beneath it. *See id.*; *see also* Regulatory Impact Analysis, 5-22. However, most existing coal ash disposal sites—70% of landfills and 65% of surface impoundments—have no liner at all. *See* Regulatory Impact Analysis, 3-4 nn.104–105, J.A. 1108. And while most new landfills and surface impoundments are constructed with liners, *see* 80 Fed. Reg. at 21,324, not all liners are alike. Composite lining, which includes a plastic geomembrane and several feet of compacted soil to act as a buffer, effectively eliminates the risk of groundwater contamination. *See* EPA, Human & Ecological Risk Assessment of Coal Combustion Residuals (Risk Assessment), 4-8 to 4-9, J.A. 1110–1111. But many impoundments are lined only with compacted soil and are therefore far less protective. *See* Regulatory Impact Analysis, 5-22, J.A. 1112. The EPA has acknowledged that it “will not always be possible” to restore groundwater or surface water to background conditions after a contamination event. *See* Response to Comments 50, J.A. 1301.

Structural failures of surface impoundments pose additional risks that are more episodic but potentially more catastrophic than harm from liner leakage. Impoundment dam ruptures can result in “significant coal slurry releases, causing fish kills and other ecologic damage, and in some instances

damage to infrastructure.” 80 Fed. Reg. at 21,457 (footnote omitted). The EPA is aware of at least 50 surface impoundments that are a “high” hazard, *see* EPA, Coal Combustion Residuals Impoundment Assessment Reports, J.A. 446–469, which the Rule defines to mean that “failure or mis-operation will probably cause loss of human life” in addition to other harms, 40 C.F.R. § 257.53. The EPA has tagged another 250 impoundments as posing a “significant” hazard, *see* Impoundment Assessment Reports, J.A. 446–469, where failure or mis-operation is unlikely to kill people, but would “probably cause economic loss, environmental damage, or disruption of lifeline facilities, or impact other concerns.” 40 C.F.R. § 257.53. Structural risk is exacerbated at sites located in geologically unstable areas, such as those with poor foundation conditions, areas susceptible to earthquakes or other mass movements, or those with karst terrains. *See id.*; 80 Fed. Reg. at 21,365–21,367.

Risks from inactive surface impoundments at inactive power plants, which the parties refer to as “legacy ponds,” are also apparent in the record. As with surface impoundments at active plants, groundwater contamination or catastrophic structural failure of a legacy pond threatens human health and the environment. But legacy ponds, which by their nature are older than most surface impoundments, are “generally unlined” and unmonitored, and so are shown to be more likely to leak than units at utilities still in operation. 80 Fed. Reg. at 21,343–21,344. Without an on-site operator to monitor and maintain such a unit, consequences of leakage or structural failure may be amplified. *Cf. id.* at 21,394 (requiring qualified personnel to conduct weekly inspections at active surface impoundments).

The EPA record reports on the many cases in which damage has already occurred. “EPA has confirmed a total of

157 cases* * * in which [Coal Residual] mismanagement has caused damage to human health and the environment.” 80 Fed. Reg. at 21,325. The EPA recounts that public pressure to regulate Coal Residuals escalated after an unlined surface impoundment in Kingston, Tennessee suffered a “catastrophic” structural failure on December 22, 2008. *See* 75 Fed. Reg. at 35,132. The impoundment released approximately 5.4 million cubic yards of Coal Residual sludge across 300 acres of land and into the nearby Emory River. *See* EPA, Damage Case Compendium: Technical Support Document, Volume I: Proven Damage Cases, 143 (2014), J.A. 1192. According to the EPA, the spill was one of the “largest volume industrial spill[s] in U.S. history.” *Id.* at 143 n.612, J.A. 1192. The Coal Residual sludge ruptured a natural gas line, disrupted power in the area, damaged or destroyed dozens of homes, and resulted in elevated levels of arsenic and lead in the Emory River. *Id.* The resulting river contamination “completely destroyed” more than 80 acres of aquatic ecosystems. *Id.* at 144, J.A. 1193. More than a year after the spill, the majority of fish collected from the river contained toxins that rendered them unsafe for human consumption. *Id.* The disaster forced the closure of the Emory River for almost two years. The Tennessee Valley Authority took four years and spent more than \$1.2 billion to remove Coal Residuals and contaminated sediment from the river and adjoining areas, to monitor and repair associated damage, and to construct a new disposal unit. *Id.* at 148, J.A. 1197.

B.

Two years after the Kingston disaster, the EPA promulgated the Proposed Rule announcing its intent to regulate Coal Residuals under RCRA. *See* 75 Fed. Reg. at 35,128.¹

A key question for the EPA had long been whether to regulate Coal Residuals as hazardous waste under the cradle-to-grave federal hazardous waste management authority conferred by RCRA Subtitle C, 42 U.S.C. §§ 6921–6939g, or to treat it as nonhazardous solid waste subject to national guidelines under Subtitle D, *id.* §§ 6941–6949a. A waste is “hazardous” and subject to regulation under Subtitle C only if it exhibits one of four hazard characteristics: ignitability, corrosivity, reactivity, or toxicity. *See id.* § 6921; 40 C.F.R. §§ 261.11, 261.20–261.24. Under Subtitle C, the EPA directly regulates all stages of production and disposition of hazardous wastes, and has administrative enforcement power as well as authority to initiate or recommend civil and criminal actions in court. *See* 42 U.S.C. §§ 6922–6928. Subtitle D, in contrast, envisions that states are primarily responsible for regulating disposal of nonhazardous wastes in landfills and dumps. The EPA’s principal role under Subtitle D is to announce federal guidelines for state management of nonhazardous wastes; Subtitle D leaves it up to the states to “use federal financial and technical assistance to develop solid waste management plans in accordance with [the] federal guidelines.” *Environmental Def. Fund v. EPA*, 852 F.2d 1309, 1310 (D.C. Cir. 1988).

¹ On several previous occasions, the EPA considered, but decided against, regulating Coal Residuals under RCRA Subtitle C. For background on the EPA’s previous determinations on Coal Residuals, *see* 75 Fed. Reg. at 35,136–35,137.

Substantively, Subtitle D prohibits the disposal of solid waste in “open dumps,” 42 U.S.C. § 6945(a), and calls on the EPA to promulgate criteria for determining whether a waste facility constitutes an open dump—criteria that, if followed, will ensure “no reasonable probability of adverse effects on health or the environment from disposal of solid waste at such facility,” *id.* § 6944(a). Subtitle D neither grants the EPA direct enforcement authority nor requires states to adopt or implement its requirements. *See id.* § 6941. Enforcement is left to states’ own policy decisions and to the initiative of people bringing citizen suits to enforce the federal standards. *See id.* §§ 6946–6947, 6972. *But see infra* Part II.A. (discussing recent amendments to RCRA).

The EPA initially published two alternative proposed rules to govern Coal Residuals, one under each Subtitle, basing the Subtitle C proposal on the toxicity of Coal Residuals. *See* 75 Fed. Reg. at 35,146. The proposals drew 450,000 public comments, the vast bulk of which spoke to the threshold question of which RCRA Subtitle to use, and the majority of which supported regulation under Subtitle C. 80 Fed. Reg. at 21,319. Most of the commenters were individuals and environmental groups pressing for stronger regulation “because state programs have failed to adequately regulate the disposal of [Coal Residuals] and because the risks associated with the management of these wastes are significant.” *Id.* Only a handful of states, for example, required any groundwater monitoring around units holding Coal Residuals, *id.* at 21,323–21,324, including only one of the eight states with the biggest volumes of Coal Residuals, Regulatory Impact Analysis, G-6, J.A. 1121. On the other hand, the enormous volume of waste permeated with relatively low concentrations of toxins posed practical difficulties for any Subtitle C regulation. *See* 80 Fed. Reg. at 21,321.

Based on many years of analysis, the EPA found “a compelling need for a uniform system of requirements to address the[] risks [from Coal Residuals],” and decided to move forward with a Final Rule. 80 Fed. Reg. at 21,327. The EPA opted to proceed under the less muscular Subtitle D even as it continued to study factors potentially supporting regulating Coal Residuals as hazardous waste under RCRA Subtitle C. *See id.* at 21,319–21,327. The EPA thus formally deferred deciding whether Subtitle C regulation is warranted, and used its Subtitle D authority to set forth guidelines on where and how disposal sites for Coal Residuals are to be built, maintained, and monitored. *See* 80 Fed. Reg. at 21,302.

The Final Rule sets minimum criteria for the disposal of Coal Residuals in landfills and surface impoundments. Among the provisions of the Final Rule at issue here are location restrictions on landfills and surface impoundments, requirements pertaining to lining, structural integrity, and groundwater monitoring, and criteria for recycling Coal Residuals for beneficial uses, such as substituting for cement in road construction, in lieu of keeping it in disposal units. *See* 40 C.F.R. §§ 257.60–257.74. The Final Rule also sets compliance deadlines, procedures for closing non-complying landfills and surface impoundments, and requirements that operators of these disposal sites make records of their compliance with the Final Rule publicly available. *See id.* §§ 257.100–257.07. We discuss the relevant criteria in more detail in addressing the merits of the consolidated petitions.

C.

Two groups of petitioners sought review of the Final Rule. Environmental Petitioners are an assortment of environmental groups that includes the Environmental Integrity Project, Sierra Club, and Hoosier Environmental Council. They generally claim that EPA did not go far enough to protect the public and the environment from the harms of Coal Residual disposal. Specifically, they claim that the Final Rule unlawfully countenances significant risks of harmful leakage by allowing unlined impoundments as well as impoundments lined only with a layer of compacted soil to continue receiving Coal Residuals. Environmental Petitioners also contend that the EPA acted arbitrarily and capriciously by exempting from regulation so-called “legacy ponds”—inactive surface impoundments at shuttered power plants—given evidence that legacy ponds are at risk of unmonitored leaks and catastrophic structural failures. They also make a claim, not raised during rulemaking, that the EPA violated RCRA’s citizen-suit provision by failing to require the operators of Coal Residual disposal sites to timely and publicly disclose records reflecting their compliance with the Final Rule.

Industry Petitioners are a collection of industry trade associations and utilities including the Utility Solid Waste Activities Group, AES Puerto Rico, LP, the Edison Electric Institute, the National Rural Electric Cooperative Association, and the American Public Power Association. They first assert that the EPA exceeded its statutory authority under RCRA to set guidelines for facilities where waste “is disposed of,” 42 U.S.C. § 6903(14), by regulating surface impoundments that no longer actively receive Coal Residuals. They further claim that the Rule’s restriction on placement of new units and expansions of existing units near aquifers, 40 C.F.R. § 257.60 (aquifer location restriction), was inadequately noticed, and

that the Rule's provision for nonconforming units to continue in operation if no alternative disposal capacity is available, *id.* § 257.103 (alternative closure provision), arbitrarily and capriciously excludes cost considerations from its definition of "available." Industry Petitioners also challenge the Rule's location restrictions and structural integrity criteria governing units in seismic impact zones. *See id.* §§ 257.63, 257.73–257.74. They contend that the deadline for existing impoundments' compliance with those provisions was arbitrarily shortened from the timeframe in the Proposed Rule, that the Rule arbitrarily applied the location restrictions to new but not existing landfills, and that EPA failed to explain the strict design criteria it adopted for new landfills and impoundments.

Environmental Petitioners intervened in Industry's petition for review, and vice versa. We consolidated the petitions. The case has been pending in this court since 2015, but several procedural matters delayed resolution until now. In June 2016, we granted the EPA's unopposed motion to remand to itself several provisions of the Final Rule not at issue here that the EPA had decided to vacate. *See Per Curiam Order, Utility Solid Waste Activities Grp v. EPA*, No. 15-1219 (D.C. Cir. June 14, 2016). In doing so, we held all proceedings in abeyance while the EPA revised portions of the Rule affected by the vacatur. *See id.* We then set oral argument for October 17, 2017.

Less than a month before oral argument, the EPA announced that it had granted the petition of several industry groups to reconsider the Final Rule, and moved us to hold all proceedings in abeyance. The EPA pointed to Congress's recent enactment of the Water Infrastructure Improvements for the Nation Act ("WIIN Act"), Pub. L. No. 114-322, 130 Stat. 1628 (2016) (codified at 42 U.S.C. § 6945(d)), in December

2016 that, among other things, amended RCRA Subtitle D to allow the EPA to approve State permitting programs “to operate in lieu of [EPA] regulation of coal combustion residuals units in the State,” provided those programs are at least as environmentally protective as the existing (or successor) EPA regulations. 42 U.S.C. § 6945(d)(1)(A). When we asked EPA to specify which provisions it planned to reconsider, the EPA filed another motion. That motion sought to remand provisions of the Rule relating to the beneficial use of Coal Residuals, alternative compliance provisions, legacy ponds, and the EPA’s statutory authority to regulate inactive surface impoundments. We deferred a ruling on both motions until now.

On July 30, 2018, the EPA promulgated an amendment to the Final Rule (i) allowing a state or the EPA, when acting as a permitting authority, to use alternate groundwater performance standards, (ii) revising the groundwater performance standards for certain constituents, and (iii) extending the timeframe for facilities to cease receiving Coal Residuals once they are required to close. *See Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Amendments to the National Minimum Criteria*, 83 Fed. Reg. 36,435, 36,436 (July 30, 2018).

II. Request for Abeyance

A. WIIN Act

At the outset, the EPA requests that this case be held in abeyance while it considers potential regulatory changes in response to Congress’s enactment of the WIIN Act, 42 U.S.C. § 6945(d). The WIIN Act amended RCRA’s Subtitle D State permitting scheme. As relevant here, Section 6945(d)

provides that the Administrator may approve qualified State “permit program[s] or other system[s] of prior approval and conditions under State law for regulation by the State of coal combustion residuals units” to “operate in lieu of [EPA] regulation of coal combustion residuals units in the State***.” 42 U.S.C. § 6945(d)(1)(A).

But the Administrator may only approve a state plan if its standards “are at least as protective as the criteria” set by the EPA in its corresponding RCRA regulations, specifically including Coal Residuals regulation, 40 C.F.R. pt. 257. 42 U.S.C. § 6945(d)(1)(C); *see id.* § 6945(d)(1)(B)(i). The WIIN Act also provides that a Coal Residuals disposal site can only qualify as a “sanitary landfill” if it is in full compliance with, among other things, the EPA’s extant (or successor) regulations governing Coal Residuals waste sites. 42 U.S.C. § 6945(d)(6).

The EPA argues that the WIIN Act has afforded it new regulatory options and makes “fundamental changes to RCRA Subtitle Das applied specifically to [Coal Residuals].” EPA WIIN Br. 4, 6, 8. On that basis, the EPA asks us to hold the case in abeyance while it decides whether or not “to alter some of its regulatory choices[.]” EPA WIIN Br. at 2, 6.

We decline to exercise our discretion to hold the case in abeyance. We leave it open for the EPA to address on remand the relevance of the WIIN Act, the Act’s express incorporation of the EPA regulations published at 40 C.F.R. Part 257, and its definition of “sanitary landfill.”

III. Environmental Petitioners' Challenges

A. Unlined Surface Impoundments

Environmental Petitioners challenge the Final Rule's provision that existing, unlined surface impoundments may continue to operate until they cause groundwater contamination. 40 C.F.R. § 257.101(a)(1). They contend that the EPA failed to show how continued operation of unlined impoundments meets RCRA's baseline requirement that any solid waste disposal site pose "no reasonable probability of adverse effects on health or the environment." 42 U.S.C. § 6944(a).

The EPA found that unlined impoundments are dangerous: It concluded that, among the studied disposal methods, putting Coal Residuals "in unlined surface impoundments and landfills presents the greatest risks to human health and the environment." 80 Fed. Reg. at 21,451. The Rule accordingly requires that all new surface impoundments be constructed with composite lining that effectively secures against leakage. *See* 40 C.F.R. § 257.72(a). But it allows existing unlined impoundments to continue to receive Coal Residuals indefinitely, until their operators detect that they are leaking. *Id.* § 257.101(a). Only once a leak is found must the operator of an unlined impoundment begin either retrofitting the unit with a composite liner, or closing it down—a process that the Rule contemplates may take upwards of fifteen years. *Id.* § 257.102(f). In view of the record evidence that led the EPA to conclude that composite liners are needed to ensure that new impoundments meet RCRA Subtitle D's "no reasonable probability" standard, Environmental Petitioners claim that the Rule's allowance for continued operation of existing, unlined

surface impoundments is arbitrary and capricious and contrary to RCRA.

The EPA and Industry Intervenors assert that the composite lining required for new units is not needed for existing units because most unlined impoundments do not leak, and an unlined impoundment that is not leaking is not dangerous. Industry Intervenors emphasize that the record suggests that “almost two-thirds of unlined impoundments *do not* leak,” and they assert that “appropriate controls on impoundments that do leak” suffice to meet RCRA’s “no reasonable probability” standard. Industry Intervenor Br. 6–7. The EPA underscores that it made no finding of any “reasonable probability that *each and every* unlined impoundment will, in fact, result in adverse effects on health and the environment.” Resp’t Br. 82. It insists that RCRA’s “no reasonable probability” standard is met by the Rule’s provisions for “extensive monitoring of groundwater to detect constituent leaking,” *id.* at 83, and “immediate action to stop that leak,” “redress that leak,” and to close the site as soon as a harmful leak is detected. Oral Arg. Tr. 100:20–100:25.

The record shows, however, that the vast majority of existing impoundments are unlined, *see* Regulatory Impact Analysis 3-4, J.A. 1108, that unlined impoundments have a 36.2 to 57 per cent chance of leakage at a harmfully contaminating level during their foreseeable use, *see id.* at 4-9, 5-22, J.A. 1111–1112, and that the threat of contamination from unlined units exceeds the EPA’s cancer risk criteria and thus “generally will be considered to pose a substantial present or potential hazard to human health and the environment,” 80 Fed. Reg. at 21,449–21,450; *see* Risk Assessment 5-5, J.A. 1041. It is inadequate under RCRA for the EPA to conclude that a major category of impoundments that the agency’s own data show are prone to leak pose “no reasonable probability of

adverse effects on health or the environment,” 42 U.S.C. § 6944(a), simply because they do not already leak.

The number of unlined impoundments is large. The EPA identified 735 existing active surface impoundments throughout the country. Of the 504 sites for which the EPA was able to collect liner data, approximately 65 per cent were completely unlined, with most of the rest lined only with compacted soil or other partial or high-permeability liners. *See* Regulatory Impact Analysis 3-4 n.105, J.A. 1108. Only 17 per cent of surface impoundments for which the EPA has liner data had composite liners—the sole liner type that the EPA found to be effective in reducing the risk of toxic chemical leakage to the level that the Agency found acceptable.

Those hundreds of unlined impoundments are at significant risk of harmful leakage. Of 157 sites where the EPA confirmed that Coal Residuals have already caused damage to human health and the environment, the damage cases “were primarily associated with unlined units.” 80 Fed. Reg. at 21,452. The record evidence shows that an impoundment with composite lining, which the Rule requires of all new impoundments, has a 0.1 per cent chance of contaminating groundwater at drinking-water wells a mile distant from the impoundment perimeter over the course of a 100-year period. Regulatory Impact Analysis 5-22, J.A. 1112. An unlined impoundment, in contrast, has a 36.2 per cent chance of contaminating groundwater at such a distance. *See id.* And the probability of contamination is higher at distances closer to the impoundment site, *id.*, J.A. 1112; measured one meter from the impoundment’s perimeter, the contamination risk jumps to 57 per cent, *id.*, J.A. 1111. *See* Risk Assessment ES-4, J.A. 1083–1084 (“In many of the potential damages cases, groundwater exceedances were discovered near the boundary” of the impoundment). According to the

administrative record, then, a significant portion of the 575 identified unlined surface impoundments are likely to contaminate groundwater.

Impoundment leakages pose substantial risks to humans and the environment. The EPA studied a wide range of toxins present in Coal Residuals, *see* Risk Assessment ES-4, J.A. 1010, and considered various forms of potential human and environmental exposures. The EPA uses risk benchmarks in assessing the propriety of regulatory action. For example, it treats a cancer risk in excess of 1×10^4 , or 1 in 10,000, as one that “generally will be considered to pose a substantial present or potential hazard to human health and the environment[.]” 80 Fed. Reg. at 21,449. For non-cancer risks, the EPA determined that a Hazard Quotient—defined as the “ratio of the estimated exposure to the exposure at which it is likely that there would be no adverse health effects,” 75 Fed. Reg. at 35,168—gives rise to such a threat when it is greater than or equal to 1. *See* 80 Fed. Reg. at 21,449. Using those benchmarks and the data it collected from the Risk Assessment, the EPA found that material human exposures derive from ingestion of contaminated groundwater or the consumption of contaminated fish. *Id.* at 21,450–21,451.² The plant and animal exposures the EPA identified as material derive from contact with contaminated surface water. *See id.*; Risk Assessment 5-8, J.A. 1044. The EPA also expressed concern about the contamination of groundwater that is not currently used as a source of drinking water because “[s]ources of drinking water are finite, and future users’ interests must

² The EPA’s Risk Assessment found that unlined impoundments created an unacceptable human cancer risk as a result of exposure to two different arsenics, and an unacceptable non-cancer risk as a result of exposure to one type of arsenic, as well as lithium, molybdenum, and thallium. *See* Risk Assessment 5-5, J.A. 1041.

also be protected.” 80 Fed. Reg. at 21,452. In view of the record’s limitation of the risk calculus associated with leakage to the subset of toxins and exposures that the EPA deemed to present a substantial risk to human health or the environment, the EPA’s assertion in its brief that, even where it occurs, leakage “will not necessarily result in contamination of groundwater, either above allowable regulatory thresholds, or at all,” is at best a red herring. Resp’t Br. at 85. Every leakage the EPA record treated as material exceeded regulatory thresholds. In defending the Rule here, the EPA looks at too narrow a subset of risk information and applies the wrong legal test.

The Final Rule’s approach of relying on leak detection followed by closure is arbitrary and contrary to RCRA. This approach does not address the identified health and environmental harms documented in the record, as RCRA requires. Moreover, the EPA has not shown that harmful leaks will be promptly detected; that, once detected, they will be promptly stopped; or that contamination, once it occurs, can be remedied.

On its own terms, the Rule does not contemplate that contamination will be detected as soon as it appears in groundwater. The EPA and Industry defend the rule as RCRA-compliant principally because, they say, it provides for retrofit with a composite liner or closure of an unlined impoundment “[o]n the *first* indication that an unlined unit is leaking[.]” Industry Intervenor Br. 6. But the required groundwater sampling need only occur “at least semiannual[ly],” or perhaps less frequently under certain geological conditions. 40 C.F.R. § 257.94(b), (d); *id.* § 257.95(c). The Rule thus contemplates that leaks will often go undetected for many months.

By the time groundwater contamination from an unlined impoundment has been detected, more damage will have been done than had the impoundment been lined: Leakage from unlined impoundments is typically quicker, more pervasive, and at larger volumes than from lined impoundments. *See* 80 Fed. Reg. at 21,406. Unlike lined impoundments, in which leaks are “usually caused by some localized or specific defect in the liner system that can more readily be identified and corrected,” leakage from unlined impoundments is more pervasive and less amenable to any quick, localized fix. *Id.* at 21,371. When an unlined impoundment begins to leak, Coal Residual sludge “will flow through the unit and into the environment unrestrained,” such that retrofit or closure of the unit are typically “the only corrective action strateg[ies] that [the] EPA can determine will be effective[.]” *See id.*

Neither retrofitting nor closure occurs immediately under the Rule; the timeline contemplates a process that takes from five to fifteen years. *See* 40 C.F.R. § 257.102. The EPA understates the harm its own record evidences by emphasizing that “leaking unlined impoundments must cease receiving [Coal Residuals] and initiate closure or retrofit activities within six months.” Resp’t Br. at 81; *see* 40 C.F.R. § 257.101(a)(1). What it neglects to account for is that the Rule gives the operator a further five years to complete retrofitting or closure activities. *Id.* §§ 257.102(f)(1)(ii), 257.102(k)(3). The Rule also allows the operators of surface impoundments to extend that window, by up to two years for smaller units and, for units larger than 40 acres—which most are, *see* 80 Fed. Reg. at 21,303—for up to ten years, *see* 40 C.F.R. § 257.102(f)(2)(ii).

The Rule addresses neither the risks to public health and to the environment before leakage is detected, nor the harms from continued leakage during the years before leakage is ultimately halted by retrofit or closure. *See generally* 40

C.F.R. §§ 257.90–257.104. In defending the Rule as compliant with RCRA, the EPA did not even consider harms during the retrofit or closure process. *See* Resp’t Br. 80–86; 80 Fed. Reg. at 21,403–21,406; *cf.* Oral Arg. Tr. 102–105 (EPA counsel unable to identify record evidence regarding how quickly leaks can be detected or how quickly and thoroughly responsive action can occur, but referring generally to a practice of immediate “pump and treat,” which the Rule does not appear to require). An agency’s failure to consider an important aspect of the problem is one of the hallmarks of arbitrary and capricious reasoning. *See United States Sugar Corp. v. EPA*, 830 F.3d 579, 606 (D.C. Cir. 2016) (*per curiam*) (citing *Motor Vehicle Mfrs. Ass’n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983)).

The EPA’s position suffers additional flaws. The EPA determined that contaminated surface waters, such as rivers, streams, and lakes, are the principal pathway of harm to environmental receptors, but the Final Rule requires only monitoring of groundwater, and only for levels of contamination that would harm human health. *See* 40 C.F.R. §§ 257.90–257.95 (calling for groundwater monitoring systems); 75 Fed. Reg. at 35,130 (defining maximum contaminant level in terms of drinking water safety). Surface water contamination poses environmental risks from “[e]levated selenium levels in migratory birds, wetland vegetative damage, fish kills, amphibian deformities, ***[and] plant toxicity,” 75 Fed. Reg. at 35,172, and to humans through the possible consumption of contaminated fish, 80 Fed. Reg. at 21,444. These risks exceed the EPA’s risk criteria for ecological receptors. *See* Risk Assessment 5–8, J.A. 1044. And some contamination levels that do not meet the risk threshold for humans may exceed thresholds for ecological receptors. *See, e.g., id.* (noting a risk exceedance unique to ecological receptors from cadmium). Yet the record

does not explain how the Rule's provisions for groundwater monitoring, followed by corrective action only when human exposure benchmarks are exceeded, will mitigate these risks. RCRA requires the EPA to set minimum criteria for sanitary landfills that prevent harm to either "health *or* the environment." 42 U.S.C. § 6944(a) (emphasis added). The EPA's criteria for unlined surface impoundments, limited as they are to groundwater monitoring for contaminant levels keyed to human health, only partially address the first half of the statutory requirement.

For these reasons, we vacate 40 C.F.R. § 257.101, which allows for the continued operation of unlined impoundments, and remand for additional consideration consistent with this opinion.

B. Liner Type Criteria

Environmental Petitioners next challenge the Final Rule's regulation of so-called "clay-lined" surface impoundments. A clay liner consists of at least two feet of compacted soil to act as a buffer between the Coal Residual sludge and the local soil. *See* Risk Assessment 4-8; J.A. 1024. Even as the Rule requires all newly constructed surface impoundments to be built with composite lining, disapproving any new impoundments lined only with compacted soil, it treats existing impoundments constructed with the same compacted soil and no geomembrane as if they were "lined." *See* 40 C.F.R. §§ 257.71(a)(1)(i), 257.96–257.98. The upshot is that such clay-lined impoundments may stay open and keep accepting Coal Residuals, subject to groundwater monitoring for leakage, *see* 40 C.F.R. § 257.101, but, unlike existing unlined impoundments—which must begin closure when they leak, *id.* § 257.71(a)(1)—clay-lined impoundments need not begin closure when they are discovered to be leaking. Rather, their

operators may attempt to repair them first. *Id.* §§ 257.96–257.98. Only if repair is unsuccessful must they then begin the protracted process to either retrofit with a composite liner or close.

The EPA contends that, by requiring the operators of clay-lined impoundments to fix leaks when they occur, the Rule comports with RCRA's mandate to ensure "no reasonable probability of adverse effects on health or the environment." 42 U.S.C. § 6944(a); *see* Resp't Br. 88–89. For their part, Environmental Petitioners point to record evidence that clay-lined units are likely to leak, and contend that the EPA's approach "authorizes an endless cycle of spills and clean-ups" in violation of RCRA. *See* Evtl. Pet'r Br. 30.

Clay-lined units are dangerous: "clay-lined units tended to have lower risks than unlined units" but, the record evidence showed, they were "still above the criteria" that the EPA set as the threshold level requiring regulation. 75 Fed. Reg. at 35,144. Clay-lined surface impoundments have a 9.1 per cent chance of causing groundwater contamination at drinking water wells at a one-mile distance from the impoundment perimeter. *See* Regulatory Impact Analysis 5-22, J.A. 1112. And, as with unlined impoundments, the EPA acknowledges that the risk of contamination from leaking clay-lined impoundments is much higher closer to the impoundment perimeter. *See* Risk Assessment 5-39 to 5-40, J.A. 1075–1076 ("[A]rsenic concentrations fall dramatically as the distance from the [waste management units] increases."); *id.* at 5-47 to 5-48, J.A. 1083–1084 ("In many of the potential damage cases, ground water exceedances were discovered near the boundary

of the W[aste] M[anagement] U[nit].”).³ Leaks from clay-lined units, the EPA found, present cancer and non-cancer risks that exceed the EPA’s risk criteria. *See* Risk Assessment 5-5, 5-30, J.A 1041, 1066.

The EPA’s regulation of clay-lined impoundments suffers from the same lack of support as its regulation of unlined impoundments. *See supra* part III.A. Just as the EPA did not explain how the Rule’s contemplated detection and response could assure “no reasonable probability of adverse effects to health or the environment” at unlined impoundments, it likewise failed regarding existing impoundments lined with nothing more than compacted soil. The EPA insists that the Rule’s criteria ensure that leaks from these clay-lined units will be “promptly” addressed, thereby satisfying RCRA. Resp’t Br. 91.

But here, too, the EPA has failed to show how unstaunched leakage while a response is pending comports with the “no reasonable probability” standard. The problem is compounded by the Rule’s unsupported supposition that leaking clay liners, unlike leaking unlined impoundments, can be repaired. The Rule thus allows an operator of a leaking clay-lined impoundment time to explore repair even before the five-to-fifteen year retrofit-or-close clock starts to run. For starters, the Rule allows operators of lined impoundments up to five months to complete an assessment of possible corrective measures, 40 C.F.R. § 257.96(a), and—given the numerous, complicated steps involved in doing so—allows an additional, indefinite amount of time to actually select a remedy. *See id.* § 257.97; 80 Fed. Reg. at 21,407–21,408. Once an operator

³ The administrative record does not show the exact probability of contamination from clay-lined units at a one-meter distance. *See* Regulatory Impact Analysis, 4-9 to 5-22, J.A. 1111–1112.

settles on a remedy, it has another three months to initiate remedial activities. *Id.* at § 257.98(a). If it turns out that no effective repair is feasible, or if an attempted repair proves unsuccessful, only then does the Rule contemplate the impoundment's operator will begin the protracted process—discussed above in connection with the closure of existing, unlined impoundments—of retrofitting the site with a composite liner or closing it. There is no evidence in the record supporting the EPA's assumption that clay liners are reasonably susceptible of repair, nor any explanation or account of how the risks of harm during the lengthy response periods the Rule allows comport with the “no reasonable probability” standard.

Just as with the EPA's regulation of unlined impoundments, the Rule's treatment of clay-lined impoundments does not capture the full range of health and environmental harms they pose, as RCRA requires. By responding only to risks from leakage contaminating groundwater a mile from the perimeter of the studied impoundments, and accordingly setting minimum criteria that focus solely on harms to humans through drinking water contamination, the EPA has failed to ensure “no reasonable probability” of adverse effects to the environment, as RCRA requires. 42 U.S.C. § 6944(a).

For these reasons, we vacate the Rule insofar as it treats “clay-lined” units as if they were lined. *See* 40 C.F.R. § 257.71(a)(1)(i).

C. Legacy Ponds

The EPA exempted inactive impoundments at *inactive* facilities, which are commonly referred to as “legacy ponds,” from the same preventative regulation applied to all other

inactive impoundments under the Rule. 40 C.F.R. § 257.50(e). The EPA considered it sufficient instead just (i) to wait to intervene until a substantial environmental or human harm is “imminent,” 42 U.S.C. § 6973, or (ii) to attempt to remediate the damage after contamination has occurred. 80 Fed. Reg. at 21,311 n.1; *id.* at 21,312 n.2. Environmental Petitioners argue that, because legacy ponds pose at least the same risks of adverse effects as all other inactive impoundments, the EPA failed to articulate a rational explanation for their dissimilar treatment.

The EPA does not dispute the dangers posed by the unregulated legacy ponds, but asserts that the difficulties in identifying the party responsible for legacy ponds justify its reactive approach. Because the EPA’s own record plainly contravenes that rationale, and the Rule pays scant attention to the substantial risk of harm to human health and the environment posed by legacy ponds, we reject the legacy pond exemption as arbitrary and capricious.

1.

Legacy ponds are a particular subset of inactive impoundments. Like all inactive impoundments, they contain a toxic “slurry” of Coal Residuals mixed with water, but legacy ponds are not receiving new deposits. 80 Fed. Reg. at 21,457 n.219. What distinguishes legacy ponds from other inactive impoundments, then, is their location. Legacy ponds are found at power plants that are no longer engaged in energy production. In other words, legacy ponds are inactive impoundments at inactive facilities.

As a result, legacy ponds present a unique confluence of risks: They pose the same substantial threats to human health and the environment as the riskiest Coal Residuals disposal

methods, compounded by diminished preventative and remediation oversight due to the absence of an onsite owner and daily monitoring. *See* 80 Fed. Reg. at 21,343–21,344 (finding that the greatest disposal risks are “primarily driven by the older existing units, which are generally unlined”). Notably, this very Rule was prompted by a catastrophic legacy pond failure that resulted in a “massive” spill of 39,000 tons of coal ash and 27 million gallons of wastewater into North Carolina’s Dan River. *Id.* at 21,394; *id.* at 21,393.

Nevertheless, the EPA chose to leave legacy ponds on the regulatory sidelines. 40 C.F.R. § 257.50(e). Unlike all the other inactive impoundments, EPA adopted a largely hands-off approach, choosing (i) to respond only after “imminent” leakage is detected and reported, 42 U.S.C. § 6973(a) (RCRA’s “imminent and substantial endangerment” provision), or to (ii) attempt an after-the-spill clean up under the Comprehensive Environmental Response, Compensation, and Liability Act (commonly known as the “Superfund” statute), 42 U.S.C. § 9601 *et seq.* *See* 80 Fed. Reg. at 21,312 n.2 (citing 42 U.S.C. § 9608(b)).

The EPA’s rationale for allowing legacy ponds, in effect, one free leak was its supposed inability to identify the owners of legacy ponds. In the absence of an identified owner or other responsible party, the EPA reasoned, enforcing the Coal Residuals regime would be difficult with no operator onsite to generate compliance certifications, conduct inspections, or otherwise implement the Rule’s substantive requirements. *See* 80 Fed. Reg. at 21,344.

The EPA’s decision was arbitrary and capricious. To begin with, there is no gainsaying the dangers that unregulated legacy ponds present. The EPA itself acknowledges the vital importance of regulating inactive impoundments at active

facilities. That is because, if not properly closed, those impoundments will “significant[ly]” threaten “human health and the environment through catastrophic failure” for many years to come. 75 Fed. Reg. at 35,177; *see also* 80 Fed. Reg. at 21,344 n.40.

The risks posed by legacy ponds are at least as substantial as inactive impoundments at active facilities. *See* 80 Fed. Reg. at 21,342–21,344 (finding “no[] measurabl[e] differen[ce]” in risk of catastrophic events between active and inactive impoundments). And the threat is very real. Legacy ponds caused multiple human-health and environmental disasters in the years leading up to the Rule’s promulgation. *See* 75 Fed. Reg. at 35,147 (proposed rule discusses multiple serious incidents). For example, a pipe break at a legacy pond at the Widows Creek plant in Alabama caused 6.1 million gallons of toxic slurry to deluge local waterways. *Id.* Another legacy pond in Gambrills, Maryland caused the heavy metal contamination of local drinking water. *Id.* And the preamble to the Rule itself specifically points to the catastrophic spill at the Dan River legacy pond in North Carolina. 80 Fed. Reg. at 21,393–21,394. Simply hoping that somehow there will be last-minute warnings about imminent dangers at sites that are not monitored, or relying on cleaning up the spills after great damage is done and the harm inflicted does not sensibly address those dangers. Certainly it does not fulfill the EPA’s statutory duty to ensure “no reasonable probability of adverse effects” to environmental and human well-being. 42 U.S.C. § 6944(a).

Confronted by those considerable dangers, the EPA’s decision to shrug off preventative regulation makes no sense. The asserted difficulty in locating the owners or operators responsible for legacy ponds does not hold water. The record shows that the EPA knows where existing legacy ponds are

and, with that and other information, the EPA already is aware of or can feasibly identify the responsible parties. After all, the owners and operators of the Dan River, Widows Creek, and Gambrills, Maryland disasters were all known. *See* 80 Fed. Reg. at 21,393–21,394; 75 Fed. Reg. at 35,147.

Also, the EPA has been compiling and maintaining a database for nearly a decade that identifies legacy ponds and their owners with specificity. *See* Regulatory Impact Analysis for EPA’s Proposed RCRA Regulation of Coal Combustion Residues, *Information Request Responses from Electric Utilities* (April 30, 2010), available at https://archive.epa.gov/epawaste/nonhaz/industrial/special/fossil/web/xlsx/survey_database_041212.xlsx. The Final Rule’s Regulatory Impact Analysis named more than thirty other owners and operators of recently, or soon-to-be, retired power plants where more than 100 legacy ponds are located. This included a State-by-State list detailing the number of already-inactive impoundments, and the utility responsible for each one. *See id.*; *see also* J.A. 1104, 1119. The database further identified 83 power plants that were scheduled to “fully close all coal-fired” facilities by the time the Rule went into effect, over 75% of which would house a legacy pond upon closure. J.A. 1116.

In sum, the EPA acknowledges that (i) it has the authority to regulate inactive units, (ii) it is regulating inactive units at active facilities, (iii) the risks posed by legacy ponds are at least as severe as the other inactive-impoundment dangers that the “[R]ule specifically seeks to address, and [(iv)] there is no logical basis for distinguishing between units that present the same risks.” 80 Fed. Reg. at 21,343. The EPA also considers it “quite clear” that older, unlined impoundments, Oral Arg. Tr. at 94:22—which are primarily legacy ponds—pose “the greatest risks to human health and the environment,” 80 Fed.

Reg. at 21,451. Because the administrative record belies the EPA's stated reason for its reactive, rather than preventative, approach—the inability to identify the responsible parties—the Rule's legacy ponds exemption is unreasoned, arbitrary, and capricious.

D. Inadequate Notice by Owners and Operators

Because of RCRA's reliance on citizen enforcement, the statute requires the EPA to “develop and publish minimum guidelines for public participation” in the “development, revision, implementation, and enforcement” of any RCRA regulation. 42 U.S.C. § 6974(b)(1). The EPA implements that statutory requirement, as relevant here, by requiring the owners of Coal Residuals units to “maintain a publicly accessible Internet site” on which they timely disclose specified information about their compliance with RCRA regulations. 40 C.F.R. § 257.107(a).

The Environmental Petitioners wage several assaults on the Rule's Internet notice requirements, arguing that they do not provide adequate or timely notice to permit the public to participate in monitoring compliance with the Rule. For example, the Environmental Petitioners object that the Rule does not require owners or operators of new Coal Residual impoundments to post a design certification—an engineer's certification that the impoundment's liner meets the EPA's criteria—until sixty days after construction begins. 40 C.F.R. § 257.107(f)(1); *see* 40 C.F.R. § 257.70. That is too late, the Environmental Petitioners argue, to put the public on effective notice of any potential design problems. They also object that the Rule does not require timely public notification about the design or liner compliance of impoundment expansions, the structural integrity of facilities, protections against airborne

coal dust, run-off control, hydraulic capacity requirements, or the nature of groundwater monitoring efforts.

The problem for Environmental Petitioners is that, although they participated in the notice-and-comment rulemaking process, they never voiced objections to the Rule's notice provisions that they now challenge. Having stood silent during the rulemaking, the Environmental Petitioners may not now raise their complaints for the first time in their petition for judicial review. *See Military Toxics Project v. EPA*, 146 F.3d 948, 956 (D.C. Cir. 1998); *see also City of Portland v. EPA*, 507 F.3d 706, 710 (D.C. Cir. 2007) ("Because [no] party raised this argument before the [EPA] during the rulemaking process, however, it is waived, and we will not consider it."). The sanction does not exist as a procedural trap; the notice-and-comment process is in place so that the agency can consider and—if necessary—revise its proposed rule in light of public comments. *United States v. L.A. Tucker Truck Lines, Inc.*, 344 U.S. 33, 37 (1952) ("[O]rderly procedure and good administration require that objections to the proceedings of an administrative agency be made while it has opportunity for correction in order to raise issues reviewable by the courts."). The EPA reasonably focuses its resources on consideration and/or modification of challenged portions of a proposed rule rather than unchallenged and apparently uncontroversial portions thereof. *See Interstate Nat. Gas Ass'n of Am. v. FERC*, 494 F.3d 1092, 1096 (D.C. Cir. 2007) (agency must respond to material comments only). Accordingly, we will not address this claim.

IV. Industry Petitioners' Challenges

Industry Petitioners bring a host of their own challenges to the Rule. As noted, these claims have dwindled over the course of this litigation. At the start, Industry Petitioners

challenged eighteen provisions of the Final Rule and questioned the EPA's statutory authority to regulate inactive surface impoundments.⁴ In response, the EPA filed an unopposed motion to sever and remand two aspects of the Final Rule (regarding five regulatory provisions). On June 14, 2016, we granted the motion. Industry Petitioners continued to challenge the thirteen remaining substantive provisions as well as to attack the EPA's statutory authority. In the parties' proposed oral argument structure, however, Industry Petitioners moved to dismiss two additional challenges (regarding three regulatory provisions). We granted that motion as well.

Accounting for these interim trims, Industry Petitioners now assert that the EPA (i) lacks authority to regulate inactive impoundments; (ii) failed to provide sufficient notice of its intention to apply the aquifer location criteria to existing impoundments, to regulate Coal Residual piles of 12,400 or more tons, and to regulate the temporary storage of Coal

⁴ Industry Petitioners' initial brief challenged portions of the following regulations: 40 C.F.R. §§ 257.50(c), 257.100 (inactive impoundments); 40 C.F.R. § 257.53 (definition of "beneficial use" and regulation of CCR "pile"); 40 C.F.R. § 257.60 (aquifer location restrictions); 40 C.F.R. §§ 257.73(e), (f)(1), 257.74(e) (minimum safety factors); 40 C.F.R. §§ 257.90(d), 257.96(a) ("release" response); 40 C.F.R. §§ 257.73(a)(4), 257.74(a)(4) (dike requirements); 40 C.F.R. § 257.103(a)(1)(i), (b)(1)(i) (prohibition on considering cost and inconvenience); 40 C.F.R. § 257.63(a) (seismic impact zone landfill requirements); 40 C.F.R. § 257.63(c)(1) (seismic impact zone deadline); 40 C.F.R. § 257.103 (inclusion of non-Coal Residuals waste streams in alternative closure provision); 40 C.F.R. §§ 257.95(h)(2), 257.97 (exclusion of risk-based compliance alternatives).

Residuals destined for beneficial use; and (iii) acted arbitrarily in regulating residual piles of 12,400 or more tons, in regulating on-site Coal Residuals destined for beneficial use, in eliminating the risk-based compliance alternatives, in issuing location requirements based on seismic impact zones, and in imposing temporary closure procedures.⁵

The EPA, now supported in part by Industry Petitioners, requests a remand of several of those issues, namely whether (i) the EPA has statutory authority to regulate inactive impoundments, (ii) the EPA arbitrarily regulated Coal Residuals piles of 12,400 or more tons, (iii) the EPA arbitrarily regulated on-site Coal Residuals destined for beneficial use, and (iv) the EPA arbitrarily eliminated risk-based compliance alternatives.

We grant the request for voluntary remand of the Coal Residuals pile-size and beneficial-use issues, and we dismiss as moot both the claim regarding risk-based compliance alternatives and the accompanying notice challenges. As to all remaining issues, we deny remand, and we deny the Industry Petitioners' petition for review.

A. EPA's Motion for Voluntary Remand

We have broad discretion to grant or deny an agency's motion to remand. *See Limnia, Inc. v. Department of Energy*, 857 F.3d 379, 381, 386 (D.C. Cir. 2017). We generally grant an agency's motion to remand so long as "the agency intends

⁵ These challenges encompass the following regulations (or portions thereof): 40 C.F.R. §§ 257.50(c), 257.100 (inactive impoundments); 40 C.F.R. § 257.103(a)(1)(i), (b)(1)(i) (alternative closure requirements); 40 C.F.R. § 257.63(a), (c)(1) (seismic impact zone requirements).

to take further action with respect to the original agency decision on review.” *Id.* (emphasis omitted). Remand has the benefit of allowing “agencies to cure their own mistakes rather than wasting the courts’ and the parties’ resources reviewing a record that both sides acknowledge to be incorrect or incomplete.” *Ethyl Corp. v. Browner*, 989 F.2d 522, 524 (D.C. Cir. 1993). Remand may also be appropriate if the agency’s motion is made in response to “intervening events outside of the agency’s control, for example, a new legal decision or the passage of new legislation.” *SKF USA Inc. v. United States*, 254 F.3d 1022, 1028 (Fed. Cir. 2001) (discussing *National Fuel Gas Supply Corp. v. FERC*, 899 F.2d 1244, 1249 (D.C. Cir. 1990) (*per curiam*)). Alternatively, “even if there are no intervening events, the agency may request a remand (without confessing error) in order to reconsider its previous position.” *Id.* at 1029.

In deciding a motion to remand, we consider whether remand would unduly prejudice the non-moving party. *See FBME Bank Ltd. v. Lew*, 142 F. Supp. 3d 70, 73 (D.D.C. 2015). Additionally, if the agency’s request appears to be frivolous or made in bad faith, it is appropriate to deny remand. *See SKF USA*, 254 F.3d at 1029; *see also Lutheran Church-Missouri Synod v. FCC*, 141 F.3d 344, 349 (D.C. Cir. 1998) (denying FCC’s “novel, last second motion to remand” because it was based on agency’s non-binding prospective policy statement).

To start, we decline the EPA’s request to remand the challenge to the agency’s authority to regulate inactive impoundments so that it can reconsider its interpretation of the statute, for two reasons. First, the EPA’s statutory authority over inactive sites necessarily implicates the Environmental Petitioners’ claim regarding legacy ponds. So, even if Industry Petitioners are willing to go along with a remand, Environmental Petitioners are not and remand would prejudice

the vindication of their own claim. Second, this claim involves a question—the scope of the EPA’s statutory authority—that is intertwined with any exercise of agency discretion going forward. Given that, the EPA has not met its burden of justifying its last-minute request for a remand in this case, and we proceed to the merits on this issue.

The EPA also initially requested a remand of its decision to exclude certain risk-based compliance measures. On July 30, 2018, however, the EPA promulgated amendments to the Final Rule. *See* Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals From Electric Utilities; Amendments to the National Minimum Criteria (Phase One, Part One) (“Final Rule Amendments”), 83 Fed. Reg. 36,435 (July 30, 2018). The Final Rule Amendments provide certain risk-based compliance measures and site-specific engineering certifications. Accordingly, we dismiss as moot Industry Petitioners’ challenge to 40 C.F.R. §§ 257.95(h) and 257.97. *See National Min. Ass’n v. Department of Interior*, 251 F.3d 1007, 1011 (D.C. Cir. 2001) (dismissing challenges as moot due to “substantial changes” in regulations and declaring “[a]ny opinion regarding the former rules would be merely advisory”).

For the remaining requests—(i) the regulation of Coal Residuals piles; (ii) the Proposed Rule’s notice of the Coal Residuals pile regulation; and (iii) the 12,400-ton threshold for beneficial use (and notice thereof)—we grant the EPA’s motion to remand.⁶ First and foremost, the EPA has explained that it plans to reconsider these provisions and has submitted a

⁶ Specifically, we remand without vacating 40 C.F.R. § 257.53 (definition of “beneficial use” and regulation of Coal Residuals “pile”).

proposed timeline to the court, thereby satisfying the requirement for remand that it “take further action with respect to the original agency decision on review.” *Limnia*, 857 F.3d at 386 (emphasis omitted). Second, although the WIIN Act does not affect the validity of the Rule itself, it does provide the EPA with new tools to pursue its regulatory goals. *See* 42 U.S.C. § 6945(d)(4) (incorporating enforcement provisions of Sections 6927 and 6928).⁷

The EPA has explained that the Final Rule was promulgated with the understanding that there would be no regulatory “overseer,” and therefore the Final Rule itself should “account for and be protective of all sites, including those that are highly vulnerable.” 80 Fed. Reg. at 21,311; *id.* (explaining how “the requirement to establish national criteria and the absence of any requirement for direct regulatory oversight” influenced the Final Rule). Although a one-size-fits-all national standard might have been necessary for the self-implementing Final Rule, more precise risk-based standards are both feasible and enforceable under the individualized permitting programs and direct monitoring provisions authorized by the WIIN Act. *See* Oral Arg. Tr. 37:12–37:14 (counsel for EPA explaining that certain provisions of the Final Rule “cry out for site specific enforcement”). Thus, the regulatory tools authorized by the WIIN Act support the EPA’s request to reconsider certain provisions of the Rule. *See SKF USA*, 254 F.3d at 1028.

⁷ On March 23, 2018, the Consolidated Appropriations Act of 2018 was signed into law. Pub. L. NO. 115-141, 132 Stat. 348. It allocates funds to the EPA to “implement[] a coal combustion residual permit program under” the WIIN Act. *Id.* at Division G, Title II. Accordingly, with its recently acquired funding, the EPA is to “implement a permit program” in non-participating states. 42 U.S.C. § 6945(d)(2)(B).

Moreover, the provisions we now remand stand unchallenged on their merits; accordingly, no party will suffer prejudice from remand without vacatur. See *FBMEBank*, 142 F. Supp. 3d at 73. Indeed, at this stage in the litigation, all parties agree that the “beneficial use” and “Coal Residuals pile” provisions should stay in effect—at least until a new rule is promulgated. See EPA Remand Mot. 2 (“EPA seeks remand of these provisions without vacatur, and thus they remain in place and fully applicable[.]”). Moreover, the only parties that object to remand—Environmental Petitioners—did not challenge any of the relevant provisions in their petition; rather they *defended* the provisions as Intervenors. See *generally* Env’tl. Intervenor-Resp’t Br. 14–22. Accordingly, any opinion we issue regarding these provisions would be wholly advisory; it would resolve no active case or controversy and would award no relief. See *Chafin v. Chafin*, 568 U.S. 165, 172 (2013) (case is non-justiciable if court is unable to grant concrete relief to any party).

We conclude that there is no reason to opine on the “beneficial use” and “Coal Residuals pile” provisions that the EPA wants remanded. At oral argument, the court pressed Industry counsel as to why Industry Petitioners did not simply dismiss their petition rather than acquiescing in the EPA’s motion. Oral Arg. Tr. 49–52. Industry counsel did not provide a clear answer. But he did make two concessions: First, he declared that Industry does not oppose remand. *Id.* at 50:16–50:23. Second, he acknowledged, “on a remand * * * the petition * * * is dismissed as a practical matter.” *Id.* at 51:6–51:10 (emphasis added). Counsel is correct in one respect. When combined with the statutory provision requiring any challenge to be brought within 90 days of the Rule’s promulgation, the legal effect of remand without vacatur is simple: The Rule remains in force and Industry Petitioners cannot bring another challenge until and unless the

EPA takes additional regulatory action. 42 U.S.C. § 6976(a)(1) (petition for review “shall be filed within ninety days from the date of* * * promulgation”). In effect, Industry Petitioners have withdrawn their petition with respect to the provisions for which it does not oppose remand.

Accordingly, we deny the EPA’s motion to remand to itself Industry Petitioners’ challenge to the EPA’s regulation of inactive impoundments and Environmental Petitioner’s challenge to the non-regulation of legacy ponds. We otherwise grant the motion to remand without vacatur.

B. Substantive Challenges

After deciding the issue of remand, we are left with Industry Petitioners’ statutory argument and its three APA challenges to the Final Rule.

1. Authority to Regulate Inactive Impoundments

Industry Petitioners first challenge the EPA’s regulatory authority to set any standards at all for inactive impoundments. That claim is without merit. Because those inactive sites house waste in “open dumps,” 42 U.S.C. § 6944, RCRA’s plain text unambiguously confers regulatory authority on the EPA.

By its terms, RCRA empowers the EPA generally to define “which facilities shall be classified as sanitary landfills and which shall be classified as open dumps[.]” 42 U.S.C. § 6944. Section 6943 of RCRA, in turn, incorporates those classification standards into minimum criteria for State regulatory plans. *Id.* § 6943. Those statutory minimums both require States to “provide for the closing or upgrading of all existing open dumps” and prohibit “the establishment of

new open dumps[.]” *Id.* § 6943(a)(2), (3). The statute also provides that, “[a]t a minimum,” the EPA must define sanitary landfills to include only facilities where “there is no reasonable probability of adverse effects on health or the environment from disposal of solid waste[.]” 42 U.S.C. § 6944(a).⁸ In this way, the statute creates a binary world: A facility is a permissible sanitary landfill, or it is an impermissible open dump. The EPA regulates both.

While the statute allows the EPA to establish criteria for distinguishing between “open dumps” and “sanitary landfills,” it also offers some definitions of its own. RCRA defines “open dump” as “any facility or site where solid waste is disposed of which is not a sanitary landfill” or a site regulated under RCRA Subtitle C’s more rigorous hazardous waste provisions. 42 U.S.C. § 6903(14). The statute likewise defines “sanitary landfill” as “a facility for the disposal of solid waste [that] meets the criteria published under section 6944,” *id.* § 6903(26), and that operates in accordance with the “applicable criteria for coal combustion residuals units under” 40 C.F.R. Part 257 or its successor regulations, *id.* § 6945(d)(6).

Finally, RCRA defines “disposal” as “the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water” in a manner by which “such solid waste or hazardous waste or any constituent thereof may enter the environment[.]” 42 U.S.C. § 6903(3).

⁸ As noted earlier, *supra*, Part II, we leave open on remand the definitional and substantive impact on the EPA’s discretion of the WIIN Act’s express incorporation of the extant or successor EPA regulations under 40 C.F.R. Part 257 into the statutory definition of “sanitary landfill.”

Notwithstanding that broad assignment of regulatory authority, *see* 42 U.S.C. § 6912, Industry Petitioners argue that “inactive” impoundments—sites that contain, but no longer receive new, solid waste—cannot be “open dumps” within the EPA’s regulatory ambit. Seizing on the phrase “is disposed of” in the definition of an “open dump,” *id.* § 6903(14), they contend that the site must actively receive new waste to come within the statutory definition of a regulable waste disposal dump. Industry Petitioners also argue that the words used to define “disposal”—“discharge, deposit, injection, dumping, spilling, leaking, or placing,” *id.* § 6903(3)—all require present and ongoing activity.

RCRA’s reach, however, is not so narrow as Industry Petitioners suppose. Rather, a straightforward reading of the statute’s language allows for the regulation of inactive sites.

We start by recognizing that, in RCRA, Congress delegated to the EPA “very broad” regulatory authority over waste disposal. *In re Consolidated Land Disposal Regulation Litig.*, 938 F.2d 1386, 1388 (D.C. Cir. 1991). We therefore review the Industry Petitioners’ challenge under the two-step *Chevron* framework. Under this rubric, if RCRA is unambiguous, its text controls. *See Chevron, U.S.A., Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837, 842–843 (1984); *see also City of Arlington v. FCC*, 569 U.S. 290, 297 (2013) (holding that an agency’s interpretation of the “jurisdictional” reach of its governing statute merits *Chevron* deference). If, on the other hand, the statute is silent or equivocal, we ask only whether the agency has offered a reasonable interpretation of the statute. *Chevron*, 467 U.S. at 843.

Resolution of this issue begins and ends with RCRA’s plain text. The definition of “open dump,” which is the key

term at issue, does not use the word “disposal.” It uses the phrase “is disposed of”: An “open dump” is “any facility or site where solid waste *is disposed of*.” 42 U.S.C. § 6903(14) (emphasis added). To divine its proper meaning, we must interpret the operative phrase “is disposed of” as a whole. Importantly, while the “is” retains its active present tense, the “disposal” takes the form of a past participle (“disposed”). In this way, the disposal itself can exist (it “is”), even if the act of disposal took place at some prior time. See *Florida Dep’t of Revenue v. Piccadilly Cafeterias, Inc.*, 554 U.S. 33, 39 (2008) (describing a past participle as a “verb form” that reaches “past or completed action”) (quoting AMERICAN HERITAGE DICTIONARY 1287 (4th ed. 2000)); *Sherley v. Sebelius*, 644 F.3d 388, 403 n.4 (D.C. Cir. 2011) (Henderson, J., dissenting) (noting that the statute at issue “combine[d] the present tense ‘are’ with the past participle ‘destroyed’” to “signify conduct that ha[d] already occurred”) (citations omitted).⁹

Properly translated then, an open dump includes any facility (other than a sanitary landfill or hazardous waste disposal facility), where solid waste still “is deposited,” “is

⁹ The concurring opinion notes that *Piccadilly Cafeterias* was ultimately resolved as a *Chevron* step two case. Concur Op. 4 n.1. True enough. But before the Court got to the *Chevron* step two stage of its analysis, it first endorsed, as the “more natural reading” of the relevant text, Florida’s construction of the past participle as “unambiguously limit[ing]” certain tax exemptions in bankruptcy proceedings. 554 U.S. at 39, 41. Only then did the Court, for argument’s sake, “assum[e]” that the relevant text were “ambiguous,” and hold that any ambiguity would fall in Florida’s favor. *Id.* at 41. The Court, in short, never found any ambiguity in the past participle’s coverage of “past or completed action[s],” and in fact embraced that more natural meaning. *Id.* at 39. We too give Congress’s adjectival past participle “is disposed of” its natural meaning.

dumped,” “is spilled,” “is leaked,” or “is placed,” regardless of when it might have originally been dropped off. *See* 42 U.S.C. § 6903(3), (14). In other words, the waste in inactive impoundments “is disposed of” at a site no longer receiving new waste in just the same way that it “is disposed of” in a site that is still operating.

Tellingly, not even Industry Petitioners embrace the full import of their interpretation. They agree that previously deposited waste “is disposed of” at an impoundment site, so long as the site is actively accepting new waste. But if EPA’s authority reaches only active disposal, it stands to reason that its authority over the site extends only to that newly deposited (or actively leaking) waste. But Industry Petitioners do not push this point—probably because, as a practical reality, waste is no less “disposed of” at a site the day after operations cease than it was the day before. That is, the waste previously dumped is still currently “placed” or “deposited” there. 42 U.S.C. § 6903(3), (14). In other words, the pile of Coal Residuals retains its regulated status whether or not anyone adds to the pile.

Think of it this way: If a kindergarten teacher tells her students that they must clean up any drink that “is spilled” in the room, that would most logically be understood to mean that a student must clean up her spilled drink even if the spill is already completed and nothing more is leaking out of the carton. A student who refused to clean up that completed spill (as Industry Petitioners would have it) might well find himself on time out.

What’s more, the Industry Petitioners’ reading butts up against the binary world created by the statute. RCRA creates two categories for Subtitle D waste: open dumps and sanitary landfills. Industry Petitioners offer no explanation of where

“inactive” sites fit into their understanding of that landscape. Nor do they explain why, once the last person turns off the lights, Congress’s concern for the substantial health and environmental dangers posed by that pile of toxic waste would completely evaporate. As our concurring colleague aptly notes, “the disposal of [Coal Residuals] in an impoundment is not a discrete act. If it were, the EPA would regulate only the transfer of [Coal Residuals] from a power facility into an impoundment, at which point the ‘disposal’ would end.” Concur Op. at 8.

The concurring opinion spies ambiguity only by splitting the operative verb “is disposed” into two distinctly analyzed parts: “is” and “disposed.” Concur Op. 2–4. But just as courts must not “construe statutory phrases in isolation,” we surely must read a single verb “as a whole” and not in pieces. *United States v. Morton*, 467 U.S. 822, 828 (1984). Even more so, we must give effect to the whole adjectival phrase “is disposed of.” A site where garbage “is disposed of” is the place where garbage is dumped and left. The status of that site does not depend on whether or not more garbage is later piled on top. A garbage dump is a garbage dump until the deposited garbage is gone.

In short, as facilities “where solid waste is disposed of,” 42 U.S.C. § 6903(14), inactive impoundments *are* “open dumps,” unless they fall into one of two statutory exceptions—neither of which the Industry Petitioners claim applies to their inactive impoundments.¹⁰ And no one denies that the EPA has authority to regulate (and to prohibit) “open dumps.”

¹⁰ The two exceptions, which Industry Petitioners do not contend apply here, are for “sanitary landfills,” as defined by the

Instead, the Industry Petitioners point to cases interpreting the term “disposal” in the Superfund statute, 42 U.S.C. § 9601 *et seq.*, to apply only to ongoing disposals. True enough. But those cases turned on the Superfund statute’s different language, which is “at the time of disposal,” not the RCRA phrase “is disposed of.” *See id.* § 9607(a) (responsible persons subject to recovery costs under the Superfund statute include “any person who at the time of disposal of any hazardous substance owned or operated any facility at which such hazardous substances were disposed of”). The specific signification of that language lies at the heart of those court rulings. *See Carson Harbor Vill., Ltd. v. Unocal Corp.*, 270 F.3d 863, 871 (9th Cir. 2001) (“We must decide in this case whether the Partnership Defendants * * * owned the contaminated property ‘at the time of disposal of any hazardous substance.’”) (citing 42 U.S.C. § 9607(a)(2)).¹¹

The Superfund statute also contains an “innocent landowner” defense by which a person can avoid liability if “the disposal or placement of the hazardous substance” occurred prior to that party’s acquisition of the property. 42 U.S.C. § 9601(35)(A). That strengthens the notion that “at the time of disposal,” as used in the Superfund statute, is time-

EPA, 42 U.S.C. § 6944, and sites housing “hazardous” waste regulated separately under RCRA Subtitle C, *id.* § 6921 *et seq.*

¹¹ *See also ABB Indus. Sys., Inc. v. Prime Tech., Inc.*, 120 F.3d 351, 356 (2d Cir. 1997) (“Under [the Superfund statute], a prior owner or operator is a responsible party if it controlled the site ‘at the time of disposal’ of a hazardous substance.”); *United States v. CDMG Realty Co.*, 96 F.3d 706, 712–713 (3d Cir. 1996) (“HMAT contends that Dowel is liable as a person who owned or operated the facility ‘at the time of disposal’ of a hazardous substance.”); *Joslyn Mfg Co. v. Koppers Co.*, 40 F.3d 750, 760 (5th Cir. 1994) (similar).

dependent and refers to the act of placing the waste in the holding site. *See Carson Harbor Vill.*, 270 F.3d at 882. RCRA's distinct language comes with no such limiting textual indicia.

In short, the fundamental flaw in the Industry Petitioners' effort to limit EPA regulation to active impoundments is that they focus on the wrong text. For all their efforts to explain the meaning of the single word "disposal," they fail to grapple with the full phrase "is disposed of." RCRA is explicit that inactive sites may qualify as open dumps if they are facilities where waste "is disposed of," regardless of whether they are also facilities where more "disposal" continues to occur. As is often true in statutory interpretation, the words make all the difference.

Even if the text were ambiguous, the EPA's interpretation is eminently reasonable under *Chevron* step two. First, the same reasons supporting our interpretation of the plain statutory text demonstrate with even greater force the reasonableness of the EPA's interpretation.

Second, the EPA's interpretation directly advances RCRA's stated regulatory purpose. RCRA directs the EPA to develop standards that limit permissible waste sites "[a]t a minimum" to those with "no reasonable probability of adverse effects on health or the environment from disposal of solid waste[.]" 42 U.S.C. § 6944(a). No one denies that inactive impoundments can have significant adverse environmental and health effects. In fact, the EPA persuasively explains that inactive sites often pose even greater health risks given their age and accompanying deterioration. 80 Fed. Reg. at 21,343 (indicating that "the risks are primarily driven by the older existing units"); *see also id.* (noting that leaks into the Dan

River from an inactive impoundment occasioned publication of this very Rule).

The EPA's construction of the text is thus consistent with a straightforward reading of statutory text and RCRA's central purpose. See *In re Consolidated Consol. Land Disposal Regulation Litig.*, 938 F.2d at 1389 (EPA's reading of the term "disposal" in RCRA's Subtitle C, 42 U.S.C. § 6924, to include "the continuing presence of waste" was reasonable under *Chevron* step two).

For all of those reasons, the Industry Petitioners' attempt to confine the EPA's authority to only active impoundments fails.

2. Notice Challenge to Aquifer Requirements

Under 5 U.S.C. § 553, an agency is required to give notice of a proposed rule and allow interested parties to comment on the rule before it is promulgated. Although the final rule need not be identical to the proposed rule, it must be the "logical outgrowth" thereof. *Shell Oil Co. v. EPA*, 950 F.2d 741, 747 (D.C. Cir. 1991) (per curiam). "A rule is deemed a logical outgrowth if interested parties 'should have anticipated' that the change was possible, and thus reasonably should have filed their comments on the subject during the notice-and-comment period." *Northeast Md. Waste Disposal Auth. v. EPA*, 358 F.3d 936, 952 (D.C. Cir. 2004) (per curiam) (citing *City of Waukesha v. EPA*, 320 F.3d 228, 245 (D.C. Cir. 2003)).

The Final Rule requires that all surface impoundments be located no fewer than five feet above the uppermost aquifer or, alternatively, that the owner or operator of the impoundment demonstrate that the impoundment will not be subject to a hydraulic connection with the groundwater supply as

groundwater levels fluctuate over the course of the year.¹² 40 C.F.R. § 257.60(a); *see* 80 Fed. Reg. at 21,361. Industry Petitioners argue that the EPA did not give adequate notice that this provision would apply to *existing* surface impoundments because the proposed regulation applied only to “[n]ew [Coal Residuals] landfills and new [Coal Residuals] surface impoundments[.]” 75 Fed. Reg. at 35,241.¹³

The Industry Petitioners’ argument ignores the plain language of the preamble to the Proposed Rule, which declares: “[b]y contrast [to landfills] * * * the proposed regulations would apply all of the location restrictions to *existing* surface impoundments.” 75 Fed. Reg. at 35,198 (emphasis added). This is exactly what the Final Rule prescribes. *See* 40 C.F.R. § 257.60. Indeed, the Rule is not only the “logical outgrowth” of the Proposed Rule; it faithfully tracks the goals set forth in the preamble. *See Shell Oil Co.*, 950 F.2d at 747. The preamble—and the Proposed Rule as a whole—advised the

¹² A “hydraulic connection” means a connection between the [Coal Residuals] unit and the underground water table. 80 Fed. Reg. at 21,362. The EPA received comments explaining that “fluctuations in groundwater levels in many geological settings can exceed ten feet over the course of the year.” *Id.* at 21,361. To account for this change in aquifer levels, the EPA revised its definition of “uppermost aquifer” to “specify that the measurement of the upper limit of the aquifer must be made at a point nearest to the natural ground surface to which the aquifer rises during the wet season.” *Id.* at 21,362.

¹³ In the preamble to the Final Rule, the EPA acknowledged that, “[i]n the proposed rule, the regulatory language should have included ‘all surface impoundments’ as opposed to only ‘new surface impoundments.’” 80 Fed. Reg. at 21,360.

public that the EPA was at least *considering* applying the aquifer restrictions to existing impoundments, thereby inviting Industry's comments on the topic. *Id.*¹⁴

3. Seismic Impact Zone Criteria

The Final Rule contains two seismic impact requirements. First, the Rule imposes safety assessment criteria on surface impoundments over a specific size. 40 C.F.R. § 257.73(e). These criteria had an implementation deadline of October 17, 2016. *Id.* § 257.73(f). Because the compliance deadline lapsed before oral argument, Industry Petitioners voluntarily dismissed this challenge. *See* Sept. 27, 2017 Per Curiam Order Granting Motion to Dismiss.

Second, every new Coal Residual landfill and landfill expansion, as well as any new and existing surface

¹⁴ Although the EPA may not “bootstrap notice from a comment,” the sheer volume of Industry Petitioners’ comments on this very provision confirms that notice was adequate. *Fertilizer Inst. v. EPA*, 935 F.2d 1303, 1312 (D.C. Cir. 1991) (internal quotation marks omitted). The EPA explains: “Overwhelmingly, the issue receiving the most comment was EPA’s intention to subject existing [Coal Residuals] surface impoundments to all of the new location criteria.” 80 Fed. Reg. at 21,360. Industry Petitioners’ comments confronted the aquifer location restrictions, including their applicability to existing surface impoundments, head-on. *See, e.g.*, Comments of the Utility Solid Waste Activities Group on Proposal, Nov. 19, 2010, J.A. 775 (“EPA states in the preamble to the proposal that it intends to subject existing surface impoundments to all of these new location restrictions* * *.”) (emphasis omitted). When combined with the clarity of the preamble, Industry Petitioners’ comments illustrate that it was both aware of, and troubled by, the aquifer restrictions.

impoundment, is subject to location restrictions that prohibit operation in a “seismic impact zone”¹⁵ unless the facility demonstrates that it has the appropriate structural components, including liners, leachate collection and removal systems and surface water control systems. 40 C.F.R. § 257.63(a). For existing surface impoundments, the deadline for demonstrating compliance with the Rule is October 17, 2018—four and one-half years after the Rule was promulgated. *Id.* § 257.63(c)(1).

Industry Petitioners attack the seismic impact zone requirements on three fronts; they argue that the EPA was arbitrary and capricious in: (i) shortening the operating life for existing impoundments from five years to four years; (ii) applying the seismic impact zone location restriction to new Coal Residual landfills and landfill expansions; and (iii) regulating the structure of Coal Residual landfills based on a 2,500-year seismic event. The parties brief these three issues separately, and we likewise address—but reject—each of Industry Petitioners’ challenges in turn.

a. Operating Expiration

Industry Petitioners argue that, although the Proposed Rule had a five-year operating expiration for impoundments, the Final Rule arbitrarily reduced that window to four years. Industry Pet’rs’ Br. 45. As a corollary, Industry Petitioners argue that four years is not enough time for impoundment owners and operators to switch from wet to dry Coal Residuals disposal. Industry Pet’rs’ Reply Br. 21–22.

¹⁵ “Seismic impact zone means an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth’s gravitational pull (g), will exceed 0.10 g in 50 years.” 40 C.F.R. § 257.53.

Industry Petitioners' arguments misconstrue both the Proposed Rule and the Final Rule. The section of the Proposed Rule that Industry Petitioners cite for the five-year deadline (proposed 40 C.F.R. § 257.65(a)) *does not apply* to the seismic impact zones; instead, it applies to "unstable areas." *See* 75 Fed. Reg. at 35,242–35,243. Indeed, the Proposed Rule does not prescribe an explicit operating deadline for seismic impact zones at all.

Moreover, even assuming the proposed five-year deadline for "unstable areas" applies to seismic impact zones, the Proposed Rule reads: "Existing [Coal Residuals] landfills and surface impoundments that cannot make the demonstration * * * must close by [date five years after the effective date of the final rule]." 75 Fed. Reg. at 35,242 (brackets in original). The "must close by" language in the Proposed Rule is different from the language of the Final Rule, which demands only that the regulated facility "complete the demonstration [that the site has met the relevant structural requirements] no later than October 17, 2018." 40 C.F.R. § 257.63(c)(1). Contrary to Industry Petitioners' representation, then, the Final Rule gives the disposal sites four years before they must demonstrate compliance. *See id.* Only if they *fail* in that demonstration must they begin the closure process. *Id.* And once the closure process begins, they have at least five years to complete it. *See id.* § 257.102(f)(1)(ii).¹⁶

¹⁶ Manifesting additional flexibility, the Final Rule's closure timeframe may be extended up to ten years (in consecutive two-year periods) "if the owner or operator can demonstrate that it was not feasible to complete closure of the [Coal Residuals] unit within the required timeframes due to factors beyond the facility's control." *Id.* § 257.102(f)(2)(i)–(2)(ii)(B). Accordingly, in some circumstances the impoundment need not complete the closure process until *19 years* after the Rule's enactment date.

Once the Rule's timeline is correctly understood, there is nothing in the record to suggest the Rule's operating deadline is arbitrary and capricious. Indeed, Industry's comments confirm that the Rule's timeline will provide a sufficient period for a non-compliant facility to close (within nine years, and more if it meets the extension requirements). *See, e.g.*, Comments of American Elec. Power Co. on Proposal at 5, J.A. 581 (“[A]t some locations, it will take at least four years from the time the new [Coal Residuals] rule becomes effective to accomplish the wet-to-dry conversion and to accomplish the switch to dry.”); Comments of SCANA Corp. on Proposal at 7, J.A. 579 (“The time frame required to site, design, permit, and construct a landfill in today’s regulatory environment is at least 5 to 10 years.”). The EPA’s conclusions are consistent with Industry Petitioners’ comments. *See* 75 Fed. Reg. at 35,202 (“[Under Subtitle C,] EPA believes that five years will, in most cases, be adequate time to complete proper and effective facility closure and to arrange for alternative waste management * * *. EPA is aware of no reason that the time frames would need to differ under subtitle D * * *.”). In sum, we conclude that the EPA’s operating timeline is not arbitrary and capricious.

b. Seismic Restrictions for New Landfills

The seismic location restrictions apply to impoundments as well as new landfills and landfill expansions, but they do not apply to existing landfills. 40 C.F.R. § 257.63(a). This distinction reflects, *inter alia*, the EPA’s determination that “the risks associated with [Coal Residuals] surface impoundments are substantially higher than the risks associated with [Coal Residuals] landfills, by approximately an order of magnitude.” 80 Fed. Reg. at 21,360. Industry Petitioners argue that, if landfills are universally less dangerous

than surface impoundments, they should not be subject to the same seismic standard as surface impoundments. In other words, the argument goes, if it is acceptable to exempt existing landfills from the seismic location restrictions, it is acceptable to exempt new landfills as well. Because Industry Petitioners failed to make this argument before the EPA, however, we reject it.¹⁷

“Under ordinary principles of administrative law a reviewing court will not consider arguments that a party failed to raise in timely fashion before an administrative agency.” *Sims v. Apfel*, 530 U.S. 103, 114 (2000) (Breyer, J., dissenting); accord *Natural Resource Def Council, Inc. v. EPA*, 25 F.3d 1063, 1073 (D.C. Cir. 1994) (“We do not reach the merits of this challenge because petitioners failed to raise this question of statutory and regulatory construction before the agency during the notice and comment period. They have therefore waived their opportunity to press this argument in court.”); see discussion, *supra*, at 33.

This fundamental principle of administrative law applies squarely to Industry Petitioners’ challenge. *Natural Resource Def Council*, 25 F.3d at 1073. In the Proposed Rule, the EPA explained that, because many Coal Residuals disposal sites are within seismic impact zones, it was “concerned that such facilities would be unable to meet the requirements, because retrofitting would be prohibitively expensive and technically very difficult in most cases, and [they] would therefore be forced to close.” 75 Fed. Reg. at 35,198. Accordingly, the EPA sought comments on “the number of existing [Coal Residuals] landfills located in these sensitive areas” and the

¹⁷ The EPA makes its failure-to-exhaust argument in its opening brief. Rep’t Br. 71–72. Industry’s reply brief offers no rebuttal. See generally Industry Pet’r’s Reply Br.

corresponding effect their closure would have on the national disposal capacity. 80 Fed. Reg. at 21,360. In spite of the invitation to comment, Industry Petitioners cannot point to any record evidence that they questioned the application of the Rule to new Coal Residuals landfills.¹⁸

Put differently, the EPA did not address the argument that new Coal Residuals landfills or landfill expansions should be exempted because the public comments gave no reason to question the position it announced in the Proposed Rule. “Indeed, the notion that a yet-to-be built landfill need *not* comply with basic seismic location restrictions that are designed to avoid the potentially catastrophic events identified in the record, borders on irrational.” Resp’t Br. 73. In light of Industry Petitioners’ failure to alert the EPA to the issue while the latter was promulgating the Final Rule, we decline reach it.

c. The 2,500-Year Standard

Both the seismic location restrictions and the seismic safety assessment criteria incorporate a 2,500-year standard. 80 Fed. Reg. at 21,384. This means a disposal site in a seismic impact area must be designed to withstand the maximum expected impact of a 2,500-year earthquake. *Id.* In establishing the 2,500-year standard, the EPA considered multiple engineering sources, including (i) *Federal Guidelines for Dam Safety: Earthquake Analyses and Design of Dams*,

¹⁸ Instead, comments focused on the non-regulation of *existing* landfills, responding to the Proposed Rule’s conclusion that applying the seismic location restrictions to existing Coal Residuals landfills could cause “disposal capacity shortfalls * * * [that] raise greater environmental and public health concerns than the potential failure of the [Coal Residuals] landfills in these locales.” 80 Fed. Reg. at 21,360.

issued by the Federal Emergency Management Agency (FEMA), and (ii) *Minimum Design Loads for Buildings and Other Structures*, International Building Code, a publication of the American Society of Civil Engineers (ASCE). 80 Fed. Reg. at 21,384; *id.* at 21,384–21,385 nn.98–99. The EPA also consulted geological sources, including the criteria of the National Earthquake Hazards Reduction Program (NEHRP) of the U.S. Geological Survey. 75 Fed. Reg. at 35,201. Further, the Final Rule’s 2,500-year standard precisely mirrors the EPA’s regulations governing municipal solid waste management. 75 Fed. Reg. at 35,193 (referencing 40 C.F.R. § 258.18).

In light of the engineering, geological and regulatory sources informing and supporting the 2,500-year standard, Industry Petitioners face an uphill battle. They nonetheless challenge the application of the seismic location restrictions to landfills—as opposed to impoundments—because landfills pose comparatively fewer risks than impoundments. Thus, although FEMA’s dam safety guidelines are applicable to dam-like impoundments structures, ASCE’s International Building Code is applicable to buildings, and EPA’s municipal landfill regulations are applicable to urban landfills, Industry Petitioners argue that Coal Residuals landfills are different and should be subject to a less demanding standard. In short, it asserts that the rule is overprotective and therefore arbitrary and capricious. We disagree.

Industry Petitioners’ argument rests on the assumption that the EPA adopted the 2,500-year standard “without explanation.” Industry Pet’rs’ Br. 48. To the contrary, the EPA first examined the structures of municipal landfills and concluded that they were “very similar to those found at [Coal Residuals] disposal facilities, and the regulations applicable to such units would be expected to address the risks presented by

the constituents in [Coal Residuals] wastes.” 75 Fed. Reg. at 35,193 (referencing 40 C.F.R. § 258.18). It then cross-referenced the 2,500-year standard with the criteria adopted by the U.S. Geological Survey and other engineering experts before adopting the Final Rule. *Id.* at 35,201. Indeed, some Industry members conceded that “the NEHRP/USGS 2%PE/50y [2,500-year] standard provides a sufficient margin of safety.” Comments of the Southern Company at 34, J.A. 481. Industry Petitioners may disagree, but the EPA’s reasoning was fully explained and is supported by the record.

Conversely, Industry Petitioners have not cited any record evidence that either challenges or provides an alternative to the 2,500-year standard. The best they can do is highlight comments stating generally that the rule is “overly protective.”¹⁹ Industry Pet’rs’ Br. 47–48. This broad stroke

¹⁹ Industry Petitioners claim that one commenter suggested a 250-year standard. *See* Comments of FirstEnergy Corp. at 11, J.A. 598. Again, Industry Petitioners misread the record. FirstEnergy’s comment declares:

EPA intends to incorporate seismic performance in section 257.63 of the proposed rule. One alternative suggested by EPA is the use of seismic impact zones. A second alternative suggests adopting criteria of the National Earthquake Hazards Reduction Program (NEHRP) of the U.S. Geological Survey, which was used to develop national seismic hazard maps. It appears the horizontal acceleration expressed as 0.01g in 250 years in the agency’s first approach closely matches the 2% ground motion probability in 50 years that the seismic maps are based upon.

does not carry their argument very far. Once the EPA selected the Subtitle D rather than the Subtitle C regulatory path, it was charged with developing uniform national standards rather than implementing a site-specific permit program. *See generally* 42 U.S.C. § 6944(a) (requiring EPA to develop minimum criteria for all disposal sites). Consistent with that mandate, the EPA developed criteria for all climates and conditions within seismic impact zones. Accordingly, it is of no moment that the criteria might be “overprotective” for a western landfill located miles from any water source. *See* Comments of Electric Power Research Institute on Proposal at 89, J.A. 596 (explaining that “cap and liners” may not be necessary in “western areas where * * * the total rainfall is less than 10 inches per year”). Congress demanded national minimum standards that ensure “no reasonable probability of adverse effects on health or the environment.” 42 U.S.C. § 6944(a). The 2,500-year standard does just that.

4. The Alternative Closure Option

RCRA states in plain terms that the “open dumping of solid waste * * * is prohibited.” 42 U.S.C. § 6945(a). Thus, if a disposal site is classified as an open dump, it must either retrofit or close. *See id.* The Final Rule stays true to the statutory mandate. Under the Final Rule, certain events—such as groundwater sampling that reveals an excess of Coal Residuals constituents in the water table—establish the disposal site as an “open dump,” which triggers the Rule’s closure requirements. 40 C.F.R. § 257.101. If the closure

Id. Thus, the “250 years” corresponds to the horizontal acceleration rate rather than a “ground motion probability” calculation such as the one upon which the 2,500-year model is based (2% in 50 years = 100% in 2,500 years). It is not a free-standing 250-year standard. That is, FirstEnergy does not appear to offer an alternative standard.

requirements are triggered, the surface impoundment or landfill ordinarily has six months to either retrofit its facility or to stop receiving Coal Residuals and to begin the closure process. *Id.* §257.101(a)(2), (4). In other words, the statutory (and regulatory) presumption is that a non-compliant disposal site—one that is polluting the groundwater—will close. *Id.*

Notwithstanding this presumption, the Rule includes an “alternative closure” exemption that allows a non-compliant Coal Residuals disposal site (an “open dump”) to receive Coal Residuals for an additional five years before it ceases operations. 40 C.F.R. § 257.103. In order to qualify for the alternative closure exception, the owner or operator must certify that, *inter alia*: “No alternative disposal capacity is available on-site or off-site.” *Id.* § 257.103(a)(1)(i). In making the certification, “[a]n increase in costs or the inconvenience of existing capacity is not sufficient to support qualification under this section.” *Id.*

Describing the rationale for its alternative closure exemption, the EPA explained that it did not want to force facilities to close and create power shortages “because there is no place in which to dispose of the resulting waste.” 80 Fed. Reg. at 21,423. The preamble includes an example: “[W]hile it is possible to transport dry ash off-site to [an] alternate disposal facility[,] that simply is not feasible for wet-generated [Coal Residuals]. Nor can facilities immediately convert to dry handling systems. As noted previously, the law cannot compel actions that are physically impossible.” *Id.*

Industry Petitioners argue that ignoring costs and inconvenience in the alternative disposal criteria is arbitrary and capricious because it effectively renders the exemption a nullity: “If costs or inconvenience cannot be evaluated, off-

site disposal capacity—no matter where it is located or how much it will cost to send [Coal Residuals] there—will always be ‘available’ somewhere.” Industry Pet’rs’ Br. 38–39. At oral argument, Industry Petitioners lamented that they might be required to hire a fleet of 1,000 vacuum trucks in order to transfer wet Coal Residuals to an off-site disposal facility. Oral Arg. Tr. 23:22–23:23. This result, it argues, would make nonsense of the alternative closure requirements.

Industry Petitioners’ hyperbole faces a roadblock. As the United States Supreme Court has explained, if the Congress directs the EPA to “regulate on the basis of a factor that on its face does not include cost, the Act normally should not be read as implicitly allowing the agency to consider cost anyway.” *Michigan v. EPA*, 135 S. Ct. 2699, 2709 (2015) (citing *Whitman v. American Trucking Ass ’ns*, 531 U.S. 457, 469–472 (2001)). Applying this rule, the Court held that the EPA is prohibited from considering costs when developing its primary ambient air quality standards under the Clean Air Act because the statute does not mention costs but instead demands standards “requisite * * * to protect the public health with an adequate margin of safety.” *American Trucking*, 531 U.S. at 475–476 (quoting 42 U.S.C. § 7409(b)(1)). Thus, “public health” provided the statutory measuring stick in that instance, notwithstanding flexible words such as “requisite” and “adequate” that the trucking industry suggested might allow the agency to consider costs. *Id.* at 468.

Simply put, “to prevail in their present challenge, [Industry] must show a textual commitment of authority to the EPA to consider costs.” *American Trucking*, 531 U.S. at 468. Under any reasonable reading of RCRA, there is no textual commitment of authority to the EPA to consider costs in the

open-dump standards.²⁰ RCRA's statutory language instructs the EPA to classify a disposal site as a sanitary landfill and not an open dump only "if there is no reasonable probability of *adverse effects on health or the environment* from disposal of solid waste at such facility." 42 U.S.C. § 6944(a) (emphasis added). There is no explicit mention of costs in section 6944; nor is there any flexible language such as "appropriate and necessary" that might allow the EPA to consider costs in its rulemaking. See *Michigan v. EPA*, 135 S. Ct. at 2709. This stands in stark contrast with other sections of Title 42—such as the Bevill Amendment—where the Congress expressly required the EPA to consider, *inter alia*, "the costs of * * * alternatives" in determining whether Coal Residuals should be classified as hazardous waste. See 42 U.S.C. § 6982(n)(6).

With *Michigan v. EPA* and *American Trucking*, then, it is far from clear that the EPA could consider costs even if it wanted to. See *Michigan v. EPA*, 135 S. Ct. at 2707 (explaining that "appropriate and necessary" language could require consideration of costs in some contexts but not others). In any case, there is no statutory support for the assertion that EPA was *required* to consider costs in developing its alternative closure plan. Excluding consideration of costs and convenience may narrow the alternative closure exemption but *including* cost and convenience would appear to violate RCRA's statutory mandate and run afoul of Supreme Court precedent. The EPA was neither arbitrary nor capricious in its decision to avoid testing that legal limit.

²⁰ At oral argument, neither Industry Petitioners nor the EPA could identify a statutory provision that allows the EPA to consider costs. Oral Arg. Tr. 83:15–83:23; 116:02–116:10.

V. Conclusion

In sum, we deny the EPA's motion for us to hold these petitions in abeyance. We grant in part the EPA's motion for a voluntary remand, remanding to the EPA the provisions in the Final Rule pertaining to (i) the definition of "Coal Residuals Piles," *see* 40 C.F.R. § 257.53; (ii) the 12,400-ton beneficial use threshold, *see id.*; and (iii) the alternative groundwater protection standards, *see id.* § 257.95(h)(2). We deny the EPA's motion to remand the provisions in the Final Rule pertaining to inactive surface impoundments and landfills at active power plants, *see id.* §§ 257.50(c), 257.100, and inactive surface impoundments at inactive power plants, *see id.* § 257.50(e).

On the claims raised by Environmental Petitioners, we hold that the EPA acted arbitrarily and capriciously and contrary to RCRA in failing to require the closure of unlined surface impoundments, in classifying so-called "clay-lined" impoundments as lined, and in exempting inactive surface impoundments at inactive power plants from regulation. We therefore vacate and remand the provisions of the Final Rule that permit unlined impoundments to continue receiving coal ash unless they leak, *see id.* § 257.101(a), classify "clay-lined" impoundments as lined, *see* 40 C.F.R. § 257.71(a)(1)(i), and exempt from regulation inactive impoundments at inactive facilities, *see* 40 C.F.R. § 257.50(e). We reject as forfeited Environmental Petitioners' challenges to the Final Rule's public notice provisions.

Regarding the Industry Petitioners' claims, we hold that (i) the EPA has statutory authority to regulate inactive impoundments; (ii) the EPA provided sufficient notice of its intention to apply the aquifer location criteria to existing impoundments; (iii) the EPA did not arbitrarily issue location

requirements based on seismic impact zones; and finally (iv) the EPA did not arbitrarily impose temporary closure procedures. As to the regulation of Coal Residuals piles of 12,400 tons or more and the regulation of Coal Residuals destined for beneficial use, we remand to the agency as requested. We dismiss as moot the two accompanying notice challenges and the issue of risk-based compliance alternatives.

So ordered.

1

KAREN LECRAFT HENDERSON, *Circuit Judge*, concurring in part and concurring in the judgment in part: A central question before us is whether the EPA exceeded its statutory authority under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6901 *et seq.*, by applying its Final Rule, 80 Fed. Reg. 21,302 (Apr. 17, 2015), to an impoundment that no longer receives coal combustion residuals (CCR) after the effective date of the Rule and thus becomes “inactive.” The answer to this question turns on our interpretation of the statutory phrase “is disposed of.” My colleagues conclude that the verb “to be,” when conjugated in the present tense (“is”), *unambiguously* applies to disposal that occurred entirely in the past. I disagree and accordingly concur in the judgment with respect to Section IV.B.1 of the opinion. I join all other sections of the *per curiam* opinion in full.

I.

I believe there are three tiers to the statutory question. First, RCRA directs the EPA to promulgate regulations that draw a dividing line between “sanitary landfills” and “open dumps.” 42 U.S.C. §§ 6944-45. Generally speaking, a sanitary landfill is a disposal site that complies with the EPA’s regulations and presents “no reasonable probability of adverse effects on health or the environment.” *Id.* § 6944(a). By contrast, “any solid waste management practice or disposal of solid waste . . . which constitutes the open dumping of solid waste or hazardous waste is prohibited.” *Id.* § 6945(a). Second, RCRA defines an “open dump” as “any facility or site where solid waste *is disposed of* which is not a sanitary landfill which meets the criteria promulgated under [§ 6944].” *Id.* § 6903(14) (emphasis added). Third, RCRA defines “disposal” as

the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste

or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters.

Id. § 6903(3).

To interpret RCRA's text, we turn to the familiar two-step framework of *Chevron, U.S.A., Inc. v. Natural Resources Defense Council, Inc.*, 467 U.S. 837 (1984). Thus, we begin with the statutory language and ask whether the Congress "has directly spoken to the precise question at issue." *Id.* at 842. If the language is plain, our inquiry ends, as we must "give effect to the unambiguously expressed intent of Congress." *Id.* at 843. If "the statute is silent or ambiguous with respect to the specific issue," however, we defer to the EPA's interpretation so long as it is "based on a permissible construction of the statute." *Id.*

We do not alter our analytical framework when the case presents a question of an agency's "jurisdiction" or core statutory authority. *City of Arlington v. FCC*, 569 U.S. 290, 297 (2013) ("[T]he distinction between 'jurisdictional' and 'nonjurisdictional' interpretations is a mirage."). If "the reality is that [the statute] is ambiguous," it is our duty to declare it so and proceed to the second step of the *Chevron* analysis. *AT&T Corp. v. Iowa Utils. Bd.*, 525 U.S. 366, 395 (1999).

II.

I believe the text—and more precisely, the grammatical structure—of RCRA's definition of "open dump" is temporally ambiguous. See *United States v. Wilson*, 503 U.S. 329, 333

(1992) (“Congress’ use of a verb tense is significant in construing statutes.”). Under RCRA, an “open dump” is a site where solid waste “is disposed of.” 42 U.S.C. § 6903(14). The operative verb is the present tense of the infinitive “to be” (“is”). The Dictionary Act tells us that “unless the context indicates otherwise . . . words used in the present tense include the future as well as the present.” 1 U.S.C. § 1. By implication, therefore, the Dictionary Act “instructs that the present tense generally does not include the past.” *Carr v. United States*, 560 U.S. 438, 448 (2010). It is plain, therefore, that “is” does not mean “was.”

The verb’s present tense formation takes on additional meaning because the “Congress could have phrased its requirement in language that looked to the past . . . but it did not choose this readily available option.” *Gwaltney of Smithfield, Ltd. v. Chesapeake Bay Found., Inc.*, 484 U.S. 49, 57 (1987). It could have conjugated the infinitive “to be” in any number of ways to unambiguously include past disposal: “is or was disposed of”; “had been disposed of”; or “has been disposed of.” See CHICAGO MANUAL OF STYLE ONLINE §§ 5.118-35 (17th ed. 2017), available at www.chicagomanualofstyle.org//home.html (explaining tenses generally). The Congress could also have included unambiguous temporal phrases such as: “ever”; “at any time”; “past or present”; or “beginning on a date certain.” It did not do so. The present tense of section 6903(14) therefore suggests that an “open dump” does not include any impoundment where solid waste “*was* disposed of.”

Significantly, the Congress used temporally unambiguous language in other RCRA provisions. For example, RCRA’s “substantial endangerment” provision plainly applies to past actions; it allows a state or individual to bring suit against “any person . . . *who has contributed or who is contributing* to the

past or present . . . disposal of any solid or hazardous waste which may present an imminent and substantial endangerment to health or the environment.” 42 U.S.C. § 6972(a)(1)(B) (emphases added). RCRA Subtitle C provides that the EPA must conduct “corrective action for all releases of hazardous waste or constituents from any solid waste management unit . . . *regardless of the time at which waste was placed in such unit.*” *Id.* § 6924(u) (emphasis added). I believe there can be no reasonable dispute that these provisions apply to past as well as present and future actions. By itself, therefore, “is” at least suggests that the EPA is *precluded* from including past acts of disposal in the definition of an “open dump.”

The ambiguity comes from the second part of the phrase: “disposed of.” A past participle like “disposed” is not singular in its purpose; it is defined as “[a] verb form indicating past or completed action or time that is used as a verbal adjective in phrases such as baked beans and finished work.” *Fla. Dep’t of Revenue v. Piccadilly Cafeterias, Inc.*, 554 U.S. 33, 39 (2008) (quoting AMERICAN HERITAGE DICTIONARY 1287 (4th ed. 2000) (emphasis removed)). In other words, a past participle can serve either as a verb (*i.e.*, the pecans *were covered* in chocolate) or as an adjective (*i.e.*, the chocolate-*covered* pecans). Moreover, in verb form, a past participle can indicate past (*i.e.*, the pecans *were* covered in chocolate), present (*i.e.*, the pecans *are* covered in chocolate) or future action (*i.e.*, the pecans *will be* covered in chocolate). In short, there is nothing unambiguous about a past participle, at least when construed without context.²¹

²¹ My colleagues cite two authorities for their conclusion that a statutory past participle *unambiguously* signifies retroactive effect. Neither authority decides the issue. First, in *Florida Department of Revenue v. Piccadilly Cafeterias, Inc.*, 554 U.S. 33, 41 (2008), the

I believe “disposed of” must be read in conjunction with RCRA’s definition of “disposal,” which includes the “discharge, deposit, injection, dumping, spilling, leaking, or placing” of solid waste into certain areas. 42 U.S.C. § 6903(3). Circuit courts disagree about whether “disposal” includes the “passive migration” of contaminants, such as a slow leak from an inactive CCR impoundment. Compare *Carson Harbor Vill., Ltd. v. Unocal Corp.*, 270 F.3d 863, 867 (9th Cir. 2001) (en banc) (concluding that “the migration of contaminants on the property does not fall within the statutory definition of ‘disposal’”), with *Nurad, Inc. v. William E. Hooper & Sons Co.*, 966 F.2d 837, 846 (4th Cir. 1992) (holding past owners liable for “disposal” of hazardous wastes that

Supreme Court assumed the statute at issue was temporally ambiguous and resolved the interpretive question at *Chevron’s* second step. Moreover, in *Sherley v. Sebelius*, the majority found ambiguity in a statute that prohibited funding for “research in which a human embryo or embryos are destroyed.” 644 F.3d 388, 390 (D.C. Cir. 2011) (emphasis added) (internal quotation marks omitted). It did so in spite of applicable regulations defining research as “a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge.” *Id.* at 394 n.* (quoting 45 C.F.R. § 46.102(d)). Notwithstanding this temporally broad definition, the majority declared that the “definition of research is flexible enough to describe either a discrete project or an extended process.” *Id.* at 394. I dissented, challenging the majority’s interpretive fallacy that “research” can be dissected into “free-standing pieces” rather than read as a “systematic [and ongoing] investigation.” *Id.* at 402-04 (Henderson, J., dissenting). Thus, I did not find the phrase “are destroyed” unambiguous standing alone; in my view, the explicit connection to research funding—and the correct definition of “research”—clarified the temporal scope of the statute to include past conduct. *Id.*

leaked from underground storage tank notwithstanding they were not owners “at the time of disposal”). Because these cases arise in a different statutory context,²² they are not precisely on point regarding the question of the EPA’s authority to regulate inactive impoundments. Nonetheless, they illustrate the ambiguity in the statutory definition of the word “disposal”; if courts disagree about the meaning of “disposal,” that disagreement strongly suggests there is ambiguity in the words “disposed of.” See Final Rule, 80 Fed. Reg. at 21,346 (surveying caselaw interpreting “disposal”).

Although there is some temporal tension between the present tense “is” and the past participle “disposed,” it can be explained by statutory context. See *Brown v. Gardner*, 513 U.S. 115, 118 (1994) (“Ambiguity is a creature not of definitional possibilities but of statutory context.”). Industry’s entire argument hinges on three words—“is disposed of”—in the definition of “open dump.” 42 U.S.C. § 6903(14). But “open dump” is also defined by what it is not: a “sanitary landfill.” *Id.* The statutory categorization is binary: a disposal site is either a sanitary landfill or an open dump and the EPA is directed to promulgate regulations that distinguish between the two. *Id.* § 6944. Thus, as the EPA promulgates new regulations that may shift the contours of what constitutes a “sanitary landfill,” see 42 U.S.C. § 6912(b) (RCRA regulations “shall be reviewed and, where necessary, revised not less frequently than every three years”), the definition of “open dump” will morph as well, see *Appalachian Voices v. McCarthy*, 989 F. Supp. 2d 30, 56 (D.D.C. 2013) (“requir[ing] the EPA to submit a proposed scheduling order setting forth a proposed deadline by which it will comply with

²² The cited cases interpret the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), which incorporates RCRA’s definition of “disposal.” 42 U.S.C. § 9601(29) (incorporating 42 U.S.C. § 6903(14)).

its statutory obligations” under RCRA). Although not every interpretation of “open dump” may be reasonable, *see Michigan v. EPA*, 135 S. Ct. 2699, 2708 (2015) (“*Chevron* allows agencies to choose among competing reasonable interpretations of a statute; it does not license interpretive gerrymanders[.]”), RCRA’s mandated flexibility contemplates that the regulatory meaning of “open dump” can change over time and thus fits the definition of “ambiguity.” *See Ambiguity*, WEBSTER’S THIRD NEW INTERNATIONAL DICTIONARY 66 (3d ed. 1993) (“admitting of two or more meanings”).

III.

Although I believe the statute is temporally ambiguous, I nonetheless agree that the EPA reasonably concluded that it has the authority to regulate inactive impoundments. *See Chevron*, 467 U.S. at 843 (deference to agency’s interpretation required so long as it is “based on a permissible construction of the statute”). In reviewing the reasonableness of an agency’s interpretation, we look to the statute’s structure and purpose as well as to precedent, *Nat’l Ass’n of Home Builders v. Defs. of Wildlife*, 551 U.S. 644, 666 (2007), keeping in mind that *Chevron* “does not require the best interpretation [of the statute], only a reasonable one,” *Van Hollen, Jr. v. FEC*, 811 F.3d 486, 492 (D.C. Cir. 2016) (internal quotation marks omitted).

First, regarding the definition of “disposal,” we have *rejected* a similar “linguistic point that [d]isposal . . . is not a continuing activity but occurs anew each time waste is placed into or on land.” *In re Consol. Land Disposal Regulation Litig.*, 938 F.2d 1386, 1389 (D.C. Cir. 1991). In doing so, we noted that RCRA’s “equation of ‘disposal’ with ‘leaking,’ which is a continuous phenomenon rather than a discrete event,

is enough to blunt the sting of the petitioners' point." *Id.* In that case, we concluded that the petitioners' suggested interpretation was, "at most an alternative reading of the statute, not an argument as to why the EPA's reading of the statute is unreasonable." *Id.* Thus, we upheld as reasonable the EPA's interpretation of "disposal" to include "continuous" leaking; we can apply a similar reading today. Indeed, the record "demonstrates that unlined surface impoundments typically operate for 20 years before they begin to leak." *See* 80 Fed. Reg. at 21326-27; *see also* 40 C.F.R. §§ 257.70-72 (imposing liner requirements to prevent leaking). As discussed in Section IV.B.1 of the *per curiam* opinion, the risk of leaking does not decrease in an inactive impoundment—indeed, it can increase. Because "disposal" includes "leaking"—and because "leaking" does not necessarily cease upon an impoundment's closure—the EPA reasonably concluded that CCR continues to be "disposed of" even after an impoundment stops receiving CCR. *See* 75 Fed. Reg. 35,128, 35,159 (June 21, 2010) ("historical or legacy sites" pose leaking risk).

Second, an impoundment where CCR "is disposed of" is different from an impoundment that is actively receiving additional CCR. 42 U.S.C. § 6903(14). As the EPA suggests, if an individual were to stand on an impoundment dam looking out over thousands of tons of wet CCR and ask "is this an impoundment where 'solid waste is disposed of,'" the answer would be "yes." EPA Br. 22. Put differently, the disposal of CCR in an impoundment is not a discrete act. If it were, the EPA would regulate only the transfer of CCR from a power facility into an impoundment, at which point the "disposal" would end. Of course, the reality is that CCR disposal and its resulting health hazards occur over long periods of time. *See* 80 Fed. Reg. at 21,309 ("estimated time to peak potential exposures of CCR through groundwater

migration to drinking water wells is 75 years” and estimated CCR unit lifespan is 40 to 80 years). CCR is not like a bag of trash that a homeowner places on the curb to be picked up. The homeowner releases control of the bag once he deposits it and the garbage truck makes its rounds. In contrast—and by definition—an impoundment owner or utility operator does not relinquish control of the CCR once it is impounded. *See* 40 C.F.R. § 257.53 (defining “owner” and “operator”); *see also id.* § 257.50(b) (Rule applies to “disposal units located off-site of the electric utility or independent power producer”). Moreover, the impoundment’s purpose is to “dispose of” CCR and, accordingly, the disposal *process* continues so long as the CCR remains in the pond. *Id.* § 257.53 (“CCR impoundment” is a “natural topographic depression, man-made excavation, or diked area, which is *designed* to hold an accumulation of CCR and liquids, and the unit treats, stores, or disposes of CCR” (emphasis added)).²³

For the foregoing reasons, and regarding Section IV.B.1 only, I concur in the judgment. Otherwise, I fully concur in the *per curiam* opinion.

²³ The EPA’s regulatory definition of “impoundment” is consistent with the dictionary definition of the verb “impound,” which manifests continuing action. *See Impound*, WEBSTER’S THIRD NEW INTERNATIONAL DICTIONARY 1136 (3d ed. 1993) (“[T]o confine or store (water)[.]”).

-----Attorney/Client Communication/Work Product-----
-----Prepared in anticipation of Litigation-----

PRELIMINARY DRAFT

REVIEW OF ELG/CCR OPTIONS

A.B. Brown and F.B. Culley Stations

B&V PROJECT NO. 190507
B&V FILE NO. 41.4200

PREPARED FOR

Vectren Corporation

08 FEBRUARY 2016



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1.0 Executive Summary

Southern Indiana Gas and Electric Company d/b/a Vectren Power Supply, Inc. (Company) has contracted with Black & Veatch Corporation (Consultant) to serve as an Owner's Engineer (OE) in the evaluation of coal combustion residuals (CCR) and effluent limit guideline (ELG) regulations for A.B. Brown (ABB) and F.B. Culley (FBC) Power Stations.

On December 19, 2014, the Environmental Protection Agency (EPA) signed the final CCR rule. The CCR rule contains specific requirements that are to be met in order to continue operation of the CCR unit(s). Failure to meet specific requirements results in requirements to cease operation and begin closure or retrofit of the CCR unit. For units that are required to close, the CCR rule allows for two options: (1) leave the CCR in place and install a final cover system or (2) remove the CCR and decontaminate the unit.

The EPA finalized an update to the ELG rule on September 30, 2015. The final rule strengthens the technology based ELGs by introducing more stringent discharge restrictions on toxic pollutants. Changes include new standards for flue gas desulfurization (FGD), flue gas mercury control (FGMC), gasification, and landfill leachate waste streams that were previously included under low volume wastes. Additionally, it establishes a zero discharge standard for fly and bottom ash transport waste streams for both new and existing point sources. The final rule did not include any changes to the previously specified cooling tower blowdown, once-through cooling, or coal pile runoff effluent standards.

1.1 A.B. BROWN STATION

A.B. Brown Station is a two unit, 530 megawatt (MW) coal fired electricity generating power facility, located on the northern bank of the Ohio River, 5 miles southwest of Evansville, Indiana. The station includes Unit 1 with a rated capacity of 265 MW and Unit 2 with a rated capacity of 265 MW. A.B. Brown Station currently utilizes an ash pond for ash handling, as well as collection of metal cleaning, FGD wash water, other process wastewaters, and storm water.

Closure of the ash pond due to the CCR ruling represents a significant reduction in reuse water, storage, and sedimentation capabilities for A. B. Brown. Of the new wastewater streams regulated under the EPA's revised ELG rule, only fly ash transport, bottom ash transport, and leachate apply to A.B. Brown. Discharge of ash transport water is no longer permissible and, as such, a new means of transport and storage of CCR materials will be necessary. All wastewater flows into the ash pond will now need to be re-directed, collected, and properly treated prior to discharge.

For this portion of the program work, AECOM served as the lead in the CCR compliance review and reporting for A.B. Brown. Babcock & Wilcox provided assistance with ash handling options and Black & Veatch served as the lead in the ELG compliance review and wastewater treatment options and water management reporting.

1.2 F.B. CULLEY STATION

F. B. Culley Station is a two unit, 369-MW coal fired electricity generating power facility, located on the northern bank of the Ohio River, southeast of Newburgh, Indiana. F. B. Culley has two units in operation; a 104 MW Unit 2 and a 265 MW Unit 3.

As with the A.B. Brown units, the CCR regulations require F.B. Culley to discontinue the use of the Unit 2 and Unit 3 ponds, referred to as east and west, respectively. The elimination of both CCR units represents a significant reduction in reuse water, storage, and sedimentation capabilities for F.B. Culley. Of the new wastewater streams regulated under the EPA's revised ELG rule, fly ash transport, bottom ash transport, leachate and wet FGD wastewater blowdown apply to F.B. Culley. All wastewater flows into the ash ponds will now need to be re-directed, collected and properly treated prior to discharge.

For this portion of the program work, AECOM served as the lead in the CCR compliance review and ELG compliance review and reporting for F.B. Culley. Babcock Power reviewed options to reduce FGD blowdown flows. Babcock & Wilcox provided assistance with ash handling options.

1.3 OBJECTIVE

The focus of the ELG/CCR Compliance Program is to identify alternative ash handling and water treatment options as well as any water reclamation or elimination options for each regulated discharge stream to bring A.B. Brown and F.B. Culley Stations into future compliance with the updated CCR and ELG regulations.

This report provides the following for both A.B. Brown and F.B. Culley Stations:

- A review of the updated CCR and ELG regulations and their impact on both stations, including timing of the respective rules and application.
- An evaluation of ash pond closure options including discussions on bottom ash and fly ash evaluations, design concepts, feasibility and present worth of capital and operating expenses for each option.
- An evaluation of treatment technology options for each station with respect to the updated ELG rulings including design concepts feasibility and present worth of capital and operating expenses for each option.

2.0 Project Timeline

This section summarizes the steps that have been taken during the course of this project to determine the most cost-effective approach to meeting the ELG/CCR requirements. Table 2-1 provides a timeline of the relevant major events that played a role in selecting technologies for A.B. Brown and F.B. Culley Stations.

Table 2-1 Major Events in Technology Selection

DATE	ACTIVITY	DESCRIPTION
August 27, 2015	CCR Compliance Evaluation for ABB and FBC	Burns & McDonnell evaluated CCR Compliance options for ABB and FBC.
December 2015	ELG Compliance Analysis for ABB	Black & Veatch conducted a review of the plant water balance and effect of ash pond closures at ABB.
December 18, 2015	CCR Compliance Cost Estimate	AECOM provided a Class 3 cost estimate for closure options at ABB and FBC.
January 8, 2016	FBC CCR Compliance Analysis - Wastewater Treatment and Reduction Study	AECOM conducted a review of the plant water balance and effect of ash pond closures on wastewater treatment at FBC. Wastewater treatment options were presented.
January 2016	Technology Selection	Black & Veatch evaluated technology options and costs to comply with ELG and CCR regulations at ABB and FBC.

3.0 Summary of Evaluations

This section summarizes the ELG/CCR Compliance Program (“Projects”) for A.B. Brown (ABB) and F.B. Culley (FBC) Stations.

3.1 COAL COMBUSTION RESIDUALS RULING

3.1.1 Background

On December 19, 2014, the Environmental Protection Agency (EPA) signed the final CCR rule. As expected, the rule regulates CCR as nonhazardous waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA). The rule was published in the Federal Register on April 17, 2015 and it was effective on October 19, 2015.

The CCR rule contains specific requirements that are to be met in order to continue operation of the CCR unit(s). These requirements include the following:

- Location restrictions.
- Design criteria, including liner design and structural integrity.
- Operating criteria including air criteria, hydrologic and hydraulic capacity requirements, and inspection requirements.
- Groundwater monitoring and corrective action.
- Closure and post-closure care.
- Record keeping, notification, and internet posting.

Failure to meet or document the above items generally results in requirements to cease operation and begin closure or retrofit of the CCR unit. For units that are required to close, the CCR rule allows for two options; either to leave the CCR in place and install a final cover system, or remove the CCR and decontaminate the unit. There are two surface impoundment closure options facilities can implement; Clean Closure or Close in Place.

Clean closure requires dewater and excavation of all CCR, removal of the underlying impacted soil and final backfill with clean soil. This option removes any groundwater contamination risks so any groundwater remediation (if required) is limited to treating the residual contamination. The option also requires only top soil which eliminates the need for an engineered cap or any post-closure care. The drawbacks are the significant construction costs associated with the dewatering, excavation and backfill efforts; and long construction durations.

Close in Place requires dewater and regrading of the existing surface, back fill and an engineered cap. This option results in minimal disturbance of the existing CCR, reduced backfill with relative short construction schedule and lowered costs. This option does require an engineered cap, typically a geosynthetic layer, and regularly scheduled post-closure care including groundwater monitoring for 30 years. There are more risks involved with this option as the potential for groundwater contamination remains and a significant cost for groundwater remediation if groundwater is incised with CCR.

3.1.2 Implementation and Enforcement

The rule is self-implementing; therefore, affected facilities must comply with the new regulations irrespective of whether a state adopts the rule. Even if a state promulgates its own rule and incorporates the federal criteria into the state's solid waste management program, the federal rule remains in place as an independent set of federal criteria that must be met (although the EPA states in the preamble that facilities in compliance with an EPA-approved state CCR solid waste management plan that is identical to or more stringent than the federal criteria should be viewed as meeting or exceeding the federal criteria). Because the rule is promulgated under Subtitle D, it does not require regulated facilities to obtain permits, does not require the states to adopt and implement the new rules, and cannot be enforced by the EPA. The rule's only compliance mechanism is for a state or citizen group to bring a RCRA citizen suit in federal district court under RCRA Section 7002 against any facility that is alleged to be in noncompliance with the new requirements.

3.1.3 Applicability

The rule applies to new and existing landfills and surface impoundments used to manage CCR generated by coal fired electric utility plants in North American Industry Classification System (NAICS) industry code 221112. The rule also applies to inactive surface impoundments (i.e., impoundments not receiving CCR on or after October 19, 2015, but that still contain CCR and liquid) located at power plants producing electricity regardless of fuel type. If an inactive surface impoundment closes (through closure in place or clean closure) by April 17, 2018, it is excluded from further regulation; however, inactive surface impoundments that cannot close within this 3 year time period are regulated in the same manner as existing CCR surface impoundment and subject to the rule's full array of requirements, including location restrictions and groundwater monitoring.

3.2 EFFLUENT LIMITATION GUIDELINE RULE

3.2.1 Background

As authorized by the Clean Water Act (CWA), the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating discharge point sources into bodies of water in the United States. Wastewater discharges from Vectren facilities are regulated under the Indiana Department of Environmental Management (IDEM) NPDES program that incorporates the standards set forth in 40 CFR 423 – Steam Electric Power Generating Point Source category.

Guidelines set forth under the 40 CFR 423 establish wastewater discharge standards for existing point sources represent the degree of effluent reduction that can be achieved by application of the best available technology (BAT) that is economically achievable. Guidelines for discharges from new point sources are set forth in new source performance standards (NSPS). In addition, guidelines for existing and new sources which discharge into a publicly owned treatment

works (POTW) are established for pretreatment standards for existing sources (PSES) and/or pretreatment standards for new sources (PSNS). These guidelines and standards are to be used by the NPDES permitting authority (IDEM in Indiana) in setting applicable discharge limits for specified effluents in new and renewed NPDES and Pretreatment permits for steam electric generation facilities.

The EPA released a final rule updating the effluent limit guidelines (ELGs) in 40 CFR 423 on September 30, 2015. The final rule strengthens the technology based ELGs by introducing more stringent discharge restrictions on toxic pollutants. The updated rule focuses on heavy metals reduction, i.e., mercury (Hg), arsenic (As), and selenium (Se), as well as any waste streams that come in contact with combustion materials. Changes include new standards for flue gas desulfurization (FGD), flue gas mercury control (FGMC), gasification, and landfill leachate waste streams that were previously included under low volume wastes. Additionally, it establishes a zero discharge standard for fly and bottom ash transport waste for both new and existing point sources. The final rule did not include any changes to the previously specified cooling tower blowdown, once-through cooling, or coal pile runoff effluent standards.

3.2.2 Review of ELG Final Rule

The ELG final rule as applicable to Vectren facilities establishes separate definitions and categories for FGD wastewater and combustion residual leachate, which were previously considered low volume waste sources.

The EPA's rulemaking sets forth technology-based effluent standards for discharges from these new wastewater streams to surface waters and POTW sewer systems. NPDES permitting authorities (Indiana Department of Environmental Management [IDEM] in Indiana) must incorporate these new ELG standards as applicable into the next renewal issuance of each existing facility's NPDES permit.

The final ELG rule requires that permits issued after the rule's January 4, 2016, effective date must incorporate the applicable new ELGs; however, the permitting authority is allowed to designate the date when the limitations will apply to each discharge and waste stream. All new ELG limits will not apply until a date determined by the permitting authority to be "as soon as possible" beginning November 1, 2018 (approximately 3 years following promulgation of this rule), but no later than December 31, 2023 (approximately 8 years following promulgation).

The technology bases for discharges from existing point sources applicable to the subject Vectren facilities set forth in the new ELG regulations are shown in Table 3-1.

Table 3-1 Technology Basis for BAT/PSES and NSPS/PSNS Effluent Limitation Guidelines

WASTE STREAMS	EXISTING BAT AND PSES
Fly Ash Transport Water	Dry Handling
Bottom Ash Transport Water	Dry Handling/Closed Loop
Wet FGD Wastewater	Chemical Precipitation+ Biological Treatment
Combustion Residual Leachate	Gravity Settling Impoundment

3.3 A.B. BROWN--IMPACT OF CCR REGULATIONS

A.B. Brown Station currently utilizes one ash pond. The pond is designed as a surface impoundment. The pond receives bottom ash and fly ash water and the FGD washwater flows as well as other low volume wastes and run-offs.

Future closure of the ash pond represents a significant reduction in reuse water, storage, and sedimentation capabilities for A.B. Brown. In conjunction with the ELG ruling, discharge of ash transport water is no longer permissible and, as such, a new means of transport and storage of CCR materials will be necessary.

3.4 A.B. BROWN--TECHNOLOGY OPTIONS FOR CCR COMPLIANCE

Vectren Corporation contracted with AECOM to develop pond closure options and to create total installed cost estimates for closure of the ash pond at A.B. Brown. A summary and breakdown of the conceptual cost estimate can be found in Section 5.0.

3.4.1 Ash Pond Closure Options

AECOM initially submitted four closure options for the ash pond. These four options included clean closure, two options for close in place, and a hybrid closure option that combined clean close and close in place. The two options for close in place were based on either balancing cut-fill or requiring outside fill to be brought in to the site. After review with Vectren and Black & Veatch, the clean close and hybrid options were removed because of cost and unrealistic construction effort and schedule; leaving only the close in place option.

The Class 3 engineering, procurement, and construction (EPC) cost estimate provided by AECOM was developed based on the Close in Place option. This closure option included the following:

- Demolition of existing outlet structures, piping, and pipe supports.
- Removal of service water and limited dewatering of existing ash.
- Regrading of the ash pond.
- Placement of a geomembrane cover, clay protective layer, and topsoil.

3.4.2 Groundwater Monitoring and Remediation

No Groundwater Monitoring and Remediation cost considerations are included in this report. The cost estimate and implementation plan for Groundwater Monitoring and Remediation are by Vectren/ Haley & Aldrich.

3.4.3 Bottom Ash

Black & Veatch worked with Vectren to evaluate five different cost-effective concepts of bottom ash handling at F.B. Culley Unit 3, also for use at A.B. Brown Units 1 and 2, as detailed in Table 3-2.

Table 3-2 Bottom Ash Handling Options

OPTION	DESCRIPTION
Vibratory ash removal	Ash is collected in a dry continuous hopper, and then advanced through a series of oscillations. The cooled ash is transferred to a collection hopper for truck disposal.
Pneumatic ash removal	Ash is collected in a hopper and dropped into small crushers. Crushers permit air flow to cool the ash. After crushing, ash is pneumatically conveyed to a collection hopper for truck disposal.
Alternative dewatering	Ash is collected using the existing hopper and clinker grinders. Alternatives were explored to convey the ash from grinders to a new collection hopper for disposal.
Customized manual dewatering	A custom solution using manual collection and removal was developed.
Submerged chain conveyor	A water-filled trough under the boiler collects, cools, and quenches the ash. Chains and flights move the ash along the horizontal trough and up a dewatering ramp to a concrete bunker. This three-sided bunker allows trucks to be loaded for disposal.

Following the evaluation, Black & Veatch recommended incorporation of a submerged chain conveyor (SCC) underneath the boiler to replace the current sluicing system at A.B. Brown. An SCC uses a submerged drag chain to collect ash and discharge the dewatered ash into a bunker for final dewatering and storage. Subsequently, the ash would be transported off-site for reuse or to a landfill for disposal. Conversion to SCC will require cooling water. A bottom ash handling solution which minimizes the use of cooling water is being developed with Babcock & Wilcox. An installed cost of \$10M to retrofit both boilers with SCC equipment has been incorporated into the treatment options in Cost Estimate Section 5.0, Table 5-2. The bottom ash solution at A.B. Brown will also be applied to F.B. Culley. See Section 3.8.6 for details of the evaluation of SCC options at F.B. Culley.

3.4.3.1 Bottom Ash Research

Vectren's plant operations undertook an evaluation to find an alternate system to the dry, bottom ash hopper, and remote submerged chain conveyor systems at F.B. Culley Unit 3, also for use at A.B. Brown Units 1 and 2. Vectren investigated the use of an auger or drag chain system that

could potentially attach to the existing bottom ash hopper and pull the bottom ash up out of the water and drop it into a container for haul off.

Vectren discussed this auger design with numerous companies with very little positive feedback. The major concern it discovered was the auger's potential inability to bring up suspended solids. One company tested the design and found that the auger would not pick up any suspended solids leading to buildup in the bottom of the housing.

One company, B&W, responded with an option that had been installed in Canada using a drag chain. After further discussions, B&W contacted Loibl, a German company that is part of the Allen-Sherman-Hoff group, to help with the design. Loibl and B&W developed a conceptual design that incorporated the use of a drag chain, resembling a similar design produced in Germany.

3.4.4 Fly Ash

A.B. Brown utilizes dry ash handling approximately 90 percent of the time for beneficial reuse, but resorts to wet fly ash handling when beneficial reuse transport is unavailable. For the dry fly ash system, the low pressure ash pond water is used to draw a vacuum on various ash hoppers through the Hydroveyor and move the fly ash to a filter/separator that is then pressurized and blows the ash to a storage silo near the river for barge loading. For sluicing the wet fly ash the vacuum portion does not change but the ash is dropped into a combine tube prior to reaching the filter/separators that mixes it with water and moves it to the ash pond for storage when the dry fly ash storage silo is full.

If the ash pond is closed, the source of water for the vacuum is lost, and the ability to wet the fly ash and move it to the ash pond is lost. To solve the loss of the vacuum source, Vectren is reviewing a mechanical exhauster system. Essentially these are vacuum pumps that will use the existing infrastructure to replace the Hydroveyor. The ash will still be pulled from the ash collection hoppers to the filter/separator system for pressurized transport to the existing dry fly ash storage silo or to a new day bin silo. The F.B. Culley Station purchased, from United Conveyor Corporation (UCC), installed, and has been operating mechanical exhausters for several years (Subsection 3.8.7). The technology and product have proven to be reliable. A.B. Brown has selected the same vendor and equipment to perform a similar function.

With mechanical exhausters, A.B. Brown has a new source of vacuum. The next problem to solve was a location to move the ash to if the dry fly ash silo was full since we no longer would have the ability to place it in the ash pond. The dry fly ash storage silo near the river accepts the pneumatically conveyed ash from the A.B. Brown units as well as trucked ash from F.B. Culley and Warrick. This silo has equipment for pneumatically unloading tank trucks into the silo and a tube conveyor for moving ash to the river for barge loading from the silo. However it does not have equipment for loading over the road trucks for disposal of dry fly ash at a landfill. The day bin silo would be a smaller silo with a paddle mixer (pug mill) to wet the ash for dust issues and would be capable of loading into over the road trucks. Again Vectren turned to UCC and the equipment that was installed at the F.B. Culley Station and has been operating successfully for several years.

Both the mechanical exhausters and the day bin silo locations have been selected at the plant site instead of at the river silo area to take advantage of the auxiliaries available for cost reduction. Fly Ash handling equipment cost is estimated at \$12 million dollars and is included in Table 5-2.

3.5 A. B. BROWN--IMPACT OF ELG REGULATIONS

The critical aspect of this review is the impact these regulations will have on the wastewater point source discharges at A.B. Brown. Black & Veatch's scope of work for this review was to identify the target areas for specific pollutants that are included in the final ruling and determine which wastewater discharge streams, if any, are affected by the updated ELG regulations.

Of the new wastewater streams regulated under the EPA's revised rule, only fly ash transport, bottom ash transport, and leachate apply to A.B. Brown. The EPA has determined that the dual alkali scrubber at A.B. Brown does not discharge FGD wastewater as it is defined in the new ELG rulemaking, and the scrubber is not subject to the FGD standards in the ELG rule. The EPA established numerical effluent limits that would correspond to the level of treatment that could be achieved based on application of these treatment technologies. Once these new ELG limits are incorporated by IDEM into the next NPDES permit issued to A.B. Brown, the facility will need to achieve these discharge limits. The ELG regulations do not specifically require installation of the BAT treatment technologies, but each facility will nevertheless need to undertake any measures or upgrades that may be needed to meet the new NPDES permit limits by the dates specified in the permit.

Wastewater at A.B. Brown is considered direct discharge from an existing source. The current ELGs for the steam electric power generating existing sources and their applicability to A.B. Brown are shown in Appendix A.

3.5.1 Operation Evaluation

A. B. Brown currently utilizes sluicing systems to transport fly ash and bottom ash to the ash pond for settling. The EPA's final rule on wastewater effluent regulation standards requires zero discharge for fly and bottom ash transport water (refer to Table 3-1). For fly and bottom ash transport, the final ELG rule specifies dry handling or closed-loop systems as the technology basis.

The removal of ash sluice water and closure of the ash pond would meet the compliance requirements for the CCR rule. All waste streams currently discharged to the ash pond were sampled to determine water quality. The sampled waste stream data indicates that A.B. Brown is anticipated to achieve the new direct discharge limits from an existing source imposed by the final rule if the sedimentation capability of the ash pond were to be sufficiently substituted.

3.6 A. B. BROWN--TECHNOLOGY OPTIONS FOR ELG COMPLIANCE

Based on review of the final ELG and capabilities of the existing plant wastewater systems to achieve these standards, Black & Veatch has identified potential modifications to the existing wastewater system as well as additional treatment options that could be implemented to meet

wastewater effluent standards. A summary and breakdown of the conceptual cost estimate can be found in Section 5.0.

3.6.1 Ash Pond Elimination

Elimination of the ash pond represents a significant reduction in reuse water, storage, and sedimentation capabilities for A.B. Brown. Ash sluice water and FGD makeup are the major consumers of reuse water and sources of wastewater. The pending ash pond closure and conversion to a closed loop SCC for bottom ash handling represents a large reduction in wastewater generation and storage requirements, which would minimize the size of any downstream treatment equipment. However, the new treatment equipment would still need to be capable of handling approximately 2.5 million gallons per day (mgd) of treated low volume wash water streams from FGD wash water and coal pile runoff.

Treatment options evaluated include physical/chemical treatment, settling and dewatering processes, and CCR compliant basins or tanks for reduction in suspended solids.

In its published response to comments on the draft ELG rulemaking, EPA has determined that the dual alkali scrubber at ABB does not discharge FGD wastewater as it is defined in the new ELG rulemaking, and the scrubber is not subject to the FGD standards in the ELG rule. As such, the FGD wastewater streams would remain categorized as low volume waste.

3.6.2 Design Concept

The basic design concept includes collecting and re-directing all existing flows that discharge to the ash pond. Collected wastewater would be transferred to the necessary users for reuse demands with the accumulated wastewater. Water not reused would be treated and transferred to the existing wastewater mercury treatment system and subsequent lined pond. The basic design concept would still utilize a significant portion of the existing equipment while providing a basin for collection and flow equalization and a system for suspended solids reduction and removal. Suspended solids reduction and removal equipment would utilize clarification or settling basins and sludge dewatering.

Using the values and water mass balance Vectren has given Black & Veatch as a starting basis, Black & Veatch was able to develop a water mass balance outlining influent and effluent flows around pieces of equipment impacted by the pending closure.

3.6.3 Collection Basin

A concrete, below grade collection basin will serve the purpose of equalizing wastewater flow rates from the coal pile runoff pond and treated effluent from the Wastewater Mercury Treatment System. The collection basin will provide a reservoir from which to draw reuse water to supply existing low-pressure water recirculation users, existing high-pressure water recirculation users, and cooling water for dry bottom ash system. The collection basin is sized to accommodate 20 minutes of retention time for all flows indicated on the water mass balance. A mixer is included

with the collection basin to prevent the settling and accumulation of solids within the collection basin.

Two 100 percent capacity, vertical sump pumps will draw suction from the collection basin to supply existing users of high-pressure ash pond recirculation pumps. Similarly, two 100 percent capacity vertical sump pumps will draw suction from the collection basin to supply users of low-pressure ash pond water. New piping from the collection basin will tie into existing high-pressure and low-pressure ash water piping. Additional piping will be included to direct recirculation water as cooling for dry bottom ash system from the high-pressure recirculation supply pumps.

Two 100 percent capacity treatment supply pumps will forward wastewater from the collection basin to a solids removal treatment option, either settling basins or clarification. Treatment supply pumps will be controlled based on level in the collection basin.

3.6.4 Options 1 and 2 – Clarification and Sludge Handling

The settling function of the ash pond will need to be accomplished by utilizing new equipment to meet the total suspended solids (TSS) limits of the NPDES permit. Clarification provides a compact solution to removing suspended solids from wastewater. Black & Veatch has developed estimates for locating the clarification and sludge handling treatment equipment in a prefabricated metal building adjacent to the collection basin. Option 1 locates the equipment and collection basin northwest of the existing lined settling pond. Option 2 locates the equipment and collection basin south of the capital pond.

Major equipment for Options 1 and 2 is identical. From the collection basin, wastewater is pumped into a floc mixing tank where coagulant and polymer are added to allow suspended solids to accumulate for more effective settling. From the floc mixing tank, water flows into a packaged lamella clarifier system. Solids are collected on lamella plates and settle to the bottom as thickened sludge. Clarified water is sent to the existing Ash Pond Mercury Treatment System, existing lined settling pond, and finally to Outfall 001.

Accumulated sludge from the clarifier is collected in a sludge holding tank. The sludge holding tank is sized to hold 12 hours of sludge accumulation. Two 100 percent capacity filter press feed pumps supply sludge from the holding tank to two 100 percent capacity recessed plate and frame filter presses that dewater the sludge. Sludge conditioning polymer, supplied from a chemical tote, is fed upstream of the filter presses to improve dewatering. Dewatered solids can be deposited in the landfill at A.B. Brown.

3.6.5 Option 3 – Settling Basins

The settling function of the ash pond can also be accomplished using concrete settling basins with little operator interface. Black & Veatch has developed estimates for locating the settling basins in the area north of the plant between Welborn Road and West Franklin Road as identified by Vectren at the kickoff meeting.

From the collection basin, wastewater is pumped to two 100 percent capacity settling basins to allow suspended solids to settle out by gravity. Each settling basin is sized to

accommodate the full wastewater flow using a conservative settling factor of 0.25 gpm/ft². The design allows for one settling basin to be in service while the solids in the other basin are removed using excavating equipment. After solids precipitate, supernate flows over a weir and flows by gravity down to Outfall 001 via the existing Ash Pond Mercury Treatment System and lined settling pond.

3.6.6 Operations and Maintenance Costs of A.B. Brown ELG Treatment Options

Black & Veatch has developed estimated costs for the operations and maintenance (O&M) of each treatment option. Costs include consumption of chemical feeds, cost to dispose of solids, power consumption, and staffing costs. The O&M costs in Table 3-1 were used to develop present worth for all options as presented in Section 5.0.

Table 3-3 Annual Operation and Maintenance Costs for A.B. Brown ELG Treatment Options

	OPTION 1	OPTION2	OPTION3
Wastewater O&M Costs			
Chemical feeds	\$27,000	\$27,000	\$0
Landfill disposal costs, offsite	\$95,000	\$95,000	\$95,000
Landfill disposal costs, onsite	\$2,000	\$2,000	\$2,000
Power costs	\$27,000	\$27,000	\$13,000
Staffing	\$50,000	\$50,000	\$10,000
Dry Bottom Ash Handling O&M Costs			
Landfill disposal costs, Offsite	\$863,000	\$863,000	\$863,000
Landfill disposal costs, onsite	\$17,000	\$17,000	\$17,000
Power costs	\$128,000	\$128,000	\$128,000
Staffing	\$10,000	\$10,000	\$10,000
Dry Fly Ash Handling O&M Costs⁽³⁾			
Landfill disposal costs, offsite	\$284,000	\$284,000	\$284,000
Landfill disposal costs, onsite	\$6,000	\$6,000	\$6,000
Staffing	\$8,300	\$8,300	\$8,300
Total O&M Costs	\$1,492,300	\$1,492,300	\$1,411,300

Notes:

1. See Table 4-1 for economic criteria.
2. Onsite landfill disposal costs are included for comparison and not included in total O&M costs; cost of building new onsite landfill not included
3. Fly ash solids are sent to landfill one month per year when not used for beneficial reuse.

3.7 F.B. CULLEY--IMPACT OF CCR REGULATIONS

The F.B. Culley facility has two CCR units: the east and west. The west pond is now an inactive surface impoundment. The east pond is an active pond. The elimination of CCR units represents a significant reduction in reuse water, storage, and sedimentation capabilities for F.B. Culley.

3.8 F.B. CULLEY--TECHNOLOGY OPTIONS FOR CCR COMPLIANCE

Vectren contracted with AECOM to develop pond closure options, and to create total installed cost estimates for closure of ash ponds at F.B. Culley. AECOM submitted four options for the F.B. Culley west ash pond, and three options for the F.B. Culley east ash pond. After review with Vectren, the total number of options was reduced to five indicated as follows:

- F.B. Culley West Pond – Close in Place.
- F.B. Culley West Pond – Clean Closure.
- F.B. Culley West Pond – Hybrid Close in Place.
- F.B. Culley East Pond – Clean Closure.
- F.B. Culley East Pond – Close in Place.

A summary and breakdown of the conceptual cost estimate can be found in Section 5.0.

3.8.1 West Pond Close in Place

The close in place option of the estimate provided by AECOM for the west pond proposes to abandon in place existing outlet structures, bulk heading or grouting, and piping.

Pore water will be pumped to the east pond, treated, and discharged via NPDES permitted outfall. CCR materials within the pond area will be excavated, decanted, and used as fill within the pond area.

A flexible membrane liner, geocomposite drainage layer, separator, and clay protective layer will be provided. Topsoil and vegetative stabilization will cover the capped area. A perimeter ring drain and ditch will be installed around the capped area.

Storm water channels and letdowns will be provided. Existing storm water culverts, stormwater force mains, and process water force mains will be re-routed.

3.8.2 West Pond – Clean Closure

The clean closure option of the Class 3 EPC cost estimate provided by AECOM proposes to demolish existing outlet structures, bulk heading or grouting, and piping. Because of the presence

of an existing transmission line structure in the northern edge of the pond, a portion of the pond would be closed in place utilizing a geomembrane cover, separator, and clay protective layer.

Surface and pore water within the pond area will be pumped to the east pond, treated, and discharged via NPDES permitted outfall. CCR materials within the pond area will be excavated, decanted, and hauled off-site. Erosion and sediment control will be provided over the pond area. Additional excavation into a potential, existing creek bed beneath the pond would likely be required to decontaminate the pond area. This excavation into the creek bed will be provided with sheet piling. The pond area and creek bed will be backfilled with clean fill and regraded.

The entire clean closed area will be provided with topsoil and seeded.

3.8.3 West Pond – Hybrid Close in Place

The hybrid closure option of the estimate provided by AECOM proposes to demolish existing outlet structures, bulk heading or grouting, and piping. Transmission area soil will be protected with a coffer dam.

Pore water will be pumped to the east pond, treated, and discharged via NPDES permitted outfall. CCR materials within the pond area will be excavated, decanted, and hauled to the north side of the pond. Erosion and sediment control will be provided over the pond area. The creek bed will be provided with sheet piling. The pond area and creek bed will be backfilled with structural soils and regraded.

A separation berm will be erected to create a storm water pond and a process water pond. The storm water pond will be provided with rock armoring and a landfill station, including two submersible pumps, metering station, and control cabling. Existing storm water culverts and force mains will be rerouted to the new storm water pond. The process pond will be lined with geosynthetic clay, geomembrane, and rock armoring. A process pond lift station will be provided consisting of two submersible pumps, metering station, and control cabling. The existing process water force mains will be re-routed to the new process water pond.

The transmission area will be closed in place utilizing a geomembrane cover, separator, and clay protective layer.

The entire close in place area will be provided with a geomembrane, separator, and clay protective layer. Drainage channels and ditches will also be provided.

3.8.4 East Pond – Clean Closure

The clean closure option for the east pond of the estimate provided by AECOM proposes to demolish existing outlet structures, bulk heading or grouting, and piping.

Pore water will be pumped to the process water pond, treated, and discharged via NPDES permitted outfall. CCR materials within the pond area will be excavated, decanted, and hauled off-site. Erosion and sediment control will be provided over the pond area.

Structural fill soils will raise the elevation of the pond area above the floodplain. Existing storm water culverts, storm water force mains, and process water force mains will be re-routed.

3.8.5 East Pond – Close in Place

The close in place option of the estimate provided by AECOM for the east pond proposes to abandon in place existing outlet structures, bulk heading or grouting, and piping.

Pore water will be pumped to the west process water pond, treated, and discharged via NPDES permitted outfall. CCR materials within the pond area will be excavated, decanted, and used as fill within the pond area.

A flexible membrane liner, geocomposite drainage layer, separator, and clay protective layer will be provided. Three new drainage channels will also be provided. Topsoil and vegetative stabilization will cover the capped area. A perimeter ring drain and ditch will be installed around the capped area.

Storm water channels and letdowns will be provided. Existing storm water culverts, stormwater force mains, and process water force mains will be re-routed.

3.8.6 Groundwater Monitoring and Remediation

No Groundwater Monitoring and Remediation cost considerations are included in this report. The cost estimate and implementation plan for Groundwater Monitoring and Remediation are by Vectren/ Haley & Aldrich.

3.8.7 Bottom Ash

As reviewed in Subsection 3.4.3, several bottom ash handling concepts were evaluated for implementation at both F.B. Culley and A.B. Brown. Retrofit of a submerged scraper underneath the boiler to replace the current sluicing system at F.B. Culley Unit 3 was recommended. An SCC uses a submerged drag chain to collect ash and discharge the dewatered ash into a bunker for final dewatering and storage. Subsequently, the ash would be transported off-site for reuse or to a landfill for disposal. Two configurations, the traditional major vendor submerged chain conveyor (SCC) and a B&W/Allen-Sherman-Hoff modified SCC installed below the existing hoppers, were compared.

The traditional SCC consists of providing equipment at the existing Boiler Building floor level. Therefore, the existing ash collection hopper and clinker grinders would have to be removed. The discharge of the SCC is routed directly through an existing roll-up maintenance door to a truck. The modified SCC proposal consists of mounting the new SCC under the existing clinker grinders and utilizes a below-grade pit with two, off-set chain conveyors.

Both arrangements had items requiring further study. The traditional arrangement has the disadvantage of a large amount of construction time required to remove and replace the hopper. The traditional approach also recommends the existing pit under the hopper to be filled with concrete to ensure better access for the new SCC. This concrete fill construction will extend the installation schedule. A second disadvantage is that the maintenance door interference forces the door to be modified to a single man-door. Major equipment access must then utilize another door for this arrangement.

The modified SCC arrangement has the disadvantage of the conveyor interfering with the existing building foundation. This interference seems resolvable but will require concrete foundation design review and construction time to modify the concrete. Two chain conveyors in the modified SCC arrangement transfer the ash around the roll-up door; however, this route interferes with electrical cabinets, conduit, piping, and a large air duct. The interference will need to be resolved during detailed design.

Both the traditional and modified bottom ash SCC designs are very similar and both are technically feasible. The traditional SCC, which would replace the existing ash hopper, may need to be reviewed by the boiler manufacture, depending on reuse of existing seals and attachments. The modified SCC arrangement, which will attach the conveyor directly to the clinker grinder, must provide a sealed connection.

The equipment cost differential between the SCC options is minor. The modified SCC will require less modification to existing equipment and less outage time, reducing construction costs. Therefore the B&W/Allen-Sherman-Hoff modified SCC is the overall best path forward. An installed cost of \$10M (Class 5 cost estimate) for Unit 3 has been incorporated into the treatment options in Section 5.0, Table 5-4. Cost for Unit 2 has not been included.

3.8.7.1 Bottom Ash Research

Refer to the review provided in section 3.4.3.1.

3.8.7 Fly Ash

The dry ash handling system is already in service at F.B. Culley using mechanical exhausters. The alternative wet sluicing line will need to be capped and abandoned in place so the capability of sluicing fly ash no longer exists to meet compliance. Refer to Section 3.4.4 for further discussion on F. B. Culley fly ash handling operations.

3.9 F.B. CULLEY--IMPACT OF ELG REGULATIONS

F.B. Culley utilizes a limestone based wet FGD scrubbing process. As such, the new ELG restrictions on wet FGD wastewater discharge are applicable to this facility. Future discharges of fly or bottom ash transport water will no longer be permitted once the ELG limits are imposed, however low volume wastewaters can still be discharged under the new rule. Conversion to SCC will require cooling water. A bottom ash handling solution which minimizes the use of cooling water is being developed with Babcock & Wilcox. A more detailed review of this rule is provided in Section 3.2.

3.9.1 Operation Evaluation

AECOM and Babcock Power Environmental have identified potential modifications to the existing wastewater system as well as additional treatment options that could be implemented to meet wastewater effluent standards. There are currently eight sources of water sent to the two ash ponds at F.B. Culley, which include Unit 2 and Unit 3 FGD Systems, air heater wash, wetted fly ash system, bottom ash, pyrite system, oil trap tank, plant drains and sumps, and coal pile runoff.

AECOM noted recommendations to increase the levels of chloride in the scrubber. In addition, instead of discharging cooling water for FGD System equipment head loads to the Unit 3 ash pond, AECOM recommended discharging cooling water through the recirculating water system. The reclaim tank overflow water could be used for makeup to the ball mill instead of clarified river water; overflow water is currently flowing to the ash pond. Another recommendation is to blend fly ash with FGD wastewater for disposal into the landfill. AECOM recommends building a new lined pond once the ash ponds are closed, as discussed in Section 3.8.

Babcock's key recommendations for water and wastewater reduction include returning hydrocyclone overflow to the absorber and reducing the operating absorber tank level, updating demister wash frequency logic, and implementing a control system to reduce the wet FGD purge rate and increase the system chloride concentration.

Wastewater treatment options are summarized in the following section.

3.10 F.B. CULLEY--TECHNOLOGY OPTIONS FOR ELG COMPLIANCE

AECOM developed four treatment options for the FGD wastewater to be in compliance with the new ELG ruling. These options include the following:

- Biological treatment of FGD purge wastewater.
- Brine concentrator/crystallizer.
- Wastewater spray dryer evaporation.
- Wastewater blending with gypsum and fly ash.

Wastewater spray dryer evaporation and wastewater blending have not been demonstrated as effective at F. B. Culley and are not currently considered viable treatment options. Biological treatment and brine concentrator/crystallizer are considered viable options, and a summary and breakdown of the conceptual cost estimate for these options can be found in Section 5.0.

3.10.1 Best Available Technology Review

Referring to the technology bases for the new ELG regulations shown in Table 3-1 in Section 3.2.2, biological treatment is the only wet FGD wastewater treatment system that Black & Veatch is aware of being commercially operated that meets the BAT limits for selenium (new ELG standards in Appendix A).

Brine concentrator/crystallizer has been used successfully at coal generation facilities operating with zero liquid discharge (ZLD) waste. The equipment is frequently cost-prohibitive because of the expensive metals required for the corrosive environment of the concentrator and crystallizer. The energy costs of evaporating present significant operating expenses. For these reasons, reduction and minimization of FGD wastewater streams is critical in reducing the costs of this option.

Fly ash and gypsum sales will not be affected by the implementation of either wastewater treatment option. Although biological treatment has a higher capital cost, this option does not require any additional costs for reducing wastewater. Biological treatment requires the least amount of equipment and operational modifications.

4.0 Economic Criteria

The economic criteria shown in Table 4-1 was used to develop the cost estimates presented in this report. The present worth discount rate, capital recovery factor, and present worth values listed in Table 4-1 do not represent Vectren's actual or proposed values. These values represent relative values that have been applied to technology scenarios to determine the most economical alternative. The results of these evaluations are summarized in Section 5.0.

Table 4-1 A.B. Brown ELG Compliance - Summary of Economic Criteria

ECONOMIC INPUTS- ALL UNITS	VALUE	UNITS
Present Worth Discount Rate	6.00	%
Economic Life	20	years
Capital Recover Factor (Calculated)	8.72	%
Present Worth Factor (Calculated)	11.47	
Salary - Full Time O&M Employee	100,000	\$/year
Power Price	0.098	\$/kWh
Plant Capacity- Brown Unit 1	65	%
Plant Capacity- Brown Unit 2	65	%
Plant Capacity- Culley Unit 2	25	%
Plant Capacity- Culley Unit 3	75	%
Polymer costs	3,075	\$/tote
Coagulant costs	7,620	\$/tote
Filter press polymer costs	3,650	\$/tote
Onsite landfill costs	24	\$/load
Onsite landfill haul capacity	30	tons/load
Offsite landfill costs	990	\$/load
Offsite landfill haul capacity	25	tons/load

5.0 Conceptual Cost Estimate Cases

Tables 5-1 and 5-2 present the Class 3 cost estimates for A.B. Brown separated into treatment options for CCR and ELG compliance, respectively. Tables 5-3 and 5-4 present the Class 3 cost estimates for F.B. Culley separated into treatment options for CCR and ELG compliance, respectively. Detailed cost summaries are provided in the noted appendices in their respective tables. Bottom ash and fly ash handling equipment cost estimates are included in Tables 5-2 and 5-4 for their respective stations and are based on Class 5 estimates.

Each scenario presents the capital cost and O&M costs for its respective treatment technologies. A net present value was then calculated for each scenario.

5.1 CALCULATION OF EVALUATED COST

Evaluated costs were developed for each of the scenarios. The evaluated cost was calculated as the present worth of the capital cost and O&M costs. Black & Veatch used this method for the following reasons:

- It accounts for the impact of both capital and O&M costs in the evaluation.
- It accounts for the capacity factor of the plant since the capacity factor is used in calculating the O&M costs.
- It accounts for the economic life of the unit.
- It accounts for Vectren's cost of money.

To perform the present worth calculation, the following steps were used:

Step 1 - Black & Veatch calculated a present worth factor (PWF) using the following equation:

$$PWF = [(1 + i)^n - 1] / [i (1 + i)^n]$$

Where:

- I = Present Worth Discount Rate (6.00 percent)
- N = Economic Life (20 years)

Step 2 - The PWF is then used to calculate the present worth of the O&M costs. Therefore, the total present worth is calculated as follows:

$$\text{Present Worth of Scenario} = \text{Capital Cost} + (\text{PWF} * \text{O\&M Cost})$$

Table 5-1 Summary of Treatment Options for CCR Compliance – A.B. Brown Station

OPTION	TECHNOLOGY DESCRIPTION	CAPITAL COST	O&M COST	EVALUATED COST (PRESENT WORTH)
Close in Place	Outlet structures and piping will be excavated and removed, pore water will be treated and removed, CCR materials will be excavated and relocated, and a geomembrane cover system will be applied.	\$99,542,000	\$1,027,000	\$111,322,000

Notes:
 1- Present worth calculated with criteria in Table 4-1.

Table 5-2 Summary of Treatment Options for ELG Compliance – A.B. Brown Station

OPTION NO.	TECHNOLOGY DESCRIPTION	CAPITAL COST ¹	O&M COST ²	EVALUATED COST (PRESENT WORTH)
B-1	Collection basin and clarification equipment located northwest of lined settling pond.	\$57,614,000	\$1,492,300	\$74,730,600
B-2	Collection basin and clarification equipment located south of capital pond.	\$55,020,800	\$1,492,300	\$72,137,400
B-3	Collection basin and settling basins located north of facility.	\$60,724,700	\$1,411,300	\$76,912,200

Notes:
 1- Cost estimate for each option includes \$10M (Class 5) bottom ash handling equipment and \$12M (Class 5) fly ash handling equipment costs.
 2- Landfill costs are included.

Table 5-3 Summary of Treatment Options for CCR Compliance – F.B. Culley Station

OPTION	DESCRIPTION	CAPITAL COST	O&M COST	EVALUATED COST (PRESENT WORTH)
West Pond – Clean Closure	Demolish existing outlet structures, bulk heading or grouting, and piping. A portion of the pond would be, closed in place utilizing a geomembrane cover, separator, and clay protective layer.	\$72,411,000	\$308,000	\$75,944,000
West Pond – North Hybrid Closure	Demolish existing outlet structures, bulk heading or grouting, and piping. Cofferdam for transmission area soil. Pore water transferred to east pond, treated, and discharged. CCR materials within the pond area will be excavated, decanted, and hauled to the north side of the pond. A separation berm will be erected to create a storm water pond and a process water pond.	\$41,037,000	\$330,000	\$44,822,000
East Pond – Clean Closure	Demolish existing outlet structures, bulk heading or grouting, and piping. Pore water transferred to process water pond, treated, and discharged. CCR materials within the pond area will be excavated, decanted, and hauled off-site.	\$31,530,000	\$228,000	\$34,145,000
East Pond – Close in Place	Abandon in place existing outlet structures, bulk heading or grouting, and piping. Pore water will be pumped to the west process water pond, treated, and discharged. CCR materials within the pond area will be excavated, decanted, and used as fill within the pond area. A flexible membrane liner, geocomposite drainage layer, separator, and clay protective layer will be provided.	\$12,280,000	\$231,000	\$14,930,000

Note:

- 1- Present worth calculated with criteria in Table 4-1.

Table 5-4 Summary of ELG Technologies – F.B. Culley Station

OPTION NO.	TECHNOLOGY DESCRIPTION	IMPLEMENTATION YEAR	CAPITAL COST	O&M COST	EVALUATED COSTS (PRESENT WORTH)
Wastewater Treatment Costs					
C-1	Biological Treatment of FGD Purge Water	2019	\$30,000,000	\$1,800,000	\$34,140,000
C-2	Brine Concentrator Crystallizer	2023	\$21,000,000	\$1,618,000	\$23,200,000
C-4a	High Pressure Reverse Osmosis	2019	\$12,800,000	\$1,032,000	\$17,600,000
C-4b	High Pressure Reverse Osmosis	2023	\$10,300,000	\$1,035,000	\$12,230,000
Dry Ash Handling Costs					
	Modified SCC Bottom Ash Handling ²		\$10,000,000	\$696,000	\$17,983,000

Note:

- 1- Cost estimates and present worth for wastewater treatment equipment are from AECOM's final report dated February 26th, 2016. O&M costs reported are the first full year of expenses.
- 2- Bottom ash handling equipment provided for Unit 3. Bottom ash handling for Unit 2 and fly ash handling costs have not been included.
- 3- Option C-1 O&M cost updated on August 11, 2016 to \$1,800,000. This cost estimate used in Vectren's IRP.

6.0 Conclusions and Recommendations

The analysis covered by this comprehensive report has shown ash pond closure options and alternative ash handling and water treatment options to bring A.B. Brown and F.B. Culley Stations into future compliance with the updated CCR and ELG regulations. No additional wastewater treatment is required beyond settling at A. B. Brown; the majority of the treatment utilizes existing water treatment equipment. F. B. Culley will require new equipment to meet the pollutant limitations of the ELG regulations.

Recommendations for each station are summarized below with associated cost estimates shown in Tables 6-1 and 6-2.

6.1 A.B. BROWN

Based on the evaluations reported in Sections 3.3 through 3.6, Black & Veatch recommends the following:

- **Close In Place for the Ash Pond.** Clean closure is unrealistic due to high costs and long construction schedule. The CCR is estimated to be above the groundwater level and therefore installation of an engineered cap would reduce any groundwater contamination.
- **Submerged Chain Conveyor for Bottom Ash Removal.** The modified SCC is technically feasible with less modification to existing equipment and reduced outage time.
- **Mechanical Exhausters for Fly Ash removal.** Match the design at F.B. Culley.
- **Collection Basin and Clarification Equipment.** The recommended location for the basin and equipment is south of the capital pond. This option avoids expensive impacts to the railway, undergrounds and is in close proximity to the power block.

6.2 F.B. CULLEY

Based on the evaluations reported in Sections 3.7 through 3.10, Black & Veatch recommends the following:

- **Close in Place for West Ash Pond.** Both the clean closure and hybrid closure options would require significant material removal and replacement, as well as dewatering which results in high costs and long construction schedule. The close in place option minimizes the amount of earthwork and would not require dewatering beyond removing surface water. Since the CCR will be left in place, the potential risk of groundwater impact will remain. However, the potential for impact is reduced by removing the surface water and placing an engineered cap to prevent surface water infiltration.
- **Close in Place for East Ash Pond.** Similar to the west pond, Close in place option is recommended for the east pond. By leaving the CCR in place, the risk of

groundwater impacts remain; however, the engineered cap will provide a reduction in the risk.

- **Submerged Chain Conveyor for Bottom Ash Removal.** The modified SCC is technically feasible with less modification to existing equipment and reduced outage time.
- **Biological Treatment of FGD Purge Water.** Biological treatment is technically feasible, is not dependent upon limiting wastewater usage, and is the only wet FGD wastewater treatment system that meets the BAT limits for selenium.

Table 6-1 Summary of Recommended Technologies – A.B. Brown Station

OPTION	TECHNOLOGY DESCRIPTION	CAPITAL COST	O&M COST	EVALUATED COST (PRESENT WORTH)
Ash Pond	Close in Place	\$99,542,000	\$1,027,000	\$111,322,000
ELG Equipment	Collection and Clarification, Location 2	\$25,614,000	\$199,000	\$27,896,500
Bottom Ash	Modified SCC Bottom Ash Handling	\$20,000,000	\$1,001,000	\$31,481,400
Fly Ash	Dry Fly Ash Handling	\$12,000,000	\$292,300	\$15,392,700
Total Cost		157,156b000	2,519,300	186,052,200

Table 6-2 Summary of Recommended Technologies – F. B. Culley Station

OPTION	TECHNOLOGY DESCRIPTION	CAPITAL COST	O&M COST	EVALUATED COST (PRESENT WORTH)
West Ash Pond	Hybrid Clean Closure	\$41,037,000	\$330,000	\$44,822,000
East Ash Pond	Clean Closure	\$31,530,000	\$228,000	\$34,145,000
ELG Equipment	Biological Treatment	\$30,000,000	\$1,228,000	\$34,140,000
Dry Ash Handling	Modified SCC Bottom Ash Handling	\$10,000,000	\$696,000	\$17,983,000
Total Cost		\$114,267,000	\$2,482,000	\$131,090,000

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Vectren Corporation | REVIEW OF ELG/CCR OPTIONS

Appendix A. Applicable Effluent Guidelines and Standards

WASTESTREAM/POLLUTANT	EXISTING SOURCE DIRECT DISCHARGE		APPLICABILITY	
	BPT ⁽¹⁾	BAT ⁽²⁾	ALB. BROWN	F. B. GUILLEY
All Waste Streams	pH: 6-9 S.U. PCBs ⁽⁶⁾ : Zero Discharge.		Yes	Yes
Low Volume Wastes	TSS: 100 ppm ⁽¹⁾ / 30 ppm ⁽²⁾ , Oil & Grease: 20 ppm ⁽³⁾ / 15 ppm ⁽²⁾ .		Yes	Yes
Flue Gas Desulfurization (FGD) Wastewater	TSS: 100 ppm ⁽¹⁾ / 30 ppm ⁽²⁾ , Oil & Grease: 20 ppm ⁽³⁾ / 15 ppm ⁽²⁾ .	Arsenic: 11 ppb ⁽⁴⁾ / 8 ppb ⁽²⁾ , Mercury: 788 ppt ⁽⁴⁾ / 356 ppt ⁽²⁾ , Nitrate/nitrite as N: 17 ppm ⁽¹⁾ / 4.4 ppm ⁽²⁾ , Selenium: 23 ppb ⁽¹⁾ / 12 ppb ⁽²⁾ .	No ⁽⁶⁾	Yes
Flue Gas Mercury Control (FGMC) Wastewater	TSS: 100 ppm ⁽¹⁾ / 30 ppm ⁽²⁾ , Oil & Grease: 20 ppm ⁽³⁾ / 15 ppm ⁽²⁾ .	Zero Discharge.	No	No
Gasification Wastewater	TSS: 100 ppm ⁽¹⁾ / 30 ppm ⁽²⁾ , Oil & Grease: 20 ppm ⁽³⁾ / 15 ppm ⁽²⁾ .	Arsenic: 4 ppb ⁽⁴⁾ , Mercury: 1.8 ppt ⁽⁴⁾ / 1.3 ppt ⁽²⁾ , Selenium: 453 ppb ⁽¹⁾ / 227 ppb ⁽²⁾ , TDS: 38 ppm ⁽¹⁾ / 22 ppm ⁽²⁾ .	No	No
Combustion Residual Leachate	TSS: 100 ppm ⁽¹⁾ / 30 ppm ⁽²⁾ , Oil & Grease: 20 ppm ⁽³⁾ / 15 ppm ⁽²⁾ .	TSS: 100 ppm ⁽¹⁾ / 30 ppm ⁽²⁾ , Oil & Grease: 20 ppm ⁽³⁾ / 15 ppm ⁽²⁾ .	No	No
Fly Ash Transport	TSS: 100 ppm ⁽¹⁾ / 30 ppm ⁽²⁾ , Oil & Grease: 20 ppm ⁽³⁾ / 15 ppm ⁽²⁾ .	Zero Discharge.	Yes	Yes
Bottom Ash Transport	TSS: 100 ppm ⁽¹⁾ / 30 ppm ⁽²⁾ , Oil & Grease: 20 ppm ⁽³⁾ / 15 ppm ⁽²⁾ .	Zero Discharge.	Yes	Yes
Once-Through Cooling	Free Available Chlorine: 0.5 ppm ⁽³⁾ / 0.2 ppm ⁽⁴⁾ .	Total Residual Chlorine if ≥25 MW: 0.2 ppm ⁽³⁾ (if ≤25 MW: equal to BPT).	No	No
Cooling Tower Blowdown	Free Available Chlorine: 0.5 ppm ⁽³⁾ / 0.2 ppm ⁽⁴⁾ .	Free Available Chlorine: 0.5 ppm ⁽³⁾ / 0.2 ppm ⁽⁴⁾ , 126 Priority Pollutants: Zero discharge except: Chromium: 0.2 ppm ⁽³⁾ / 0.2 ppm ⁽⁴⁾ Zinc: 1.0 ppm ⁽³⁾ / 1.0 ppm ⁽⁴⁾ .	Yes	Yes
Coal Pile Runoff	TSS: 50 ppm ⁽⁵⁾ .		Yes	Yes
Chemical/Metal Cleaning Wastes	TSS: 100 ppm ⁽¹⁾ / 30 ppm ⁽²⁾ , Oil & Grease: 20 ppm ⁽³⁾ / 15 ppm ⁽²⁾ , Copper, total: 1 ppm ⁽¹⁾ / 1 ppm ⁽²⁾ , Iron, total: 1 ppm ⁽¹⁾ / 1 ppm ⁽²⁾ .	Copper: 1.0 ppm ⁽³⁾ / 1.0 ppm ⁽⁴⁾ Iron: 1.0 ppm ⁽³⁾ / 1.0 ppm ⁽⁴⁾ .	Yes	Yes

Source: [40 CFR Part 423]
⁽¹⁾Maximum concentration for any one day.
⁽²⁾Average daily values for 30 consecutive days.
⁽³⁾Maximum concentration.
⁽⁴⁾Average concentration.
⁽⁵⁾Instantaneous maximum.
⁽⁶⁾The pH of all discharges, except once-through cooling water, shall be within the range of 6.0 - 9.0. For all effluent guidelines, where two or more waste streams are combined, the total pollutant discharge quantity may not exceed the sum of allowable pollutant quantities for each individual waste stream. BAT, BPT, NSPS allow either mass or concentration based limitations.
⁽⁷⁾Polychlorinated biphenyl compounds (PCBs) commonly used in transformer fluid.
⁽⁸⁾The EPA has ruled that the type of wet FGD system utilized at ABB, dual alkali scrubber, produces only low volume wastewater. Refer to Attachment E.

Appendix B. List of Assumptions for A.B. Brown

The conceptual cost estimate is provided for alternative treatment options for each stream that discharges into the ash pond to bring A.B. Brown into compliance with ELG regulations. The A.B. Brown site includes existing coal fired plants.

The cost estimate is based on the following assumptions.

B.1 GENERAL ASSUMPTIONS

- Ash pond will be closed in place. No costs associated with its closure are included in the estimate.
- All underground pipe will be buried so that the top of pipe is below frost depth. All aboveground pipe will be supported on sleepers.
- Pipe that is running under an existing rail track is assumed to be jack and bored into place.
- Existing buried pipe under 12 inches that will no longer be in service will be capped and abandoned in place. Existing pipe greater or equal to 12 inches will be backfilled. An allowance is also included to remove some large bore piping when in the area of installation of any new piping. No other demolition of any existing structures is included.
- Existing soil will have sufficient strength to support the new basins and building. Cost is added to include a geotechnical survey to confirm this assumption.
- No cost is included for existing gravel road repair or new roads.
- One railroad crossing would be required for Option 2 for new access road.
- A liner was assumed to be needed under collection basin and settling basins. A liner was not assumed to be needed under new piping.
- A new 80 foot by 50 foot metal building with heating, ventilating, and air conditioning (HVAC) is included for new water treatment equipment. A 2 foot thick slab was assumed to be sufficient to support any equipment needed inside the metal building. Piles are not included. There are 2 tons of support steel for miscellaneous equipment inside of the metal building.
- A 2.5 ton jib crane is included for the settling basin.
- No site leveling or raising is included in the estimate.
- The site has sufficient area available to accommodate construction activities including, but not limited to, construction offices (trailers), laydown, and staging.
- Wastewater treatment will include one clarification and sludge handling train. All transfer pumps, sludge pumps and chemical feed pumps will be designed with 2x100 percent redundancy. Wastewater treatment will include programmable logic controller (PLC) control panel, input/output (I/O) cabinets, and motor control center (MCC) all located in the metal building.
- Sludge hauling dumpster is not included in the estimate.

- No provisions for future expansion of the new wastewater treatment equipment are included.
- An emergency generator is not provided.
- Construction power will be provided by Vectren.
- The existing fire protection hydrant loop from the existing facility will be extended as required to serve the new metal building and water treatment areas. It is assumed that existing fire water pressure and volume are sufficient, therefore, no new fire pumps are included.
- Existing auxiliary power system can supply a minimum 100 amperes at 4160 volts.
- A new distributed control system (DCS) remote input/output (RIO) cabinet is located in the new electrical room in the metal building.
- There is fiber-optic connection to plant DCS.
- Add 30 percent for DCS programming engineering, arc flash coordination study.
- Uninterruptible power supply (UPS) feeds are based on typical primary/backup feed to DCS cabinets; other option is local mini-UPS located in Electrical Building. Power provided by available plant UPS.
- Heat trace loads that are nonfreeze protection lines (nonwater) are allowed off 120/208V panel in the power distribution center (PDC) in accordance with previous project work.
- Building will have 20 foot hi-bay ceilings, with potential 2nd floor open grated level.
- All cables fed from plant; not from cooling tower area based on lack of information.
- New collection basin and wastewater treatment equipment sizing is based on two operating units.
- No changes to the current FGD wastewater mercury treatment equipment or any upstream piping or devices from either unit.
- Current coal pile runoff pump capacity is adequate to reach new collection basin based on topography, pump curve, and Black & Veatch flow modeling.
- New collection basin sizing is based on 20 minutes retention time for all flows identified on the Vectren water mass balance (WMB).
- Treatment vessel will flow by gravity to the existing ash pond wastewater mercury treatment system.
- No electrical equipment or storage building provided at location No. 3.
- Treatment system is not designed to handle chemical cleaning wastes.
- Required instrumentation is included in cost of treatment system.
- Bottom ash handling equipment costs are based on F.B. Culley design.
- New high-pressure and low-pressure recirculation pumps will tie in to existing piping within plant.
- Existing excavated dirt is assumed to be suitable for backfill material. No imported fill is included.

B.2 DIRECT COST ASSUMPTIONS

The following assumptions are included in the base construction cost estimate for direct costs:

- All costs are expressed in January 2016 dollars. Escalation is included for 2020 commercial operation of the unit.
- Direct costs include the costs associated with the purchase of equipment, erection, and all contractor services.
- Construction costs are based on a turnkey construction approach. Construction is assumed to be performed based on a 50 hour work week. Local union rates are used that include payroll, payroll taxes, and benefits. The consolidated labor rate used is about \$75 per man-hour.

B.3 INDIRECT COST ASSUMPTIONS

The following assumptions are included in the base construction cost estimate for indirect costs:

- General indirect costs include all necessary services required for checkouts, testing services, and commissioning.
- Insurance, including builder's risk and general liability.
- Field construction management services including field management staff, supporting staff personnel, field contract administration, field inspection/quality assurance, and project controls.
- Technical direction and management of startup and testing, cleanup expense for the portion not included in the direct-cost construction contracts, safety and medical services, guards and other security services, insurance premiums, performance bond and liability insurance for equipment and tools.
- Transportation costs for equipment and materials delivery to the job site.
- Startup/commissioning spare parts. Only miscellaneous parts used during the startup process are included. All major equipment long-term spare parts should be included in Vectren's costs.
- Construction contractor contingency costs.
- Construction contractor typical profit margin.

The following additional items of cost are not included in the construction estimate. These costs shall be determined by Vectren and included in Vectren's cost estimate:

- Owner's contingency costs.
- Federal, state, and local taxes.
- Major equipment spare parts.
- Land.
- Interest during construction.
- Cost and fees for electrical, gas, and other utility interconnections.

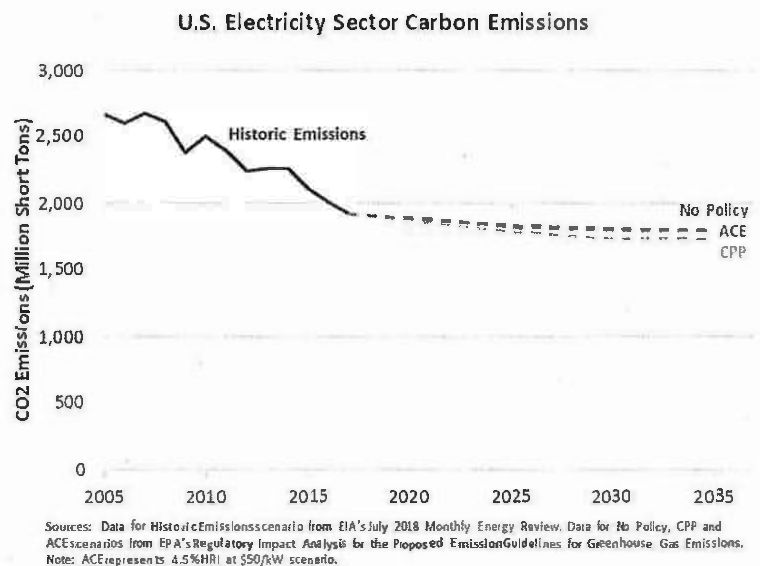
- Project development costs, legal, and community outreach.
- All operating plant vehicles.
- No permitting costs have been included.
- Furniture, maintenance and office equipment, supplies, consumables, communications and plant IT systems, and startup fuel.
- Emissions credits.
- Environmental mitigation.

The Brattle Group's Notes on the Affordable Clean Energy Rule

On August 21, 2018, the Trump administration issued a proposal to replace the Clean Power Plan (CPP), which broadly covered carbon dioxide (CO₂) emissions from the entire existing generation fleet, with the Affordable Clean Energy (ACE) rule that features more narrowly-focused guidelines for improving efficiency at existing coal plants. Depending on how states would use their discretion under the proposed rule to set emission standards for specific coal plants, the ACE rule may marginally increase the efficiency of coal plants but will not likely have significant impacts on industry-wide emissions. ACE also changes the New Source Review (NSR) process for plant efficiency projects so that those projects would unlikely be considered a "major modification" that triggers major NSR permitting requirements.

We provide our key observations on the proposed ACE rule below:

- **ACE is not actually an emissions standard.** The EPA identified "Heat Rate Improvements" (HRI) at fossil-fuel steam plants as the "Best System of Emissions Reduction" (BSER) for electric power sector CO₂ emissions. The EPA provided a list of HRI measures and indicated that each measure may provide heat rate improvements ranging from 0.1% to 2.9%. The EPA has left the decision of how to apply these HRIs *at the individual unit level* entirely up to the states, accounting for a multitude of site-specific factors (such as age, size, and useful remaining life) that enable states to factor in the cost of the measures. Therefore, the states will have substantial flexibility to set the required HRIs on a unit-specific basis.
- **The EPA's analysis indicates minimal impact on CO₂ emissions.** The EPA's analysis shows that ACE would reduce U.S.-wide emissions by 13 to 30 million tons (MT) in 2025, or by 1% to 2%. That is equivalent to the emissions from six 800 MW plants (about 2% of the total coal fleet) running at 75% capacity factor. It is less than the CO₂ reductions already achieved by many individual states during the period 2006 through 2016: Alabama (31 MT), Georgia (31 MT), Illinois (30 MT), Indiana (43 MT), Ohio (53 MT), and Pennsylvania (45 MT). The EPA's own analysis shows that the ACE rule will not really achieve any more reductions in CO₂ emissions by 2035 than the continuation of the historical trends since 2005, as shown in the chart to the right.

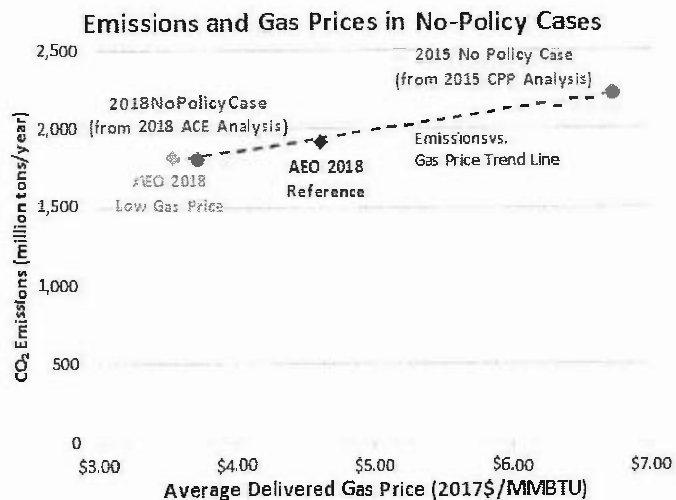


The Affordable Clean Energy Rule

- **The EPA's estimated (minimal) emissions reductions are likely overstated.** The EPA's analysis assumes that all states would adopt emissions standards that require 2% to 4.5% HRI at every plant. But some states will likely adopt lower HRI requirements for many plants and none at all for some plants, since the states have the discretion to set unit-specific emissions standards. In addition, the potential HRIs may be overstated, since they appear to be based to some extent on potential improvements at inefficient plants that have already retired. If so, the surviving fleet may have already employed some or most of the BSER measures and therefore don't have as much room for improvement.
- **CO₂ emissions could rise because ACE does not prevent substitution of coal for gas-fired generation.** Under the CPP's mass-based compliance option, future CO₂ emissions were capped even if higher future gas prices resulted in increased coal generation and emissions. But the ACE rule could result in running the coal units more (particularly the ones that implemented HRIs) especially if gas prices increased, and may result in increasing the total emissions in the electric sector compared to the No Policy case.
- **The EPA's own analysis shows ACE may be more expensive than CPP.** The EPA claims that ACE is more affordable than the CPP under some scenarios, avoiding \$6.4 billion in compliance costs. However, that conclusion hinges on inconsistent assumptions about the cost of heat rate improvements under CPP vs. ACE. Under consistent assumptions for cost of HRIs (\$100/kW), the EPA's analysis shows the compliance cost under ACE would be \$1.7 to \$3.0 billion *higher* than the costs under CPP. This somewhat counterintuitive result is likely due to the ability under CPP to trade emissions allowances through emission-reduction measures (such as dispatch switching) that are less expensive than implementing HRIs at \$100/kW.
- **ACE proposes a "major modification" of the NSR process.** The EPA gives the states the option to adopt a revised NSR process in order to make it more difficult for efficiency improvements to trigger a "major modification" finding. If a state adopts the revised NSR process, then an hourly emissions increase test that may take the form of "maximum achievable emissions" would be adopted. In that case, HRI projects would not trigger NSR even if the annual emissions increase, since the decrease in CO₂ rate per MWh due to the project would always reduce the hourly maximum achievable emissions. Under current NSR implementation, if an HRI project improves efficiency (and thus reduces variable cost) and that produces an increase in dispatch greater than the efficiency gain (both in percent terms), then the annual emissions would be projected to rise, hence potentially triggering NSR.

The Affordable Clean Energy Rule

- **ACE does not provide any emissions reductions credits to low-CO₂ resources.** Unlike CPP, the ACE rule does not provide a mechanism (either through credits or higher energy prices) to benefit any low-CO₂ generation technologies, including nuclear, natural gas, and renewables. This may result in greater risks for nuclear retirements and contradict the administration's efforts to prevent retirements of "fuel secure" baseload plants including nuclear. In fact, the EPA RIA study projects that an additional 5,000 MW of nuclear generation will retire by 2030 due to replacing CPP with ACE.
- **EPA's choice of gas price has more emissions impact than the policy itself.** The ACE RIA assumed a \$3.70/MMBtu gas price in 2030, about \$0.90 below EIA's most recent forecast. Our analysis of 2030 emissions and gas prices from the ACE and CPP RIAs and the AEO Reference and low gas price cases shows that the EPA's gas price assumption reduced emissions by about 120 million tons in 2030 – about four times the reductions claimed by the ACE rule under its most optimistic assumptions.



For more information about this topic, please contact [Metin Celebi](#), [Marc Chupka](#), [DL Oates](#), [Mike Hagerty](#), or [Yingxia Yang](#).

ABOUT US

The Brattle Group provides consulting and expert testimony in economics, finance, and regulation to corporations, law firms, and governments around the world. We aim for the highest level of client service and quality in our industry.

We are distinguished by our credibility and the clarity of our insights, which arise from the stature of our experts, affiliations with leading international academics and industry specialists, and thoughtful, timely, and transparent work. Our clients value our commitment to providing clear, independent results that withstand critical review.

For more information, please visit brattle.com.

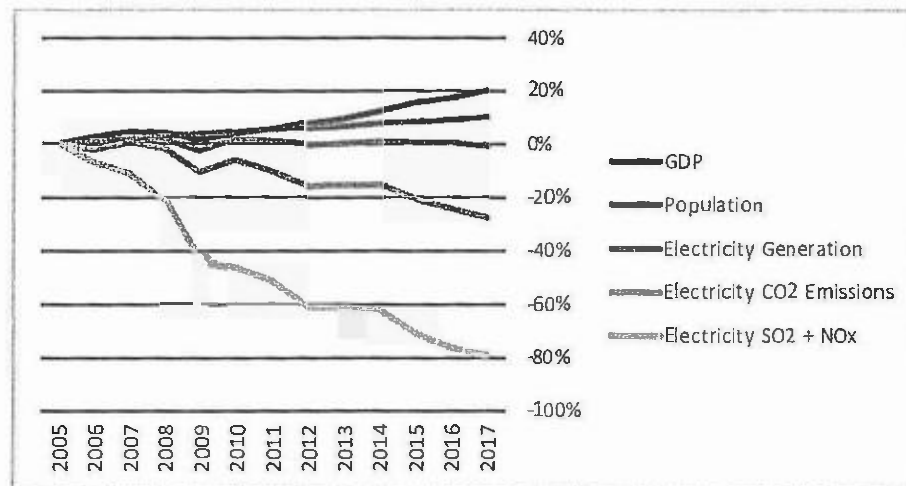


FACT SHEET Proposed ACE Rule – CO₂ Emissions Trends

- On August 21, 2018, the U.S. Environmental Protection Agency (EPA) proposed the Affordable Clean Energy (ACE) rule which would establish emission guidelines for states to develop plans to address greenhouse gas (GHG) emissions from existing coal-fired power plants.
- The ACE rule would replace the 2015 Clean Power Plan (CPP), which EPA has proposed to repeal because it exceeded EPA's authority. The CPP was stayed by the U.S. Supreme Court and has never gone into effect.
- The proposed ACE rule is informed by the more than 270,000 public comments that EPA received on its December 2017 Advance Notice of Proposed Rulemaking.
- The ACE rule has several components: a determination of the best system of emission reduction (BSER) for GHG emissions from coal-fired power plants, a list of "candidate technologies" states can use when developing their plans, a new preliminary applicability test for determining whether a physical or operational change made to a power plant may be a "major modification" triggering New Source Review, and new implementation regulations for emission guidelines under Clean Air Act section 111(d).

CO₂ EMISSIONS STEADILY DECLINING

- EPA projects that, compared to a no CPP scenario, the ACE rule will reduce carbon dioxide (CO₂) emissions in 2025 by between 13 and 30 million short tons, resulting in \$1.6 billion in monetized domestic climate benefits.
- EPA evaluated three illustrative implementation scenarios. EPA estimates that the ACE rule could reduce 2030 CO₂ emissions by an amount equivalent to the annual emissions of up to 5 million cars. The rule could also reduce co-pollutant emissions by up to 2%.
- These illustrative scenarios suggest that when states have fully implemented the ACE rule, U.S. power sector CO₂ emissions could be around 34% below 2005 levels.
- CO₂ emissions in the power sector have steadily declined in recent years due to a range of factors including: market forces, technology improvements, regulatory and policy changes. As a result, the industry has increased the use of natural gas and renewable energy sources. These trends have resulted in CO₂ emission reductions even as the U.S. has sustained economic growth and job gains across the economy—and this has all happened without the CPP ever going into effect. The ACE rule will continue this trend.



- The power sector emitted roughly 1.9 billion tons of CO₂ in 2017, compared to 2.7 billion tons in 2005—a 28% decrease.¹
 - Table 1 in the appendix to this fact sheet provides state-level CO₂ emissions data for 2005 and 2016 as well as the state-level percentage of generation by fuel-type for 2016.²
- Approximately 600 coal-fired electric generating units at 300 facilities could be covered by this rule.
- The U.S. leads the world in reducing CO₂ emissions. The Energy Information Administration (EIA) found that U.S. energy-related CO₂ emissions fell by 14 percent between 2005 to 2017, with coal-related CO₂ emissions down 39 percent over that period. During that time, global energy-related CO₂ emissions rose by 21 percent.

FOR MORE INFORMATION

- Additional fact sheets along with copies of the proposed rule and accompanying Regulatory Impact Analysis are available on EPA's website at <https://www.epa.gov/stationary-sources-air-pollution/proposal-affordable-clean-energy-ace-rule>

¹ EIA Table 12.6, available at <https://www.eia.gov/totalenergy/data/browser/index.php?tbl=T12.06#/?f=A&start=2005&end=2017&charted=0-1-6-9>.

² 2017 state-level data is not yet available from the Energy Information Administration (EIA).

APPENDIX

Table 1: CO₂ Emissions and Generation Mix by State³

	CO ₂ Emissions (million short tons)		2016 Generation Mix (percent of total generation by fuel-type) ⁴				
	2006	2016	Coal	Natural Gas	Nuclear	Renewable ⁵	Other ⁶
Alaska	3.9	3.4	8%	50%	0%	28%	13%
Alabama	92.1	61.2	25%	41%	29%	5%	0%
Arkansas	31.0	34.1	40%	30%	23%	6%	0%
Arizona	58.6	49.0	28%	31%	30%	11%	0%
California	52.0	41.0	0%	47%	10%	43%	0%
Colorado	46.4	39.6	55%	23%	0%	22%	0%
Connecticut	11.9	8.7	0%	48%	47%	3%	2%
District of Columbia	0.1	0.0	0%	0%	0%	100%	0%
Delaware	6.2	4.0	6%	91%	0%	1%	1%
Florida	138.0	119.0	17%	67%	13%	1%	2%
Georgia	94.5	63.6	29%	41%	27%	3%	0%
Hawaii	9.6	7.4	16%	0%	0%	12%	71%
Iowa	40.7	27.4	45%	5%	9%	40%	0%
Idaho	0.6	1.4	0%	21%	0%	79%	0%
Illinois	103.7	73.3	31%	9%	54%	6%	0%
Indiana	134.5	91.9	74%	20%	0%	6%	1%
Kansas	39.8	28.1	49%	4%	17%	30%	0%
Kentucky	103.7	79.5	84%	10%	0%	5%	2%
Louisiana	42.5	40.2	16%	53%	23%	2%	6%
Massachusetts	25.1	13.2	6%	66%	17%	7%	4%
Maryland	32.6	19.3	38%	13%	40%	7%	1%
Maine	3.4	2.1	1%	33%	0%	63%	3%
Michigan	80.5	60.8	37%	26%	29%	6%	2%
Minnesota	39.5	30.4	39%	15%	24%	21%	1%
Missouri	87.6	68.8	77%	8%	12%	3%	0%
Mississippi	28.2	28.5	9%	82%	10%	0%	0%
Montana	21.3	18.1	51%	2%	0%	44%	3%
North Carolina	78.4	56.1	29%	30%	33%	7%	0%
North Dakota	34.2	32.5	70%	3%	0%	27%	0%

³EIA's Detailed State Data, available at <https://www.eia.gov/electricity/data/state/>.

⁴ These data exclude industrial and commercial sources.

⁵ Includes geothermal, hydroelectric (conventional and pumped storage), biomass (including wood and wood derived fuels), solar (thermal and photovoltaic), and wind.

⁶ Includes petroleum and other gases.

Nebraska	24.0	23.9	60%	1%	26%	13%	0%
New Hampshire	7.6	2.7	2%	24%	56%	17%	0%
New Jersey	20.9	22.5	2%	57%	39%	2%	1%
New Mexico	37.0	25.5	56%	30%	0%	14%	0%
Nevada	18.3	15.4	6%	73%	0%	22%	0%
New York	53.6	32.1	1%	42%	31%	24%	1%
Ohio	141.0	87.9	58%	24%	14%	2%	1%
Oklahoma	56.3	39.4	24%	47%	0%	29%	0%
Oregon	7.2	8.7	3%	26%	0%	71%	0%
Pennsylvania	136.0	91.1	26%	31%	39%	3%	0%
Rhode Island	2.6	2.8	0%	96%	0%	4%	0%
South Carolina	43.6	30.1	22%	17%	59%	2%	0%
South Dakota	4.0	2.9	18%	8%	0%	74%	0%
Tennessee	62.5	39.7	39%	14%	38%	8%	0%
Texas	255.0	233.1	30%	45%	10%	15%	0%
Utah	39.6	30.1	69%	22%	0%	9%	0%
Virginia	41.1	37.3	18%	45%	33%	3%	1%
Vermont	0.0	0.0	0%	0%	0%	100%	0%
Washington	10.9	10.6	4%	10%	9%	77%	0%
Wisconsin	48.6	42.7	52%	24%	16%	8%	0%
West Virginia	93.2	74.9	95%	1%	0%	3%	0%
Wyoming	48.8	45.7	88%	0%	0%	12%	0%



NEXT GENERATION SUSTAINABILITY

2017 **Vectren Corporation** Sustainability Report



— NEXT — GENERATION SUSTAINABILITY

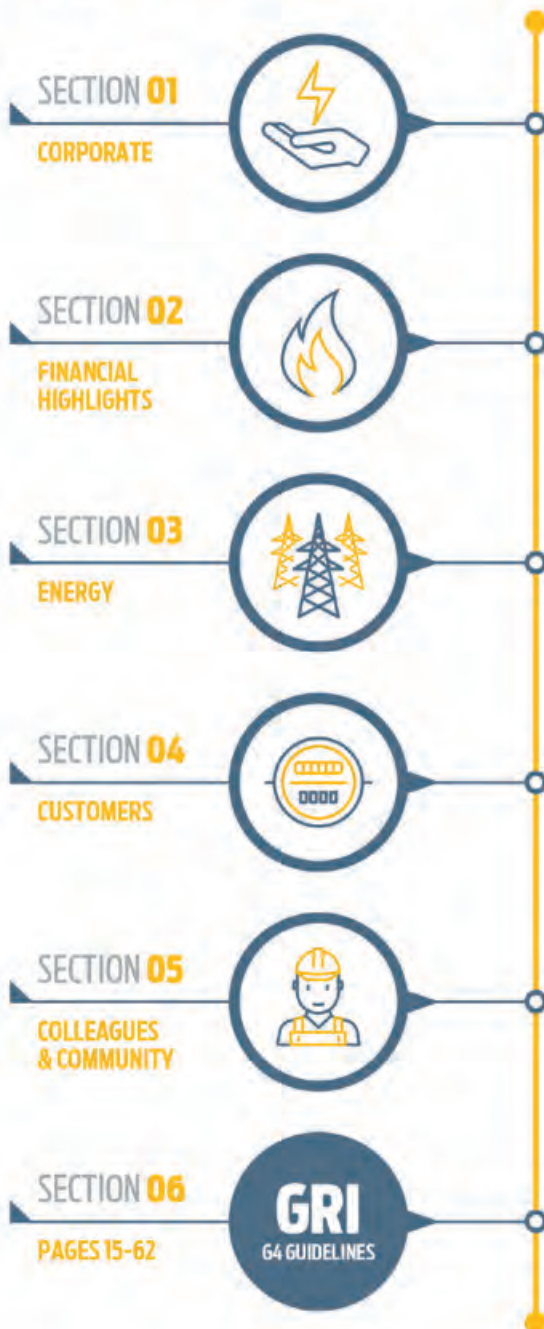
Our 2017 Sustainability Report reflects the new direction that Vectren is taking as it transitions its electric generation portfolio from nearly total reliance on baseload coal to a fully diversified portfolio of fuels, along with our grid modernization plan that we believe will provide Vectren's future long term electric supply needs in a safe, reliable and lower-emitting manner.



NEXT GENERATION SUSTAINABILITY

2017 Vectren Corporation Sustainability Report

WELCOME



In 2011, Vectren published its inaugural sustainability report. The title – Sustainability in Practice – was selected because we believe that Vectren was leading with sustainable business practices before the concept of sustainability became as widely recognized as it is today. In subsequent reports Vectren focused on its sustainable business practices relating to such things as environmental stewardship, electric reliability, energy conservation, safety, financial performance and its successful community sustainability programs.

We are excited to release our latest report entitled – Next Generation Sustainability – which reflects the evolving direction that Vectren is taking as it transitions its electric generation portfolio from nearly total reliance on baseload coal to a fully diversified and balanced energy mix that, along with our grid modernization plan, we believe will ensure Vectren meets its long term electric supply needs in a safe and reliable manner while dramatically lowering our carbon emissions. Our plan for a diversified generation portfolio is the result of a comprehensive integrated resource planning process, which included multiple opportunities for stakeholder input, and provides for the retirement of three aging coal-fired units and exit of a fourth, replacement of those units with new highly-efficient natural gas-fired generation and investment in utility solar projects commencing as early as 2018. Our new generation portfolio is expected to reduce Vectren's emissions of carbon 60% from 2005 levels, well below the emission targets called for in international accords, as well as provide for significant reductions of other air emissions and wastewater.

In addition to planning for a diversified fuel portfolio, in 2017 Vectren released its future electric grid modernization plan, another significant step toward Next Generation Sustainability. Vectren's multi-year grid modernization plan consists of more than 800 infrastructure projects through 2024 and joins its existing gas infrastructure investment plan to ensure Vectren continues to provide safe, reliable, service that meets the needs of its customers.

And finally, in furtherance of our continued efforts to enhance our corporate and sustainability governance and transparency, we have included a detailed discussion in this report of our current corporate governance structure, including the formation of a new Corporate Sustainability Disclosure Committee to ensure our stakeholders can continue to rely on the consistency and accuracy of the information contained in this and future sustainability reports and across all public disclosures by the Company on such matters.

Respectfully,

Carl L. Chapman
Chairman, President & CEO

John D. Engelbrecht
Chair, Corporate Responsibility & Sustainability
Committee of the Board of Directors

Angila Retherford
Vice President, Environmental Affairs
& Corporate Sustainability



OUR BOARD

Our Board of Directors consists of ten independent directors and our Chairman and Chief Executive Officer. The Board includes the position of an independent Lead Director who is elected by independent board members and is charged with the responsibility to coordinate the activities of the non-employee, independent directors.



Carl L. Chapman
Chairman, President &
CEO, Vectren Corporation



Derrick Burks
Retired Managing Partner,
Ernst & Young, LLP



James DeGraffenreid, Jr.
Retired Chairman &
CEO, WGL Holdings, Inc.



John D. Engelbrecht
Chairman & President, South
Central Communications Corp



Anton H. George
Principal, Vision
Investments, LLC.



Robert G. Jones
President & CEO,
Old National Bancorp



Patrick K. Mullen
President & CEO,
Chicago Bridge & Iron



R. Daniel Sadlier
Retired President & CEO,
Fifth Third Bank (Western Ohio)



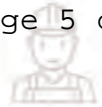
Michael L. Smith
Retired Executive Vice
President & CFO, Anthem, Inc.



Teresa J. Tanner
Executive Vice President
& CAO, Fifth Third Bank



Jean L. Wojtowicz
President & Founder, Cambridge
Capital Management Corp.



CORPORATE GOVERNANCE

Board Committees & Risk Management

The Board is ultimately responsible for risk oversight across the organization. That responsibility is shared by five standing committees comprised solely of non-employee directors which oversee financial, compensation, compliance, reputational and governance risks with specific responsibility for reviewing management's risk oversight function delegated to the Board's Audit and Risk Management Committees.

- **Nominating and Corporate Governance.** This committee is primarily responsible for corporate governance matters affecting the Company and its subsidiaries. Responsibilities include overseeing the succession planning process for the Board, chief executive officer, senior management and the leadership of Company's subsidiaries.
- **Audit and Risk Management.** This committee oversees the Company's financial reporting process. Responsibilities include overseeing the integrity of the Company's financial statements, the Company's internal audit function, Company's system of internal controls and disclosures, and Company's practices and processes relating to strategic risk assessment and risk management.
- **Compensation and Benefits Committee.** This committee is responsible for establishing compensation for the Company's executive officers and administering the Company's management compensation plans.
- **Finance Committee.** This committee provides oversight relating to the financing activities of the Company's utility and nonutility businesses.
- **Corporate Responsibility and Sustainability.** This committee is primarily responsible for both ensuring the discharge of the Board's duties relating to oversight of the Company's sustainability initiatives, as well as monitoring the Company's policies, practices and procedures designed to ensure compliance with governmental regulations.

Enterprise Risk Management

The Company has an enterprise Risk Management Committee composed of senior level management whose purpose is to ensure an enterprise-wide approach to managing risk and compliance. The primary responsibility of the Committee is to anticipate, identify, prioritize and proactively manage the Company's material risks and report the results of the Committee's activities to the Audit and Risk Management Committee of the Board. Under this enterprise risk management approach, the Committee oversees and approves a comprehensive company-wide risk assessment every two years, including an assessment of which risks are significant and provides assistance to business unit managers with risk monitoring and the implementation of strategies to mitigate risk in their areas. **The Committee periodically reviews and reports the following to the Audit and Risk Management Committee of the Board, as well as the full Board:**

1. All material business risks;
2. The processes, procedures & controls in place to manage material risks; and
3. The overall effectiveness of the enterprise risk management process.

Corporate Code of Conduct

The Audit and Risk Management Committee is responsible for reviewing and updating the Corporate Code of Conduct, as well as ensuring that management enforces and monitors compliance with the Code and that the Code complies with all applicable rules and regulations.

Sustainability Governance

Environmental, social and governance initiatives are integrated into the policies and principles that govern our company and reflect our commitment to sustainable growth. The Company initiated its corporate sustainability program in 2011 with the publication of its initial corporate sustainability report. Since that time the Company continues to develop strategies that focus on those environmental, social and governance factors that contribute to the long-term growth of the Company's sustainable business model. The Company's sustainability policies and procedures are designed to assure compliance with applicable laws and regulations, and are directly overseen by the Corporate Responsibility and Sustainability Committee. The Corporate Responsibility and Sustainability Committee meets at least three times a year.

The Committee charter requires that the Vice President of Environmental Affairs and Corporate Sustainability provide a report as to the Company's environmental compliance and sustainability strategies at each of the three regular Committee meetings, and the Vice President of Environmental Affairs and Corporate Sustainability meets with the full Board on an as-needed basis to discuss sustainability strategies, sustainability reporting and any issues that may arise throughout the year. In 2017 the Company established a Corporate Sustainability Disclosure Committee composed of management employees and overseen by the Company's Chief Financial Officer whose purpose is to ensure accuracy and consistency of the Company's sustainability disclosures across all of the Company's sustainability reporting platforms.

In 2015 the Corporate Responsibility and Sustainability Committee was renamed (formerly the Corporate Affairs Committee), and the Committee charter modified to emphasize the Committee's sustainability responsibilities.

The Committee shall oversee the Company's policies, practices and procedures relating to sustainability, including monitoring of current and emerging political and social action, and public policy and environmental issues that may affect the business operations, material financial performance or public image of the company. Such oversight shall also consider policies for sustainability consistent with long-term preservation and enhancement of the Company's financial, environmental and social capital.



FINANCIAL HIGHLIGHTS

Highlights of a Successful 2017

Vectren achieved another year of solid earnings growth in 2017, extending our record of consistent earnings growth to seven years. Reported net income was \$216.0 million, or \$2.60 per share. The foundation for this performance continues to be Vectren's utility group, which earned its overall allowed return on equity for the sixth straight year. Our electric utility also achieved a successful start to its 7-year grid modernization plan in 2017. The utility performance was supplemented with strong years from our two nonutility businesses, energy services and infrastructure services.

2017 also marked Vectren's 58th consecutive year of dividend increases, a record we are very proud of and that was extended in November when the Company raised the dividend 7.1%, in line with our long-term target. Earnings and dividend growth over the next 10 years remain targeted at 6-8%, in line with our seven percent compounded annual growth rate achieved over the last several years.

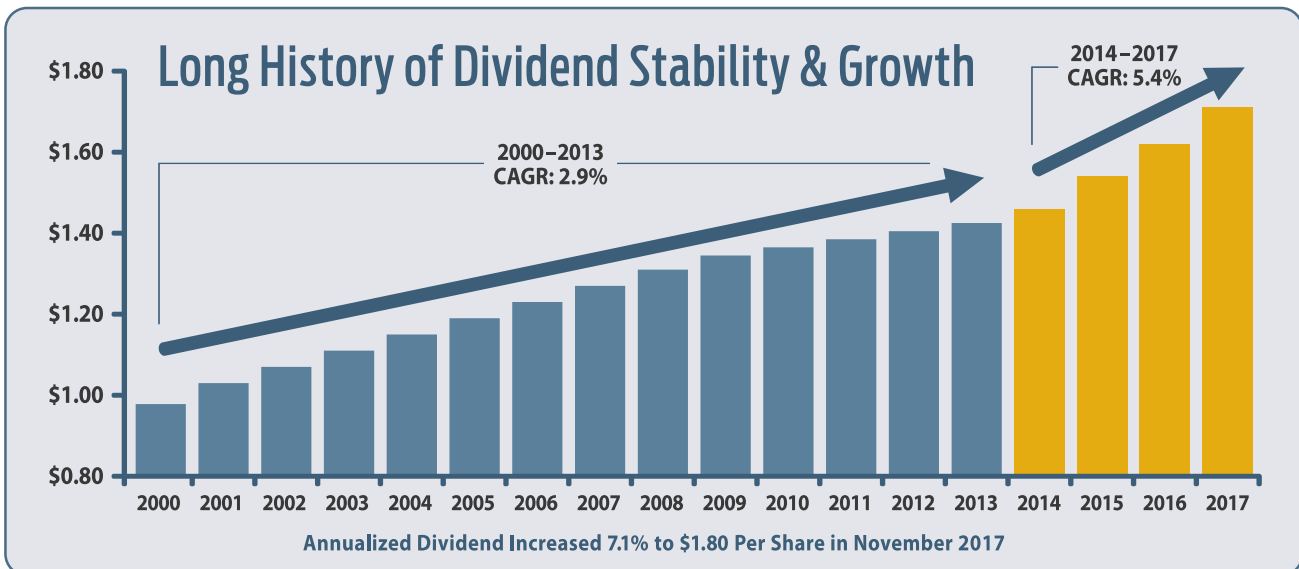
"Results for 2017 were on plan at \$2.60 per share, reflecting yet another year of earnings growth. The Utility Group performed as expected, largely driven by our continued investment in gas infrastructure programs," said Carl Chapman, Vectren's chairman, president and CEO. "Infrastructure Services and Energy Services also performed very well this year, each with record annual revenues."

"Late in 2017, we saw the enactment of the first major tax reform legislation in over three decades. The lower federal corporate income tax rate will allow us to flow back that reduction to our customers. We are working with regulators in both Indiana and Ohio to implement those bill reductions timely. The lower tax rate also provided an earnings benefit to the non-rate-regulated operations. That benefit, I'm pleased to announce, has allowed us to make a nearly \$70 million contribution to fund the Vectren Foundation for over a decade and demonstrates our longstanding commitment to the communities we serve, while eliminating the need for Foundation funding expense over the same period."

“Results for 2017 were on plan at \$2.60 per share, reflecting yet another year of earnings growth. The Utility Group performed as expected, largely driven by our continued investment in gas infrastructure programs.

Carl Chapman

Chairman, President & CEO of Vectren Corporation”



SECTION 02 – FINANCIAL HIGHLIGHTS



DIVIDEND INCREASED 7.1% IN NOVEMBER 2017 – 58 CONSECUTIVE YEARS OF DIVIDEND INCREASES

Natural Gas & Electric Infrastructure Investment Plan

Vectren’s multi-year grid modernization plan consists of over 800 infrastructure projects through 2024 and joins its existing natural gas infrastructure investment plan to ensure Vectren continues to provide safe, reliable, service that meets the needs of its customers.

.....

Smart Energy Future

Investment Plans for Gas & Electric Businesses of \$6.5 Billion

GAS
INFRASTRUCTURE:
~\$3.8 BILLION
of CapEx (2018-2027)

ELECTRIC GRID
MODERNIZATION:
~\$1.1 BILLION
of CapEx (2018-2027)

GENERATION
TRANSITION:
~\$1.3 BILLION
of CapEx (2018-2027)

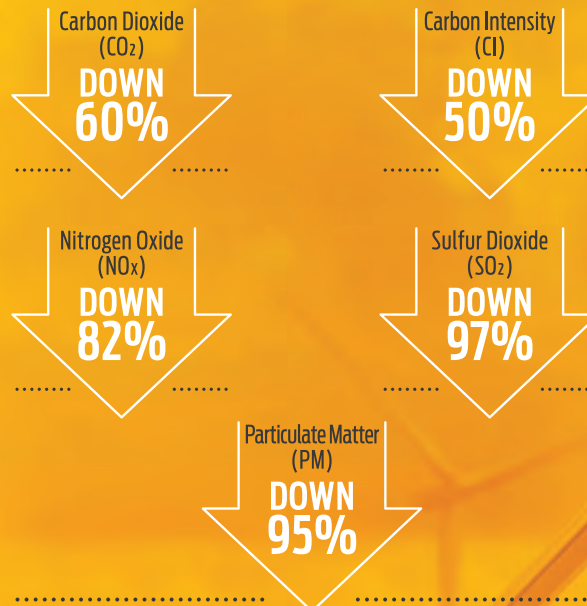
SECTION 03 – ENERGY



VECTREN'S NEW ENERGY PORTFOLIO

- Lower Emitting Fleet
- Zero Emission Renewables
- Energy Efficiency Programs

Projected 2024 Emission Reductions:



*Assumptions based on Vectren's preferred Integrated Resource Plan portfolio with reductions from a 2005 emissions baseline.

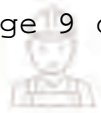
Vectren's New Energy Portfolio

Today Vectren owns and operates approximately 1,000 megawatts of coal-fired generation, 245 megawatts of natural gas-fired peaking units and a 3-megawatt landfill gas-to-electricity facility. The Company also has 80 megawatts of wind power through two long-term purchase agreements and 32 megawatts of coal generation through its ownership in the Ohio Valley Electric Corporation. This portfolio, dependent largely on coal, is about to change dramatically. On February 20, 2018, Vectren filed a request with the Indiana Utility Regulatory Commission seeking authority to implement changes to its generation portfolio. These proposed changes would transition our electric generation portfolio from nearly total reliance on baseload coal to a fully diversified and balanced portfolio of fuels, including coal, natural gas and renewables.

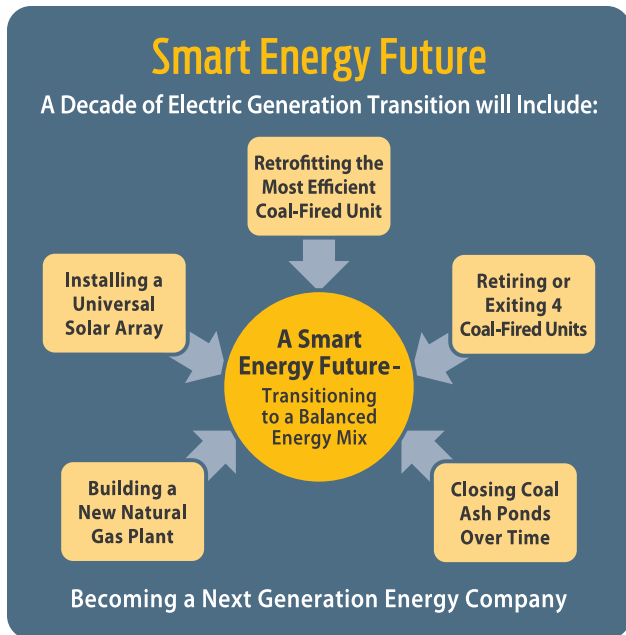
If authorized by the Indiana Utility Regulatory Commission, Vectren plans to construct a 800-900 megawatt natural gas combined cycle plant to replace the coal-fired generation which the Company has slated for retirement.

Vectren will also be upgrading the wastewater treatment equipment at its coal-fired unit at the F.B. Culley 3 plant and commencing closure of the Culley West ash pond. Vectren will commence closure of its two remaining ash ponds in 2024 upon the retirement of the A.B. Brown coal-fired units and completion of the planned upgrades to F.B. Culley's wastewater discharge equipment; however, the Company is currently exploring potential recycling opportunities that could result in commencement of preliminary pond closure activities as early as 2019.

These steps, combined with our continuing efforts to modernize the critical infrastructure required to provide electric service to our customers and provide customers with the tools to manage their energy usage, will ensure that Vectren continues its steady progress toward its goal of becoming a next generation energy company, offering a safe, reliable and lower carbon electric service that our customers demand over the long term. Since 2011, Vectren has kept its promise to hold electric rates flat, and as it transforms its generation portfolio, the Company will continue its efforts to mitigate impacts to customer bills.



GENERATION TRANSITION



Vectren's Solar Projects

Not only is Vectren upgrading its electric system, but we are also continuing our path toward a balanced energy mix with universal solar projects. Vectren will partner with First Solar, Inc. to build a 50-megawatts (MW) solar array that will be situated on approximately 300 acres and will consist of about 150,000 solar panels. The array will be mounted on a single-axis tracking system, which enables the panels to automatically pivot to enhance energy generation as the sun's rays move across the surface of the Earth. The facility, which should be operational in the fall of 2020, is expected to generate enough power to meet the needs of more than 11,000 households per year. The project will provide up to 250 jobs at its peak, many of which will be union labor. Construction will begin after the Indiana Utility Regulatory Commission authorizes the project; a decision is expected in the first half of 2019. "This significant renewable resource will be connected to our system to serve our local customers, which will bring one of the largest single-sited solar farms in the Midwest to southern Indiana," said Chapman.

Vectren Planned Solar Projects:

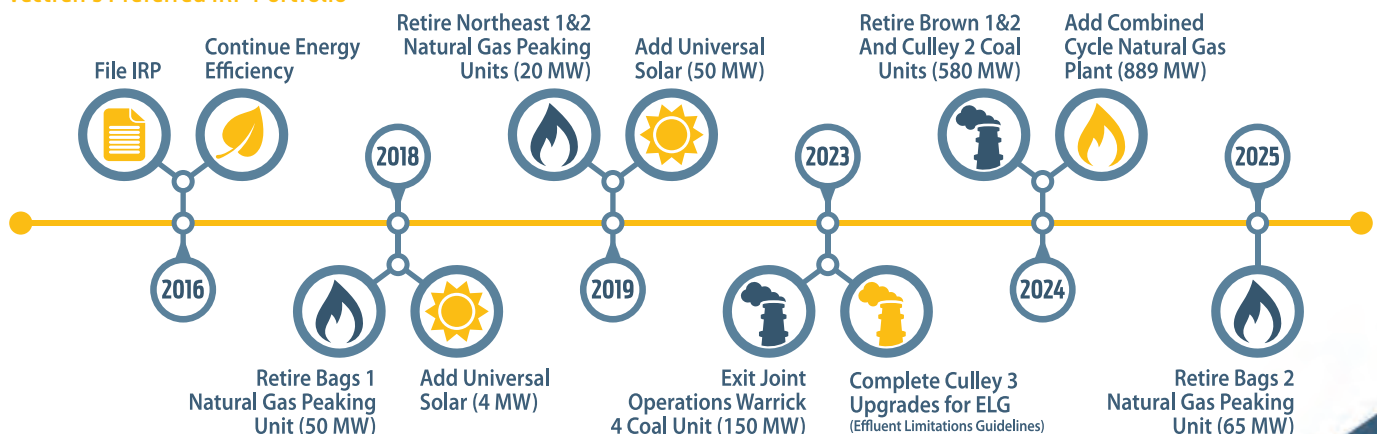
- **50MW Utility-Scale Solar Array Built in Spencer County, Indiana**
- **(2) 2MW Projects** that will be built in 2018, one near Highway 41 in Evansville, Indiana and the second near Oakhill Cemetery in Evansville, Indiana. These two combined will supply enough renewable energy to power 600 homes each year.

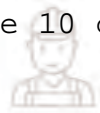
Vectren's Planning Process

In 2016, Vectren completed an extensive year-long integrated resource planning process, which considered a broad range of potential resources and variables to ensure the plan offered a long-term reliable and reasonably priced generation portfolio as well as a balanced energy mix. In arriving at a preferred generation portfolio we considered the costs to continue operating our existing coal-fired generation units in a manner that complies with current and anticipated future environmental requirements, as well as various resource alternatives, such as the use

of energy efficiency programs and renewable resources as part of the overall generation portfolio. The Company received robust stakeholder participation and feedback, holding three public stakeholder meetings. Vectren's generation transition plan was presented to the public in November 2016 and includes the retirement of A.B. Brown Units 1 & 2, F.B. Culley Unit 2 and exiting joint operations of Warrick Unit 4 with Alcoa, the construction of a new natural gas-fired combined cycle unit and the addition of 54 megawatts of solar by 2025.

Vectren's Preferred IRP Portfolio





OUR APPROACH TO CARBON

Carbon strategy is a cornerstone in Vectren's corporate planning process. Vectren regularly assesses the risks and opportunities associated with carbon as part of our overall strategic business planning and enterprise risk management processes. **Under Vectren's smart energy future transition plan the Company has identified three critical components of a sustainable carbon strategy:**

1. **Reducing our own emissions and compliance with environmental standards.**
2. **Ensuring our infrastructure is resilient to changing climate. See page 8 in our report for more information on steps the Company is taking to modernize its grid.**
3. **Helping our customers reduce their emissions. See page 9 in our report for more information on steps the Company is taking to help customers meet their own carbon reduction goals.**

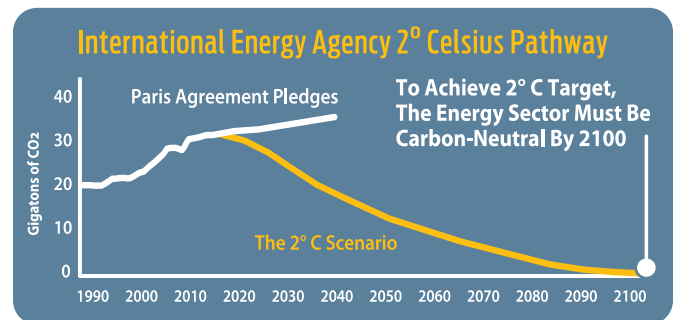
Reducing Our Own Emissions

Vectren has a long-standing commitment to environmental performance. Since the 1990's, Vectren's coal-fired generation fleet has shown a steady reduction of sulfur dioxide, nitrogen oxide, mercury and particulate emissions through its investments in scrubbers, selective catalytic reduction technology and fabric filters. In addition to reductions of these traditional pollutants, the Company has reduced its emissions of carbon by 35% below 2005 levels (on a tonnage basis) through the retirement of F.B. Culley 1, expiration of municipal contracts, successful execution of electric conservation programs, the addition of renewable generation and the installation of more efficient dense pack turbine technology.

But our commitment to carbon emission reductions does not stop there. Once approved and with the successful execution of Vectren's electric generation transition plan, Vectren will achieve its goal of 60% reduction of carbon emissions below 2005 levels by 2024. Moreover, the carbon intensity of Vectren's generation fleet will drop from 1,950 lbs CO₂/MMBtu to 980 lbs CO₂/MMBtu, well below the intensity targets set in EPA's Clean Power Plan. While it is still unclear as to the short-term future of any carbon regulation, Vectren's smart energy future transition plan will position the Company to successfully comply long-term with carbon reduction requirements.

Science-Based Goal

With its smart energy future transition plan, Vectren is taking action to reduce its own carbon emissions consistent with the international community's goal of preventing global temperatures from rising more than two degrees Celsius by the year 2100. Using guidance from the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency's 450 parts per million (ppm) scenario, the Company assumes a 50% carbon emission reduction from 2005 levels by 2050 would be required to align with the IPCC goal. Vectren's actions being taken today as part of our electric generation transition plan will exceed the IPCC emission reduction targets meant to limit global temperature increases to two degrees Celsius by 2100 as depicted in the chart below.



EPA Natural Gas STAR Methane Challenge Program

Vectren is a founding member of the U.S. Environmental Protection Agency's Natural Gas STAR Methane Challenge Program, whereby natural gas utilities are working on an effort to reduce carbon emissions through voluntary commitments to reduce methane emissions. The natural gas companies participating in the program represent 66% of the natural gas customers served in the United States.

Vectren has committed to replacing unprotected steel and cast iron mains and services at a rate of at least five percent annually through 2021.

Further, Vectren expects to have eliminated all such piping on its system by 2023. Moreover, Vectren Infrastructure Services Company assists other natural gas utilities to do the same.



SECTION 03 – ENERGY



VECTREN'S CARBON REDUCTION GOAL: 60% REDUCTION OF CO₂ EMISSIONS FROM 2005 LEVELS BY 2024

Modernizing Electric & Natural Gas Infrastructure for a Smart Energy Future

As electric assets continue to age and new, more reliable and efficient technologies emerge, we must continue making essential investments in our system. Continued electric system reliability and safety, shorter electric power outages, faster electric outage identification, fewer estimated customer bills, quicker service and more information to improve customer control over energy use are all pieces of Vectren's plan to continue delivering reliable electric service to our 145,000 customers as part of our Smart Energy Future.

In 2017, Vectren sought and received approval to begin enhancing our electric system by investing approximately \$450 million in new infrastructure. Encompassing more than 800 projects over the next seven years, Vectren's energy grid modernization plan is an integral part in the company's strategy to become a next generation energy company. This robust electric infrastructure improvement strategy will enhance reliability and modernize the electric grid that delivers power to Southwestern Indiana. These electric system improvements include upgrades to portions of Vectren's substations as well as the transmission and distribution networks. This work will also prepare the grid to accept advanced technology, improving service to customers and providing them with access to better information about their energy use.

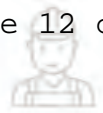
According to a study conducted by Indiana University, this grid modernization plan will provide significant benefits for the economy, including a positive economic impact of nearly

\$650 million over the investment period. Studies show this plan will generate around \$20 million in state and local government tax revenue effects through 2023, and at its peak it will support approximately 1,000 jobs.

Enhancements will also be done at the meter level. In December 2017, Vectren began a year-long program to install smart meter technology to all electric customers. Smart meters will not only provide and improve system reliability and resiliency, they also enhance the customer experience by virtually eliminating estimated bills, enabling quicker service, faster electric outage identification and more tools to manage energy use. Full deployment is expected by December 2018.

While Vectren recently received approval for its grid modernization program, work continues on its existing gas infrastructure plan. Vectren gas programs include the replacement of bare steel and cast iron distribution pipelines, as well as improvements to transmission and other distribution gas system assets. Since 2008, Vectren has invested approximately \$581 million in the replacement of aged bare steel and cast iron gas distribution pipeline infrastructure in Indiana and Ohio. Vectren has also invested approximately \$233 million on improvements to its gas transmission pipeline infrastructure since 2012, and \$78 million on improvements to its gas distribution system infrastructure since 2013. Vectren's total investment in gas infrastructure modernization programs in Indiana and Ohio is approximately \$892 million.

Changes in weather patterns resulting in more frequent and severe weather increase the risk of interruptions to service for Vectren customers. Modernizing and strengthening of the Vectren system infrastructure builds resilient service for our customers.



CUSTOMER PROGRAMS / SMART METERING / ENERGY EFFICIENCY

Transforming Our Customers' Experience

Vectren is executing an integrated, multi-year business transformation initiative focused on the technologies, which allow us to provide excellent customer experience as well as improved strategic operations. Program ExCEL (Excellent Customer Experience Lifecycle) includes enhancements to technology systems and processes associated with electric and natural gas metering as well as customer care and billing systems.

In order to support the energy grid infrastructure improvements, the strategic operations enhancements include technology added to the electric distribution system to help manage electric outage information and customer data. When fully deployed, these systems will help pinpoint causes and locations of system interference, allowing field crews to respond faster and provide better restoration times to those impacted customers.

Program ExCEL launched in 2017 with a multi-year phased approach. Systems will begin to come online in 2018 with new enhancements and offerings coming online in subsequent years.

Benefits for Customers

- Access to detailed energy usage information
- Accurate billing data due to virtual elimination of estimated meter reads
- Power outage alerts
- More precise outage restoration information

Warehouse Upgrades Lead to Increased Energy Efficiency

In 2017, Park Creek J.V. LLC made the decision to improve their heating system in their 150,000 sq. ft., Plainfield, Ind., warehouse facility. After an energy assessment and rebate from Vectren, the company was able to install six rack unit heaters to replace their previous 27 inefficient unit heaters. This replacement will allow Park Creek to use less energy and better manage their energy costs. Vectren rebates were able to offset the total project cost by more than 30 percent.

"Finding ways for businesses to manage energy costs makes a positive impact on not only their overall financial state, but also the environment as a whole since they are burning less natural gas," said Rina Harris, Vectren director of energy efficiency. "Vectren has been offering energy efficiency programs to customers for nearly a decade."

Customer Energy Efficiency

Since 2010, Vectren electric energy efficiency programs, have saved more than 1.3 million megawatt hours which equals enough energy to power

115,422
Homes for a Year

Since 2007, Vectren gas energy efficiency programs in Indiana have saved a total of more than 167 million therms which would heat

208,443
Homes for a Year

Since 2009, Vectren gas energy efficiency programs in Ohio have saved a total of more than 38 million CCFs which would heat

49,885
Homes for a Year

**All of These Programs Together
Equal a Carbon Savings of**

**1.2 Million Tons
of Carbon Dioxide**

SECTION 04 – CUSTOMERS



Energy Systems Group Water Resource Recovery Project - Niskayuna, New York

The Town of Niskayuna, New York partnered with Energy Systems Group, Vectren's leading energy services provider, to serve as the prime contractor of a multi-year project that will include improvements to its 3 million gallons per day (MGD) wastewater treatment plant. In addition to meeting New York State Department of Environmental Conservation (NYSDEC) wet weather management obligations, the plant improvements will expand the plant's treatment capacity to 3.5 MGD, positioning Niskayuna for future economic growth.

www.energysystemsgroup.com/niskayuna/

The new systems will improve treatment during storms and wet weather, ensuring the protection of the nearby Mohawk River. The plant upgrades address much needed infrastructure renewal and will improve operational efficiency and reduce the wastewater treatment plant's carbon footprint by incorporating renewable energy. One aspect of the project will leverage the existing anaerobic digesters' excess capacity to accept organic waste, produce additional biogas and use it as fuel for onsite electricity production. The plant's new ability to produce energy on-site will make it a energy net zero facility and will create a new source of revenue for the town.

Key Installed Technologies

- New influent wet weather improvements – 300,000 gallon storm water storage tank and associated infrastructure
- Activated sludge aeration system
- New UV disinfection system and plant water system
- New biogas-driven cogeneration system

SECTION 05 – COLLEAGUES & COMMUNITY



CURRENTLY 30% OF OUR FIELD WORKFORCE IS ENROLLED IN FORMAL APPRENTICESHIP PROGRAMS, WITH 48 SLATED TO GRADUATE IN 2018.



SAFETY –

ENSURING SAFETY THROUGH EMPLOYEE ENGAGEMENT & CONSTANT LEARNING

Safety culture is the collective set of attitudes, norms, beliefs and practices that are shared with respect to risk and safety. Vectren is committed to a positive safety culture that creates collaboration, positive attitudes toward compliance, responsibility for the safety of each other and the public, protection of the environment and collective investment in the health of the business. **Vectren's safety culture is visible within the organization through:**

- **Routine and Formal Communications** about risk identification, awareness and mitigation activities
- **Fostering Mutual Trust** at all levels from all levels from the Board of Directors and CEO to management to the individual colleague, with open and honest communication
- **Allocating Resources** to enable continuous improvement of safety performance
- **Inspiring and Enabling Our Workforce** to promote changes necessary to enhance safety
- **Cultivating Organizational Excellence** by encouraging a learning environment and employee ownership
- **Pursuing Operational Excellence** through consistent and efficient business processes and data-driven decision making
- **Prompt and Effective Incident Response** to minimize the adverse impacts
- **Leadership Commitment and Stakeholder Engagement** to enable the effective implementation and continuous improvement of safety

Vectren's Safety Management System (SMS) is a framework of goals, objectives, processes and procedures. It enables us to execute strategies using risk management, established controls, assessment and continuous improvement to meet safety and business objectives. It is built on processes providing more discipline in the use of data and other information for better decision making. Our SMS objectives strengthen and broaden Vectren's safety culture. Our overall safety performance will improve by making risk-reducing decisions.

In 2017, Vectren met with the Indiana Pipeline Safety Division and PHMSA as a courtesy to review Vectren's SMS and for PHMSA to formulate SMS audit plans based on Vectren's SMS. Vectren has demonstrated that its Safety Management System is an industry leading program. PHMSA confirmed that in its on-site program review in 2017. Vectren has participated in the American Gas Association (AGA) Safety Management System Pilot Program with twelve other utilities over the last two years. Vectren has been a leader in the program and continues to present at AGA, National Association of Pipeline Safety Representatives, and other industry conferences about the SMS journey. Every member of our workforce is expected to be a champion of Safety. With clear expectations of ownership and accountability, Vectren has seen increased engagement across the organization and outside the organization with our contractors, excavators and first responders.

Vectren is committed to keeping employees and the communities we serve safe. One of the pillars of employee safety is education, and Vectren strives to provide a continual learning environment. At Vectren, learning starts at the hiring and apprenticeship stage and continues with advanced training throughout an employee's career. Vectren currently has ten formal apprenticeship programs. These programs have evolved over time based upon employee feedback and the continued evolution of technology advancement, and include a significant portion of time in the field with mentors. The Company shows its commitment to employee learning with regional learning centers. In 2017, we completed construction of the Yankee Learning Center in Ohio and plans are underway for construction of a new learning center in Evansville. These two new learning centers will join our existing training center in Franklin, Ind. to drive a consistent approach to formalized hands-on learning in a controlled environment and will continue to drive success for years to come.

Safety from the Ground Up

While employee knowledge and skill are critical to ensuring safety, Vectren's workforce development strategy also focuses on employee awareness and engagement. Vectren has standing Safety Teams at the power plants and divisional levels. These teams drive common business unit plans that enable teams to learn from each other and solve problems holistically. A Safety Culture Advisory Team consisting of representatives from both Vectren and Union leadership monitor the activities of the Safety Teams and set collaborative strategy. The Safety Teams work to solve problems locally, but also have the ability to move up and down the organization as needed to resolve concerns. And we are not just focused on safety for employees in the field. Each physical area of the corporate and call center facilities have designated Safety Captains, which help to promote safe activities and training for office roles, and includes risk reduction with ergonomic assessments, emergency planning and hazard recognition.

Structured Safety Meetings

One example of the collaborative approach to employee safety between teams is the creation of Structured Safety Meetings, which was a concept proposed by Union leadership to increase participation and ownership of local safety meetings. The teams employ standard work instructions and visual management boards to communicate safety issues, training and metrics. Conversation is not limited to employee safety, but also has a focus on public and infrastructure safety awareness – expanding the idea that overall risk management is all of our jobs.



DIVERSITY, INCLUSION & HUMAN EQUITY

At Vectren we recognize that people are what differentiate a high performing company resulting in better communities, customer service, innovative energy solutions and financial outperformance relative to our peers. In order to be successful as a company it is our people that drive that differentiation and success.

What sets us apart is how intentional and deliberate our efforts and actions are in this area, driven by our Human Equity Strategy. We believe that moving from Diversity to Inclusion and ultimately Human Equity (D,I, & HE) is a required shift. Our strategy aims to ensure that each employee feels valued, included and is an integral part of our organizations success. This positions us to leverage the unique skills, attributes and talents of each individual.

The transition starts from the top down, with all our senior executives leading the way and supporting Vectren's Human Equity Vision. The D,I, & HE strategy is divided into four key focus areas. Each area focuses on defined strategic initiatives, projects and programs to drive our transformation and are led by our executive team.

The 4 Focus Areas Are:

- **Talent Attraction and Retention** – Enabling the organization to identify, attract, recruit, develop and retain the best talent is key to a successful human equity strategy. This area focuses on Vectren becoming a talent magnet and an employer of choice for all.
- **Culture and Environment** – Culture includes Vectren's Vision, Mission, Core Values, norms, working language, systems, symbols, beliefs and habits. This area focuses on the collective behaviors of our leadership and associates and the meanings that they attach to their actions. "Culture is what individuals do when no one is looking."
- **Customer Focus, Supplier Diversity and Recognition** – Understand and recognize that the diversity of our clients and suppliers enable Vectren to improve customer satisfaction and enhance economic opportunity. This area also focuses on the external recognition for being an employer and supplier of choice and an advocate for human equity with our various external stakeholders.
- **Leadership Development** – Leadership behavior is key to achieving human equity within Vectren. This area focuses on ensuring Vectren leaders exhibit Equitable Leader competencies and are engaged in the execution of the human equity strategy and plans.

Human Equity is about organizational effectiveness not just the right thing to do. A culture of human equity drives how we assess talent, evaluate organizational/departmental needs and align employees with positions and roles that align with their skills, knowledge and intangibles. Organizations that have a sustainable, strong, productive culture have something that endures beyond any specific leader. Human Equity will positively affect Vectren's culture, engagement, empowerment and sustainability.

VECTREN FOUNDATION

One of Vectren's core values is a commitment to the communities in which we serve. Vectren and its employees support the communities in which we live and work via the Vectren Foundation, employee giving and volunteerism.

In 2017, Vectren funded the Vectren Foundation from earnings as the result of recent tax reform. The \$70 million infusion will be used to help local communities grow in their quality of life and take place over a 10-year period.

2017 Vectren Community Impact

Using Everyday Opportunities to Achieve Extraordinary Outcomes

With \$5 Million in Grants and Sponsorships to 400+ Organizations, Here's How We Impacted Our Communities in 2017:

Education:

\$1,300,000 Invested

Supported 209,000 Students and 2,800 Teachers



Community Sustainability:

\$3,940,000 Invested

14,500 Workforce Trained and Assisted 35,000 with Services

Environmental + Energy Conservation:

\$323,500 Invested

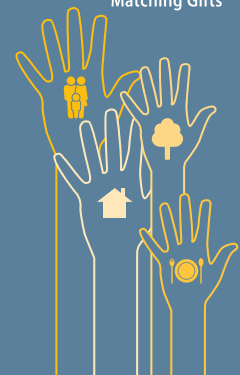
Planted 255 Trees and Removed 79,200 lbs. of Trash



Team Vectren:

56,000+ Hours Contributed by

1,500 Team Members Sparking \$93,000 Matching Gifts



Disaster Assistance:

\$205,000 Invested

Supported Disaster Relief Efforts for Hurricanes Harvey, Irma and Maria



Learn more at vectren.com/foundation

SECTION 05 – COLLEAGUES & COMMUNITY



Community Catalyst Program

Vectren’s community sustainability strategy centers upon Vectren’s ability to bring participants together to revitalize neighborhoods. Community Catalyst is a key program initiated by the Vectren Foundation to drive targeted sustainability efforts across the Vectren service territory. Through this effort, Vectren builds strategic partnerships with community stakeholders in a variety of fields including education, healthcare, non-profit organizations and neighborhood residents. Stakeholders in partnership with Vectren work together to organize neighborhoods into partnerships, develop strategic action plans driven by residents, and invest time and funds to make an impact in communities served by Vectren.

Cities & Neighborhoods Served by our Community Catalyst Program:

Anderson, Indiana
Sweet 16
Neighborhoods
(Near West Side)

Lafayette, Indiana
Wabash Neighborhood

Marion, Indiana
Mag 7 Area

Dayton, Ohio
McCook Field &
Old North Dayton
Neighborhoods

Muncie, Indiana
Thomas Park/Avondale
& South Central
Neighborhoods

Evansville, Indiana
Jacobsville &
Tepe Park
Neighborhoods

Terre Haute, Indiana
Ryves Neighborhood

Making an Impact In Terre Haute, Indiana

In 2015, Vectren brought together local leaders with a vested interest in revitalizing the Ryves Neighborhood in Terre Haute, Ind. The group is focused on business development and employment, beautification, housing and access to services. Vectren was the catalyst which fostered new partnerships which began to make positive differences in the local community. Through this collaboration, it is possible to make a bigger, lasting impact and serve more families in the Ryves Neighborhood.

Habitat for Humanity was one partner organization who has been able to make a significant impact in the Ryves Neighborhood. In 2017, they were able to complete their first revitalization project with the help of a grant from the Vectren Foundation. The first project was an aging home which required a variety of exterior projects ranging from replacement of siding to fixing a garage door opener. The most beneficial enhancement was the installation of a new porch and railing on the front of the home. This replaced an uneven leaky porch which posed challenges for the homeowner and concerns about the impact to the overall structural foundation.

This grant from Vectren will further allow Habitat to repair homes and restore dignity to the surface of neighborhoods, assist other partners with community gardens and education and most importantly empower neighborhood residents.

Another supporting partner of the Ryves neighborhood revitalization effort joining Vectren is Rose-Hulman Institute of Technology. With funding from the Vectren Foundation, Rose-Hulman partnered with Benjamin Franklin Elementary for the Ryves Up! initiative. Ryves Up! is an afterschool program dedicated to helping students learn about STEAM (science, technology, engineering, arts and mathematics) and empowering the students in an impoverished area through gardening. The gardening program gives students social and environmental context for problem solving.

The food raised in the garden is used in the school or sold at low cost to area residents to raise funds and awareness for the program. If students can learn about growing food and see the process in their own playground, perhaps their enthusiasm could trickle out to their families and other community members. The Ryves community has some of the most intense poverty in Terre Haute and residents lack access to grocery stores and other sources for healthy, natural food. Ryves Up! is helping to close the gap for this neighborhood.





ABOUT THIS REPORT

This report is 'In Accordance' with the Global Reporting Initiative (GRI) G4 Guidelines – Core option. GRI is a sustainability framework aimed at increasing transparency among businesses and organizations worldwide.

This index includes the Electric Utility Sector Supplement (EUSS). Indicators specific to the EUSS are shown as EU (#) and can be found in the 'Standard Disclosures' section.

The reporting period for most information is 2017. Data from additional years is provided where appropriate.

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STANDARD DISCLOSURES

This section of indicators contains fundamental information about our organization, details about basic strategy and analysis and descriptions of our management structure and stakeholders.

STRATEGY & ANALYSIS

G4-1 Statement from the Most Senior Decision-Maker of the Organization

In 2011, Vectren published its inaugural sustainability report. The title – Sustainability in Practice – was selected because we believe that Vectren was leading with sustainable business practices before the concept of sustainability became as widely recognized as it is today. In subsequent reports Vectren focused on its sustainable business practices relating to such things as environmental stewardship, electric reliability, energy conservation, safety, financial performance and its successful community sustainability programs.

We are excited to release our latest report entitled – Next Generation Sustainability – which reflects the evolving direction that Vectren is taking as it transitions its electric generation portfolio from nearly total reliance on baseload coal to a fully diversified and balanced energy mix that, along with our grid modernization plan, we believe will ensure Vectren meets its long term electric supply needs in a safe and reliable manner while dramatically lowering our carbon emissions. Our plan for a diversified generation portfolio is the result of a comprehensive integrated resource planning process, which included multiple opportunities for stakeholder input, and provides for the retirement of three aging coal-fired units and exit of a fourth, replacement of those units with new highly-efficient natural gas-fired generation and investment in utility solar projects commencing as early as 2018. Our new generation portfolio is expected to reduce Vectren's emissions of carbon 60% from 2005 levels, well below the emission targets called for in international accords, as well as provide for significant reductions of other air emissions and wastewater.

In addition to planning for a diversified fuel portfolio, in 2017 Vectren released its future electric grid modernization plan, another significant step toward Next Generation Sustainability. Vectren's multi-year grid modernization plan consists of over 800 infrastructure projects through 2024 and joins its existing gas infrastructure investment plan to ensure Vectren continues to provide safe, reliable, service that meets the needs of its customers.

And finally, in furtherance of our continued efforts to enhance our corporate and sustainability governance and transparency, we have included a detailed discussion in this report of our current corporate governance structure, including the formation of a new Corporate Sustainability Disclosure Committee to ensure our stakeholders can continue to rely on the consistency and accuracy of the information contained in this and future sustainability reports and across all public disclosures by the Company on such matters.

Carl L. Chapman
Chairman, President & CEO

John D. Engelbrecht
Chair, Corporate Responsibility & Sustainability
Committee of the Board of Directors

Angila Retherford
Vice President, Environmental Affairs
& Corporate Sustainability

ORGANIZATIONAL PROFILE

G4-3 Name of the Organization

Vectren Corporation

G4-4 Primary Products, Services & Divisions

Vectren Corporation is an energy holding company. Vectren's wholly owned subsidiary, Vectren Utility Holdings, Inc., serves as the intermediate holding company for three operating utilities: Vectren Energy Delivery of Indiana-North (Vectren Indiana-North), Vectren Energy Delivery of Indiana-South (Vectren Indiana-South) and Vectren Energy Delivery of Ohio (Vectren Ohio).

Vectren Indiana-North provides energy delivery services to 592,400 natural gas customers located in central and southern Indiana. Vectren Indiana-South provides energy delivery services to 145,200 electric customers and 111,500 gas customers located in southwestern Indiana. Vectren Indiana-South also owns and operates electric generation to serve its electric customers and optimizes those assets in the wholesale power market. Vectren Ohio provides energy delivery services to approximately 318,100 natural gas customers located in west central Ohio.

Vectren's Nonutility Group is involved in Infrastructure Services and Energy Services. Infrastructure Services provides underground pipeline construction and repair services (Miller Pipeline and Minnesota Limited). Energy Services provides energy performance contracting and sustainable infrastructure services, such as renewables, distributed generation, and combined heat and power projects (Energy Systems Group).

G4-5 Headquarters

Vectren Corporation is based in Evansville, Indiana. Additional information can be found on the About Vectren page on [Vectren.com](http://www.vectren.com) (www.vectren.com/corporate/about).

G4-6 Countries of Operation

Vectren solely operates in the United States of America.

G4-7 Ownership & Legal Form

Vectren Corporation is an investor-owned corporation trading on the New York Stock Exchange under the symbol, VVC.

G4-8 Markets Served

Vectren energy delivery subsidiaries provide natural gas and/or electricity to more than 1 million customers in the adjoining service territories which cover nearly two-thirds of Indiana and about 20 percent of Ohio, primarily in the west-central area. While the energy delivery subsidiaries serve residential, commercial and industrial customers within a regulated footprint of Indiana and Ohio, Vectren's nonutility subsidiaries and affiliates offer energy-related products and services to customers throughout the United States. The infrastructure services division serves the pipeline industry by providing underground pipeline construction and repair to utility infrastructure. The targeted business sectors include natural gas, oil, gasoline/petroleum, water and sewer. Vectren's energy services division serves schools, hospitals, governmental facilities and other private institutions across America. For a detailed description of the company, please see our 2017 Annual Report and Form 10-K (investors.vectren.com).

G4-9 Scale of the Reporting Organization

Workforce

As of December 31, 2017, Vectren and its consolidated subsidiaries had approximately 5,500 employees. Of those employees, 700 are subject to collective bargaining arrangements negotiated by Vectren's utility division and 2,800 are subject to collective bargaining arrangements negotiated by the infrastructure services division. Please see response to Standard Disclosures indicator G4-10 for a detailed breakdown of Vectren utility and corporate employees by region.

Shareholders

As of December 31, 2017, Vectren had 83.0 million shares outstanding and approximately 7,800 registered shareholders. Vectren had a market capitalization of 5.4 billion and our largest shareholder was BlackRock, Inc. which held approximately 8.3 million shares, or 10 percent.

Financial Information

All revenues are sourced from operations within the U.S. In 2017, Vectren reported operating revenue of \$2,657.3 million. For additional financial data, please see the response to Economic indicator G4-EC1 and our 2017 Annual Report and Form 10-K (investors.vectren.com).

Products & Services

Vectren provides energy delivery services of natural gas and electric to customers in Indiana and Ohio. For a detailed breakdown of our customers by fuel source and region, please refer to indicator G4-EU3.



G4-10 Total Utility & Corporate Workforce

Total Workforce by Gender & Territory (2017)*

	Males	Females	Total
Vectren Indiana–North	380	68	448
Vectren Indiana–South	786	477	1,263
Vectren Ohio	152	32	184
Total Employee Headcount	1,318	577	1,895
*Excludes subsidiaries. Vectren does not track this information for contractors.			

G4-11 Percentage of Employees Covered by Collective Bargaining Agreements

Total Workforce by Employment Type/Contract & Territory (2015-2017)*

	2015	2016	2017
Total Bargaining Headcount	706	704	708
-Vectren Indiana-North Bargaining Headcount	267	274	277
-Vectren Indiana-South Bargaining Headcount	324	311	307
-Vectren Ohio Bargaining Headcount	115	119	124
Total Non-bargaining Headcount	1,117	1,160	1,187
Total Employee Headcount	1,823	1,864	1,895
-% Bargaining	38.7%	37.8%	37.4%
*Excludes subsidiaries. Vectren does not track this information for contractors.			

G4-12 Supply Chain

Role of Supply Chain

Supply Chain partners with other business units to develop strategic relationships that provide the best value to the company. Sourcing decisions are based on the total cost of ownership which includes quantitative and qualitative considerations. Our collaborative, comprehensive approach ensure supplier agreements look beyond the price paid and are reflections of Vectren's core values.

How Vectren Buys Smart

Supply Chain practices are governed by a strategic plan that brings transparency and sound management principles into the procurement process. Our procurement policies provide clear direction to our colleagues that make purchasing decisions on when and how to involve Supply Chain to fulfill requirements for goods and services. Information systems are leveraged to ensure defined processes are followed and desired results are achieved.

Vectren provides new suppliers with the Corporate Code of Conduct, demonstrating external business partners are expected to conduct business with the same level of integrity as our employees.

Risk Mitigation

During 2017, Vectren spent more than \$450 million to modernize our natural gas and electric infrastructure. To ensure this work is carried out safely, Supply Chain utilizes Oracle's Supplier Life Cycle Management (SLM) application to monitor each contractor's compliance with Vectren's qualification criteria. SLM alerts Supply Chain and other groups of pending expires, allowing for proactive supplier management. A cross-functional committee meets monthly to review the status of contractor relationships and remove non-compliant contractors from the supply base.

Formal contracts are used extensively with at-risk contractors due to the complexity of the agreements. Supply Chain leverages an electronic contract management system which serves as the central repository for agreements pertaining to materials and services. Supply Chain receives automatic notifications of contract expiration dates, ensuring agreements remain current. In addition, the contract management application ensures agreements follow Vectren's contract review process.

Supplier Diversity & Development

Vectren recognizes that a diverse and inclusive corporate culture is an essential asset for maintaining a competitive advantage in the marketplace. Our company's commitment to integrating diversity and inclusion into all aspects of our operations strengthens our business capacity, maximizes shareholder value, connects us to our community and positions us as leaders in the utilities industry.

Our proactive procurement processes allowed us to provide equitable opportunities to minority, women, veteran, service disabled veteran, small disadvantaged business owned enterprises and HUB Zone businesses to compete in our procurement opportunities.

Our Supplier Diversity commitment includes encouraging our primary, large non-minority suppliers to utilize diverse businesses in the fulfillment of their contracts with us, as Tier II diverse spend reporting has become a best practice among many utilities. This practice expands our overall supplier diversity efforts and spurs a much larger impact across the industry.

Vectren spent \$58 million in 2017 with Tier I and Tier II diverse business enterprises to support its operations, thus closing the year with 9.5% of total sourceable spend with diverse business enterprises. Our diverse spend is inclusive across all three operating utilities with our total spend reflective of our operational activities in Indiana (\$35M) and Ohio (\$23M). The diverse business enterprise makeup of our total dollars spent resulted in 29% with Minority Owned, 61% with Women Owned, 2% with Veteran and Service-Disabled Veteran Owned, and 7% with Small Disadvantaged and HUB Zone Businesses.

Our Supplier Diversity outreach efforts extends from local Chamber groups in Indiana and Ohio, to regional councils of the National Minority Supplier Development Council, Women Business Enterprise National Council, Elite Veteran and Service Disabled Veteran Owned Business Network and the National Association of Women Business Owners (NAWBO) Indianapolis. In addition, Vectren participated in collaborative outreach events with the Indiana Energy Association's Supplier Diversity Committee.

NAWBO Indianapolis recognized Vectren's outreach efforts with the 2017 Indianapolis Choice Award, for being a powerful advocate for inclusion on behalf of their certified members and women-owned businesses throughout the state.

Supply Chain's Impact

Supply Chain efforts resulted in over \$10 million in direct savings and cost avoidance in 2017. Procurement strategies resulted in over \$325 million spent with Indiana and Ohio suppliers.



G4-13 Significant Changes During the Reporting Period Regarding Size, Structure, Ownership or Supply Chain

None

G4-14 Precautionary Approach

Please see our 2017 Annual Report and Form 10-K for an assessment on company risk (investors.vectren.com).

G4-15 External Initiatives & Endorsements

Vectren supports the programs of the United Way. Please see response to Standard Disclosures indicator G4-16 for additional information.

G4-16 Memberships in Associations

American Association of Blacks in Energy , American Gas Association, Association of Energy Services Professionals, Better Business Bureau of the Miami Valley, Boston College Center on Corporate Citizenship, Builders Association of Greater Indianapolis, Central Indiana Clean Cities Alliance, Central Indiana Corporate Partnership, Common Ground Alliance, Dayton Building Owners and Managers Association, Downtown, Dayton Partnership, Dayton Society of Nat. History, Edison Electric Institute, Evansville Sports Corp, Greater Dayton Air Conditioning and Heating Association, Greater Indianapolis Progress Committee, Indiana 811, Indiana Association of Cities and Towns, Indiana Chamber of Commerce (and a variety of local state Chambers of Commerce), Indiana Coal Council, Inc., Indiana Economic Development Association, Indiana Association of Community Economic Development, Indiana Fiscal Policy Institute, Indiana Industry Liaison Group, Indiana Legal Foundation, Indiana Manufacturing Association, Indiana Philanthropy Alliance, Indiana Recycling Coalition, Indiana Sports Corporation, Indiana State University, Indiana Technology Partnership, Institute for Supply Management, Kentucky 811, Main Street Marion, Mid-States Minority Supplier Development Council, Midwest Energy Association, Midwest Energy Efficiency Alliance, Multicultural Professional Network, The Nature Conservancy, National Association of Manufacturing, National Coal Alliance, National Fuel Funds Network, Ohio 811, Ohio Chamber of Commerce (and a variety of local state Chambers of Commerce), Ohio Gas Association, Ohio Minority Suppliers Development Council, One Southern Indiana, One Zone Commerce Connected, Philanthropy Ohio, Society for Diversity, Southern Indiana Builders Association, Tri-State Better Business Bureau, Urban Land Institute, Utility Solid Waste Activities Group, United States Chamber of Commerce

IDENTIFIED MATERIAL ASPECTS & BOUNDARIES

G4-17 Operational Structure

Vectren Corporation is an energy holding company headquartered in Evansville, Indiana. Vectren's wholly owned subsidiary, Vectren Utility Holdings, Inc. (Utility Holdings or VUHI), serves as the intermediate holding company for three public utilities: Vectren Energy Delivery of Indiana-North (Vectren Indiana-North), Vectren Energy Delivery of Indiana-South (Vectren Indiana-South) and Vectren Energy Delivery of Ohio (Vectren Ohio). Vectren's consolidated utility operations are collectively referred to as the Utility Group.

Vectren is also involved in nonutility activities in two primary business areas: infrastructure services and energy services. Infrastructure services are provided through the company's wholly owned subsidiaries Miller Pipeline, LLC, and Minnesota Limited, LLC. Energy services are performed through Vectren's wholly owned subsidiary Energy Systems Group, LLC. Vectren's nonutility operations are collectively referred to as the Nonutility Group.

The GRI responses in this report focus solely on the Utility Group comprised of Vectren's energy delivery subsidiaries (Vectren Indiana-North, Vectren Indiana-South and Vectren Ohio), with the exception of the Economic Performance indicators which include data on both the Utility Group and the Nonutility Group.

G4-18 Process for Defining Report Content

Vectren conducted a materiality survey in accordance with GRI guidelines to determine which aspects were most important to our stakeholder groups. Each stakeholder group was asked to rank the aspects in order of importance (see response to Standard Disclosures indicator G4-24 for identified stakeholder groups).

Results from this exercise identified public safety, employee safety, emissions and compliance as the highest-ranked materiality aspects (see Standard Disclosures indicator G4-19 for a complete list of identified material topics).

G4-19 Material Aspects Identified in the Process of Defining Report Content

Material Aspects	Scope	Aspect Boundary
Economic Performance	Meeting and exceeding performance targets while driving efficiency and managing costs	Employees, Communities, Suppliers, Investors, Government
Indirect Economic Impacts	Continuing to economically grow Indiana and Ohio through infrastructure and capital investments	Communities, Government, Non-Governmental Agencies (NGOs)
Energy	Providing energy efficient solutions for our customers and maximizing energy efficiency in our own operations	Investors, Government, Customers
Emissions	Monitoring and reducing harmful emissions	Customers, Investors, Government, NGOs
Effluents and Waste	Monitoring our effluents and waste while keeping in compliance with all regulations	Customers, Communities, NGOs
Environmental Compliance	Complying with all local, state and federal environmental laws	Customers, Employees, Communities, Suppliers, Investors, Government, NGOs
Environmental (overall)	Engaging in environmentally friendly practices to create a more sustainable business and community	Communities, Government
Employment	Maintaining and retaining a skilled and engaged workforce	Employees
Occupational Health and Safety	Keeping employees healthy and safe on and off the clock	Employees, Suppliers, Government
Training and Education	Maintaining a safe, educated and well trained workforce	Employees, Investors
Diversity and Equal Opportunity	Ensuring equal opportunity employment and maintaining a diverse workforce	Employees, Government
Non-discrimination	Ensuring no stakeholder will be treated differently regarding race, gender, ethnicity, etc.	Customers, Employees
Local Communities	Benefitting the communities in which we operate	Communities, Investors
Anti-corruption	Demonstrating ethical business behavior	Customers, Government
Public Policy	Engaging with local, regional and federal leaders to maintain compliance	Government, NGOs
Customer Health and Safety	Ensuring the safety, security and privacy of all residential and commercial customers	Customers, Employees, Investors, Communities, Government, NGOs
Product Service and Labeling	Correctly labeling products and services for health and safety concerns	Customers



G4-20 Aspect Boundary Within the Organization

The material aspects identified in Standard Disclosures indicator G4-19 are applicable to the Utility Group operating units (Vectren Indiana–North, Vectren Indiana–South and Vectren Ohio) identified within the scope of this report. Please see Standard Disclosures indicator G4-19 for material aspects inside the boundary of the organization.

stakeholders, including customers and local communities, identified the following aspects as highest priority: customer health and safety, product services and labeling, environmental issues and local communities. Please see Standard Disclosures indicator G4-19 for more information on material aspects and the external stakeholders that each material aspect affects outside of the organization.

G4-21 Aspect Boundary Outside of the Organization

Material aspects identified in Standard Disclosures indicator G4-19 affect many of our external stakeholders outside the actual Utility Group operating units (Vectren Indiana–North, Vectren Indiana–South and Vectren Ohio). Our external

G4-22 Restatements of Information

None

G4-23 Significant Changes in Scope & Boundaries

None

STAKEHOLDER ENGAGEMENT

G4-24 Stakeholder Groups

The following table includes the identified stakeholder groups and key topics of concern identified in our materiality survey.

Stakeholder	Key Topics Of Concern
Communities	Community impact; Environmental compliance; Environmental stewardship; Community engagement; Customer health and safety; Effluents and waste
Customers	Emissions; Effluents and waste; Environmental compliance; Non-discrimination; Anti-corruption; Customer health and safety; Customer satisfaction; Customer privacy
Employees	Economic performance; Environmental compliance; Employee hiring, turnover, benefits and retention; Employee health and safety; Training and education; Diversity and equal opportunity; Non-discrimination; Customer health and safety; Customer satisfaction
Government	Economic performance; Indirect economic impacts; Energy consumption and conservation; Emissions; Compliance; Occupational health and safety; Diversity and equal opportunity; Public policy; Customer health and safety; Customer privacy
Investors	Economic performance; Energy consumption and conservation; Emissions; Environmental compliance; Community engagement; Customer satisfaction
Non-Governmental Agencies	Indirect economic impacts; Energy consumption and conservation; Compliance; Customer satisfaction; Customer privacy
Suppliers	Economic performance; Environmental compliance; Employee health and safety

G4-25 Identification of Stakeholders

Vectren defines a stakeholder as any person or group impacted by or impacting company operations. Please see response to Standard Disclosures indication G4-24 for a list of identified stakeholder groups.

G4-26 Approaches to Engaging Stakeholders

Stakeholder	Methods of Engagement
Communities	Vectren Foundation; Online grant applications; Community events and sponsorships; Low income energy assistance; Employee volunteerism; Community partnerships to revitalize lower income neighborhoods; City and County Council meeting presentations
Customers	Call center; Vectren website; Customer service online webchat; Social media; Television, radio, email and marketing campaigns; Mobile application to report outages and make payments; Speaker's Bureau (presentations to local clubs and agencies on energy efficiency and understanding the bill); Bill inserts; Email newsletters; Customer surveys and focus groups; Energy efficiency/demand side management initiatives; Trade shows; Large business customer forums; Business and commercial account managers
Employees	Call center; Vectren website; Customer service online webchat; Social media; Television, radio, email and marketing campaigns; Mobile application to report outages and make payments; Speaker's Bureau (presentations to local clubs and agencies on energy efficiency and understanding the bill); Bill inserts; Email newsletters; Customer surveys and focus groups; Energy efficiency/demand side management initiatives; Trade shows; Large business customer forums; Business and commercial account managers
Government	Comments on proposed rules; Regulatory filings and hearings; State and Federal Government Affairs staff; Corporate lobbying efforts; Trade organization participation
Investors	Quarterly earnings calls, webcasts, presentations and press releases; Analyst and investor meetings; Industry conferences; Shareholders services online and by phone; Annual shareholders' meeting; Annual report to shareholders; Availability of Investor Relations staff
Non-Governmental Agencies	Vectren website; Sustainability reporting; Annual reporting; Stakeholder dialogues
Suppliers	Request for proposals; Periodic meetings with key suppliers to review Key Performance Indicators (KPIs); Supplier diversity events; Industry trade show participation; Fair dealing; Timely payments; Competitive bidding processes; Supplier Code of Conduct; Ethics call-in line; Supplier Diversity and Development Program

G4-27 Response to Stakeholder Concerns

Please see response to Standard Disclosures indicator G4-19 for stakeholder material topics and concerns. These topics are addressed through indicators within this report and through publicly available reports such as the 2017 Annual Report and Form 10-K (investors.vectren.com).



REPORT PROFILE

G4-28 Reporting Period (E.G., Fiscal/Calendar Year) for Information Provided

January 1, 2017– December 31, 2017 (data from additional years provided where appropriate)

G4-29 Date of Most Recent Previous Report

Released Vectren's 2016 Sustainability Report in accordance with GRI G4 in November 2017.

G4-30 Reporting Cycle

Annual

G4-31 Contact Point for Questions

sustainability@vectren.com

G4-32 GRI Content Index

This report was developed using the GRI G4 Guidelines reporting framework with the Electric Utilities Sector Supplement. This report is "In Accordance" with the GRI G4 Guidelines – Core option. The GRI G4 Content Index is contained within this listing.

G4-33 External Assurance

This report has not been externally assured. However, all aspects referencing the 2017 Annual Report and Form 10-K have been externally assured by Deloitte.

GOVERNANCE

G4-34 Governance Structure

Mr. Carl Chapman holds the combined position of Board chair, president and chief executive officer (CEO). The Board has determined that with the exception of Mr. Chapman, all members of the Board are independent and satisfy Vectren's director independence standards. The Board's composition continues to evolve due to changes in risk and corporate strategy. The election of three new directors in the past four years and the succession of a new lead director demonstrate the Board's ability to embrace new perspectives while maintaining a balanced mix of skills and experiences.

The Board is ultimately responsible for risk oversight across the organization. That responsibility is shared by the committees of the Board in addressing financial, compensation, reputational and governance risks, with specific responsibility for reviewing management's risk oversight function delegated to the Audit and Risk Management (Audit) Committee, as provided for in its charter.

The Nominating and Corporate Governance (Governance) Committee is a standing committee of the Board primarily responsible for corporate governance matters affecting Vectren and our subsidiaries. The Compensation and Benefits (Compensation) Committee is a standing committee of the Board responsible for administering Vectren's management incentive and stock-based compensation plans as well as overseeing the administration of Vectren's retirement and welfare plans. Additionally, this committee is responsible for establishing the base salary, incentive compensation and any other compensation for Vectren's president and CEO, as well as each of the other executive officers.

The Finance Committee is a standing committee of the Board responsible for ensuring the discharge of the Board's duties relating to the financial activities of our utility and nonutility businesses. The Corporate Responsibility and Sustainability (CRS) Committee is a standing committee of the Board responsible for oversight of policies and strategies fostering the sustainability of Vectren to meet the evolving needs of our stakeholders.

G4-38 Composition, Mandate & Responsibilities of the Board of Directors

As of December 31, 2017, the eleven member Board consists of two women and two minorities. The non-employee Board members are elected to various committees. The standing Board level committees are: the Governance Committee, the Audit Committee, the Compensation Committee, the Finance Committee and the Corporate Responsibility and Sustainability (CRS) Committee. The name, tenure, age, gender and Board committee membership of the current Board members are summarized in the following table:

Board Composition & Committee Membership (2017)

Director	Term Start	Age (Gender)	Committee(s)
Carl L. Chapman	2009	62 (M)	
Derrick Burks	2017	61 (M)	Audit; Finance
James H. DeGraffenreidt, Jr.	2010	64 (M)	Governance; CRS
John D. Engelbrecht	2000	66 (M)	Chair of CRS; Finance
Anton H. George	2000	58 (M)	Compensation; CRS
Robert G. Jones	2011	61 (M)	Chair of Finance; CRS
Patrick K. Mullen	2014	53 (M)	Compensation; Governance
R. Daniel Sadlier	2003	70 (M)	Audit; Chair of Compensation
Michael L. Smith	2006	69 (M)	Chair of Audit; Governance
Teresa Tanner	2015	49 (F)	Compensation; Finance
Jean L. Wojtowicz	2000	60 (F)	Audit; Chair of Governance; Lead Director

The name, primary job function and other commitments of the current Board members are summarized in the following table:

Board Commitments (2017)

Director	Primary Job Function & Other Commitments
Carl L. Chapman	Chairman, President & CEO of Vectren Corporation <i>Other commitments:</i> Director and Board chair of VUHI, Vectren Infrastructure Services Corporation (VISCO) and Vectren Energy Services Corporation (VESCO); Director of IGC, SIGECO and Vectren Ohio
Derrick Burks	Retired Managing Partner, Ernst & Young, LLP (Indianapolis) <i>Other commitments:</i> Indiana University's Kelley School of Business Dean's Advisory Council, Indianapolis Metropolitan Academy, Children's Museum of Indianapolis, Heart Change Ministries, Super Bowl Host Committee, and Visit Indy
James H. DeGraffenreidt, Jr.	Retired Chairman & CEO of WGL Holdings, Inc. <i>Other commitments:</i> Director of Massachusetts Mutual Life Insurance Company and Harbor Bankshares Corporation; President of the Walters Art Museum Board of Trustees; and Open Society Institute – Baltimore

Continued on Next Page



Board Commitments (2017) Continued

John D. Engelbrecht	Chairman & President of South Central Communications Corporation <i>Other commitments:</i> Treasurer and Director of Deaconess Health Systems, Inc.
Anton H. George	Principal of Vision Investments, LLC <i>Other commitments:</i> Board chair of Hulman and Company and its affiliates Clabber Girl Corporation, Indianapolis Motor Speedway Corporation and Indy Racing League, LLC; Director of Hulman and Company Foundation, First Financial Corporation, Indianapolis Motor Speedway Foundation, R.J. Oil company Inc., Vision Racing, LLC, Vision Real Estate, LLC, Riley Children’s Foundation, Terre Haute Boys and Girls Club, Indiana State University Foundation, and First Financial Corporation; and Serves on the board of Rose Hulman Institute of Technology
Robert G. Jones	Chairman & CEO of Old National Bancorp <i>Other commitments:</i> Serves on the board of the University of Evansville; Director of Old National Bancorp, International City Management association, WNIN Public Broadcasting, and Evansville Regional Business Council
Patrick K. Mullen	President and CEO of Chicago Bridge & Iron <i>Other commitments:</i> Interfaith of the Woodlands and Interfaith Community Clinic
R. Daniel Sadlier	Retired President & CEO of Fifth Third Bank (Western Ohio) <i>Other commitments:</i> Director of Fifth Third Bank (Greater Cincinnati); Trustee chair-elect of Sinclair Community College, Salvation Army of Dayton, Trait Foundation, and Air Camp, Inc.
Michael L. Smith	Retired Executive Vice President & CFO of Anthem, Inc. <i>Other commitments:</i> Director and Compensation Committee chair of Envision Healthcare Holding, Inc. (formerly known as Emergency Medical Services Corp.); Director of Hulman & Company, LDI Ltd., LLC, Carestream Health Services, Inc., Agilon, Inc., Norvax, Inc., Drive Medical Corporation, and DePauw University
Teresa Tanner	Executive Vice President & Chief Administrative Officer of Fifth Third Bancorp <i>Other commitments:</i> Arts Wave, Ronald McDonald house, Freestore Food Bank, and Cincinnati Health Collaboration
Jean L. Wojtowicz	President & Founder of Cambridge Capital Management Corporation <i>Other commitments:</i> Director of First Merchants Corporation, First Internet Bancorp, American United Mutual Insurance Holding Company, Visionary Enterprises Inc., Pacific World Trade, Civic Science, Oak Security Group, LLC, Goodwill Industries of Central Indiana Inc., Indiana State Chamber of Commerce and Indiana State Chamber Foundation, Central Indiana Community Foundation, Indianapolis Chamber of Commerce, Rose Hulman Institute of Technology – Indianapolis Board of Associates, United Way of Central Indiana Inc., Sagamore Institute Trustee, Greater Indianapolis Progress Committee, Double Down Spirits, LLC, Assurance Health System, LLC, Indiana Department of Financial Institutions, and NABDC

G4-39 Board Chair

Mr. Carl Chapman is the Board chair as well as the president and CEO. The combination of the Board chair and CEO positions positively serves Vectren's interests. Based upon Mr. Chapman's performance since he assumed leadership of the company, the Board continues to believe combining the responsibilities of the Board chair and CEO is in the best interest of Vectren and our stakeholders. Mr. Chapman's insights and perspective resulting from his first-hand knowledge of Vectren's operations are beneficial to the Board during its deliberations on company affairs.

To ensure the preservation of good governance, the Board has and will continue to maintain the position of an independent lead director who is elected by independent Board members and is charged with the responsibility to coordinate the activities of the non-employee, independent directors. More information on the lead director's responsibilities can be found in the Corporate Governance Guidelines on the Corporate Governance page on **Vectren.com** (www.vectren.com/corporate/governance).

G4-41 Board Processes for Resolving & Avoiding Conflicts of Interest & Disclosure Practices

Vectren monitors transactions with related persons (directors and executive officers or their immediate family members, or shareholders owning 5 percent or greater of our outstanding stock). The approach to monitoring related party transactions with Board members is described in our Corporate Code of Conduct, Code of Ethics for the Board and annual disclosure practices by Board members. Vectren's Corporate Code of Conduct directs Board members to avoid relationships with, and financial interests in, business partners and those who are seeking to become business partners. Board members complete an annual acknowledgment stating that they agree to abide by the Code of Conduct. In addition, Board members complete annual questionnaires requesting information about, among other matters, related person transactions. Vectren policy requires Board members to promptly disclose to the chair of the Governance Committee any situation that involves, or may potentially involve a conflict of interest. The Governance Committee reviews all relationships that exist between Vectren and the non-management Board members, other than relationships relating to service on the Board. Material relationships are disclosed annually to stakeholders in the Report of the Nominating and Corporate Governance Committee posted on the Corporate Governance page on **Vectren.com** (www.vectren.com/corporate/governance).

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ETHICS & INTEGRITY

G4-56 Organizational Values & Code of Conduct

Corporate audit is responsible for promoting the Corporate Code of Conduct (the Code) and training employees regarding the Code and ethical behavior in general. Employees, including all corporate officers, complete an annual

certification stating they have read the Code and agree to abide by it. This annual awareness training familiarizes employees with 1) the Code, 2) the responsibility of Vectren representatives to demonstrate ethical behavior, and 3) the communication lines available to report violations or seek advice. Various annual awareness processes exist for different employee groups, but all of them result in communication, acknowledgment and acceptance of the Code. New employees receive training and acknowledge acceptance of the Code as part of the on-boarding process. The Code is posted on the Corporate Governance page on **Vectren.com** (www.vectren.com/corporate/governance). No waivers from the Code's provisions were granted in 2017.

On a periodic basis, employees participate in an employee engagement survey that encompasses the entire employee experience. A survey was conducted in 2016. Certain questions gauge the employee's ethical perception of whether Vectren is a good place to work, whether senior management "walks the walk" and whether employees are treated with respect and know how to address ethical issues. Employee responses are compared to a benchmark of high-performing companies. For the ethics-related questions, engagement scores compared favorably to these benchmarks and increased compared to the last survey conducted in 2014. The next survey will be conducted in 2019.

G4-57 Mechanisms for Ethical Consultation

The Code lists the communication lines available for seeking advice or reporting concerns about unethical or unlawful behavior. Employees are informed of the various methods for seeking advice or reporting violations in the annual Code awareness training. In addition, posters publicizing where to find the Code, how to report issues and how to seek advice are located in break rooms and on intranet sites where company policy and procedures are maintained.

G4-58 Reporting Ethical Concerns & Violations

Employees can report concerns about unethical or unlawful behavior without fear of retaliation. Certain internal and external mechanisms listed in the Code allow stakeholders to report concerns or request advice anonymously, including the third-party ethics hotline and direct correspondence with the chair of the Audit Committee. The third-party ethics hotline is available 24 hours a day, 7 days a week.

Vectren's fraud and misconduct reporting framework ensures Code violations are investigated and questions are addressed in a timely, consistent manner, regardless of how issues are reported. The ultimate outcome of this framework is Vectren's ability to monitor overall adherence to its established standards and to elevate material issues to senior leadership and the Board. Investigations of Tier 1 issues are led by corporate audit. Tier 1 issues are characterized by the following: officer or Board member involvement, manipulation of financial results, theft that exceeds \$30,000, or outside legal costs that exceed \$250,000, or a pattern of lower tier violations either in terms of offender or offense.



ELECTRIC UTILITY SECTOR SUPPLEMENT

G4-EU1 Installed Capacity

Capacity (2017)

	MW
Installed Capacity	1,248
– Installed Capacity: Coal	1,000
– Installed Capacity: Natural Gas	245
– Installed Capacity: Landfill Gas	3
Purchased Capacity	112
– Purchased Capacity: Coal	32
– Purchased Capacity: Wind	80

G4-EU2 Net Energy Output

Net Energy Output (2017)

	Total (MWh)
Coal	4,538,667
Natural Gas	27,426
Landfill Gas	11,670
Purchased Coal	141,341
Purchased Wind	220,685
Total Energy Output	4,939,789

G4-EU3 Number of Residential, Industrial, Institutional & Commercial Customer Accounts

Customer Accounts by Territory (2017)

	Residential	Commercial	Industrial	Other	Total
Vectren Indiana–North	540,013	51,514	957	-	592,484
Vectren Indiana–South (Natural Gas)	101,064	10,304	112	-	111,480
Vectren Indiana–South (Electric)	126,443	18,648	112	40	145,243
Vectren Ohio	293,736	23,662	674	-	318,072

G4-EU4 Length of Above & Underground Transmission & Distribution Lines by Regulatory Regime

We calculate circuit lengths and transmission circuits in circuit-miles (not pole or line miles). Vectren's system is in one regulatory regime (Indiana).

Transmission & Distribution Primary Circuit-Miles (All Voltages - 2017)

	Miles
Transmission (All Voltages)	1,007.3
Distribution (All Voltages)	4,311.4
Total Transmission and Distribution	5,318.7
– Overhead Transmission and Distribution	4,037.2
– Underground Transmission and Distribution	1,281.5

Transmission & Distribution Primary Circuit-Miles by Voltage Category (2017)

Voltage	Miles
4.16kV	81.7
12.47kV	4,229.7
69kV	568.0
138kV	375.5
345kV	63.8

G4-EU5 Allocation of CO₂ Emissions Allowances or Equivalent, Broken Down by Carbon Trading Framework

Not applicable in the United States.



ECONOMIC

This section of indicators contains information about our economic performance and position and how we directly and indirectly impact markets and communities.

ECONOMIC PERFORMANCE

G4-DMA Economic Performance

Vectren's utility business remains the core of the company and is the key driver of achieving consistent earnings growth by focusing on the execution of infrastructure programs and cost control strategies. The company considers these next several years as a time of transformation for the utility. This transformation involves three components. The first component is the continuation of Vectren's successful gas infrastructure investment programs to further improve the company's ability to deliver safe and reliable service to its gas customers in Indiana and Ohio. The company earns current returns on a large percentage of the new infrastructure investments as provided in Indiana and Ohio legislation/regulation. The second component is a 7-year electric infrastructure plan to modernize and upgrade Vectren's electric transmission and distribution grid that will improve the reliability of the electric system, reduce the frequency and duration of service outages, and enhance the overall customer experience. This component of the transformation plan began in 2017 and is off to a successful start. The third component is the diversification of Vectren's generation fleet that will improve our overall fuel-source flexibility, further reduce emissions, and enhance the utility's ability to adapt to new technologies and changing customer needs. In February 2018, the company filed its generation transition plan with the Indiana Utility Regulatory Commission, which proposes construction of an approximate 800-900 megawatt combined cycle natural gas turbine to replace approximately 70% of the company's existing coal-fired generation. This filing is in line with the Integrated Resource Plan (IRP) filed in December 2016. The IRP and electric infrastructure plans, combined with our ongoing gas investments, will transform and prepare the utility business for a smart energy future. The 2016 IRP can be viewed at www.vectren.com/IRP.

In addition to these strategic long-term investments, the utility is aggressively managing costs through performance management and strategic sourcing activities. Together, these initiatives allow the utility companies to earn at or near Vectren's allowed rate of return, which is key to achieving the Company's financial targets.

In the Nonutility business, organic growth is expected to be the principal driver of earnings growth with the completion of commodity business divestitures and key acquisitions between 2011 and 2015. Infrastructure Services is well positioned in this strong demand environment. Infrastructure Services' distribution business is focused on utility pipeline replacement and modernization work, while maintenance and integrity work remains the focus in the transmission business. Infrastructure Services' organic growth strategy is focused on adding high quality, highly skilled field personnel to serve existing and new customers exceptionally well.

Energy Services' platform for energy performance contracting and sustainable infrastructure growth has well positioned the business to compete in all market segments (federal, public sector, and sustainable infrastructure) and meet the long-term demands as the national focus on energy conservation, security, renewable energy, and sustainability continues to grow given the expected rise in power prices across the country and customer focus on efficiency.

The combination of business mix and focused strategies will enable Vectren to continue achieving its established financial targets and provide excellent shareholder returns.

Financial Targets

Over the past several years, Vectren has developed a utility growth strategy focused on infrastructure replacement throughout its service territories, while narrowing its nonutility business mix by exiting commodity-based businesses and making key acquisitions within the Infrastructure and Energy Services business sectors. The goal of these initiatives is to achieve consistent and higher earnings growth, while simplifying the business structure and reducing risk. The company communicated its plan for a Smart Energy Future in early 2017 reflecting increased capital investment needs at our electric utility coupled with our continuing gas infrastructure investments and supplemented by a strong nonutility group outlook. As a result of this focus, Vectren affirmed in February 2018 the increased financial targets communicated in 2017 and announced a generation plan.

- Provide total annual shareholder return of 9-11%
- Deliver consolidated earnings & dividend growth of 6-8%
- Deliver utility earnings growth of 5-7%
- Deliver long-term nonutility EPS growth of approx. \$0.06-0.10/year
- Target a consolidated payout ratio of 60-65% with a utility payout ratio of 70%

G4-EC1 Direct Economic Value Generated & Distributed

Selected Financial & Corporate Data for Vectren Corporation (2015-2017)

(In millions except per share data)	2017	2016	2015
Total Operating Revenues	\$2,657.3	\$2,448.3	\$2,434.7
Total Operating Expenses	\$2,338.9	\$2,066.8	\$2,072.9
Net Income	\$216.0	\$211.6	\$197.3
Total Assets	\$6,239.3	\$5,800.7	\$5,409.9
Total Liabilities	\$4,390.0	\$4,032.6	\$3,726.1
Total Shareholders' Equity	\$1,849.3	\$1,768.1	\$1,683.8
Basic and Diluted Earnings per Share of Common	\$2.60	\$2.55	\$2.39
Net Cash from Operating Activities	\$498.8	\$524.1	\$505.2
Payments to capital providers and the government	\$305.1	\$272.7	\$370.7
– Dividends on common stock	\$141.9	\$134.2	\$127.3
– Interest Paid	\$86.4	\$86.6	\$84.2
– Taxes Paid	\$76.8	\$51.9	\$159.2
Capital expenditures, excluding AFUDC equity	\$602.6	\$542.0	\$476.9
Community investments*	\$5.6	\$5.2	\$5.5

Data from 2017 Vectren Form 10-K filed with the SEC on 2/21/2018, 2016 Vectren Form 10-5 filed with the SEC 2/23/2017 and 2015 Vectren Form 10-K filed with the SEC on 2/23/2016

* Includes Community Sustainability O&M, Low Income Assistance, as well as Foundation Contributions

Our 2017 Annual Report and Form 10-K, which was filed with the SEC on 2/21/2018, and our 2018 Proxy Statement can be found online at investors.vectren.com.



INDIRECT ECONOMIC IMPACTS

G4-DMA Indirect Economic Impacts

Vectren is committed to enhancing the communities in which we operate. Our community investments, volunteer work, and philanthropic giving creates jobs, promotes gross domestic product growth, and elevates overall social well-being for the people and businesses within our service territory. **This is accomplished through:**

- Proactive community engagement
- Designing & constructing infrastructure to serve new sites
- Reliable electrical & natural gas delivery
- Continuous engagement of all internal & external stakeholders

Economic Development Initiatives Within Vectren's Indiana Service Territory

In 2017, Vectren saw continued economic growth throughout its Indiana and Ohio service territories. This was facilitated by continued partnerships with the Indiana Economic Development Corporation, Jobs Ohio, and regional/local economic development organizations.

Specific to Vectren Indiana-North, these partnerships resulted in the announced investment of approximately \$2 billion, with the projected creation of over 11,500 full-time jobs over the next several years. A large majority of announced new jobs (~85%) were the result of existing business expansions, with the rest (~15%) coming from new business attraction. The 5 largest capital investment projects announced in 2017 include United Postal Service (\$261M expansion), Grotec Aquaculture (\$144M expansion), NTK Precision Axle (\$100M expansion), BWI North America (\$82M new location) and Fukai (\$57M expansion).

In Vectren Indiana-South, announced capital investment was approximately \$1 billion, with the projected creation of around 1,200 jobs. Most new investment came from expansions (~90%), with the rest coming from new location projects (~10%). Several companies announced the creation of over 100 new jobs including Eagle Railcar Services (100), Toyota Motor Manufacturing Indiana (400), BWXT (110), and Alcoa (196). In 2017, Vectren Indiana-South was a microcosm of Indiana's diverse economy, with a wide variety of industries announcing growth projects. Examples of these sectors include automotive, railroad, pharmaceuticals, plastics, information technology, and defense.

Economic Development Initiatives Within Vectren's Ohio Service Territory

In 2017, the Vectren Ohio economic development team worked with regional and local economic development partners resulting in a record, \$949.7 million in new capital investment. The new investment was centered in Montgomery County, with nine surrounding counties experiencing a total growth of approximately 2,078 new jobs. These jobs accounted for \$112.3 million in new annual payroll, resulting in an average annual salary of \$54,000 per new job. The region also retained approximately 10,207 jobs. The 37 economic development projects were led by Hematite, Inc., Midmark Corp., and Alkermes, Inc. creating a total of 289 new jobs.

G4-EC7 Development & Impact of Infrastructure Investments

Vectren invests substantially in natural gas pipeline and electric system infrastructure upgrade and replacement programs. The gas programs include the replacement of aged bare steel and cast iron (BS/CI) distribution pipelines, as well as improvements to transmission and other distribution gas system infrastructure assets. The gas investments are driven by existing or pending pipeline safety regulations and existing transmission and distribution integrity management program requirements. The electric program includes transmission and distribution system improvements to enhance system reliability, reduce system risk, improve customer experience, and optimize the grid to accept new technology.

Since 2008, Vectren has invested approximately \$581 million in the replacement of aged BS/CI gas distribution pipeline infrastructure in Indiana and Ohio. Vectren has also invested approximately \$233 million on improvements to its gas transmission pipeline infrastructure since 2012, and \$78 million on improvements to its gas distribution system infrastructure since 2013. Vectren's total investment in gas infrastructure modernization programs in Indiana and Ohio is approximately \$892 million.

In 2017, Vectren completed the first year of its seven-year electric transmission and distribution system improvement program. This program proactively addresses aging assets, supports enhanced reliability and safety, and enables integration of newer technologies to better serve customers. During the year, Vectren invested approximately \$28 million in electric distribution system improvements, and approximately \$12 million in electric transmission system improvements. Vectren's total investment during 2017 in electric system reliability, safety, and modernization programs within Indiana is approximately \$40 million.

Since their inception in 2008, Vectren's gas and electric infrastructure modernization programs have had a significant economic impact, supporting hundreds of direct, indirect, and induced jobs each year. In 2017, there were approximately 730 jobs in Indiana and approximately 400 jobs in Ohio to directly support these programs. Business to business and household spending linked to this work also help to lift the economy with indirect and induced effects that create additional jobs. Additionally, our programs have supported our communities via local, state, and federal taxes over the 10 year investment period.

G4-DMA Availability & Reliability

Vectren maintains its generation fleet for reliable operation. An all-inclusive maintenance management process for work identification, prioritization and scheduling allows us to achieve reliable operation of our generating units. Continuous improvement projects and employee training are also key elements of our short and mid-term reliability strategy. In the long term, the Integrated Resource Plan (IRP) helps to assure the best resource plan is in place to reliably meet future load requirements, please see Vectren's IRP plan at www.vectren.com/IRP.

G4-EU10 Planned Capacity Against Projected Electricity Demand

Planned capacity and projected demand are addressed in our IRP, which is submitted to state regulatory agencies. The 2016 IRP can be viewed at www.vectren.com/IRP.

No new capacity is currently under construction, however the 2016 IRP release tells of future changes to our generation portfolio. Vectren's existing coal fired generators are 100 percent equipped with sulfur dioxide (SO₂) scrubbers and 90 percent are equipped with selective catalytic reduction systems for nitrogen oxide (NO_x) removal.

G4-DMA Demand Side Management

Energy efficiency (EE) has generally been accepted as a critical function of utilities to mitigate climate change, delay the need to build new generation, save customers money on their utility bills and improve customer satisfaction. Vectren's commitment to EE programs continues to achieve significant energy savings.

Vectren's gas and electric EE programs encourage customers to manage their energy use through a variety of approaches including: residential and business audits which help customers identify energy savings opportunities; in-store lighting discounts which apply utility-sponsored rebates at the time of purchase; appliance recycling which encourages customers to remove their inefficient refrigerators and freezers; rebates on equipment and services which reduce the initial higher costs for efficient products; home energy reports that utilize behavioral science to influence energy usage; and commercial equipment upgrades and maintenance. In 2017, the Vectren EE portfolio achieved more than 44,000 MWh electric savings and approximately 4.4 million therms for measures implemented or installed in that year. Most of these measures will continue to reap savings for many years to come. Since their inception in 2010, Vectren's electric EE programs have saved enough energy to power over 115,000 homes. Vectren's natural gas EE programs have saved enough energy to heat over 250,000 homes since their inception in 2006.

Vectren's EE programs are generally separated into two groups: residential and commercial. In 2017, the residential electric programs achieved over 24 million kWh of savings and the natural gas residential programs achieved approximately 3.5 million therms of savings. The Commercial electric programs achieved 20 million kWh of savings and the natural gas business programs achieved an estimated 883 thousand therms of savings.

As evidence of its commitment to long-term EE, in 2017, Vectren Indiana-South completed implementation of its Conservation Voltage Reduction (CVR) program. The CVR technology was deployed on the Buckwood Substation in 2017, with the plan for another substation to follow in 2020. The CVR program is an energy savings and demand response (DR) program that achieves conservation through automated monitoring and control of voltage levels provided on distribution circuits. With the CVR, the utility systematically reduces voltages in its distribution network, resulting in a proportional reduction of load on the network. Consumers receive a lower but still acceptable voltage and use less energy to accomplish the same tasks. End use customers realize lower energy and demand consumption when CVR is applied to the distribution circuit from which they are served. The CVR strategy can provide benefits for emergency load relief, sub-station voltage reduction, peak load management and customer end-use efficiency.

Vectren continues to offer integrated EE programs, meaning that its electric and natural gas programs are jointly delivered to best penetrate customer markets. With combined efforts, the same home or business may be given deeper savings in the same retrofit rather than having to participate in separate programs.

Demand Response

Vectren's DR program, referred to as Summer Cycler, is a voluntary energy management program which uses direct load control (DLC) switches to briefly cycle air conditioning and water heating units in customer homes during periods of peak electricity demand. Summer Cycler participants earn \$5 monthly bill credits during the cooling season of June through September. By cycling off major electric appliances for short periods of time, peak power demand can be trimmed with little or no customer discomfort or inconvenience. As of 2017, about 23,000 residential customers have switches installed. Today, our DLC program is able to curtail 19.2 MW in peak demand savings during times of high use.

Future of Demand Side Management

With changes in technology, there are many opportunities for Vectren to position itself to provide customers with actionable steps for better managing their energy usage and costs. Vectren's EE and DR programs are expanding by integrating smart/Wi-Fi thermostats into the program mix. In 2018, Vectren's Income Qualified Weatherization and Multi-Family Programs will begin installing Nest thermostats in homes to help improve efficiency, in lieu of programmable thermostats.

As the market shifts towards all things smart, Vectren will also launch a "Smart Cycle" initiative. Smart Cycle encompasses various avenues for customers to participate in EE and DR related smart thermostats programs. This initiative includes the 2,000 smart thermostat units which were installed in eligible homes in 2016. Beginning in 2018, Vectren will offer two additional ways to engage customers in this initiative.



1,000 direct load control (DLC) Summer Cycler Switches will be changed out for Nest Thermostats in 2018. These thermostats provide two-way communication and serve as a strategic option for cost effective load control solutions. As an alternative to the older DLC switches, the thermostats provides customers more control over their energy use through optimization of heating and cooling of a home. Over the next decade, Vectren plans to replace all DLC switches with smart thermostats.

The Bring Your Own Thermostat Program, also planned to kick off in 2018, allows customers who have their own Smart/Wi-Fi enabled device from multiple potential vendors to participate in DR and other load curtailing programs managed through the utility.

Empowering and engaging the customer can significantly improve participation and satisfaction with the program.

G4-DMA Research & Development

Vectren actively monitors and tracks trends and advancements in both conventional and emerging energy technologies as a normal part of its operations. Vectren employs a cross functional approach to engage multiple departments in sharing information and discoveries, and jointly delving into market research and strategic analysis of emerging technologies. Vectren's research activities play an important role in understanding the future of the utility industry and how to better serve its customers.

Vectren colleagues actively develop and maintain relationships with industry peers, new technology and solution providers, and research organizations. Vectren also cultivates connections with public and private market and technical research organizations. The company's research activities cover a broad range of subject areas including distributed grid operations and energy resources, environmental control technologies such as carbon capture and storage, and other cutting edge solutions such as microgrids, energy storage and resource aggregation. In addition, Vectren is actively exploring innovative service offerings to increase customer access to renewable energy sources and to increase quality of life through smart city solutions.

Vectren is leading multiple projects to advance the company's research and pilot emerging technologies. Vectren is leading the design of exploratory energy technologies in the new Urban Living Research Center, a mixed use development that will host a variety of emerging technologies including solar, lithium-ion battery energy storage, electric vehicle charging, high-efficiency HVAC and water heating, smart home technologies, and customer energy management solutions. The facility will demonstrate the feasibility of these technologies and provide a platform for ongoing validation and verification of the energy savings and customer benefits achievable with emerging energy technologies. Vectren will engage with independent third parties to verify the accuracy of the experimental design and to ensure consistent and reliable findings.

G4-EU11 Average Generation Efficiency of Thermal Plants

Fleet Efficiency (2017)

	Efficiency
Coal Fleet Annual Efficiency	11,001 BTU per kWh (31.0% efficient)
Natural Gas Peaking Unit Fleet Efficiency	13,449 BTU per kWh (25.4% efficient)

Federal Energy Regulatory Commission Form 1 Heat Rates (2017)

	Fuel Burned	Avg. Fuel Heat Content	Avg. BTU per kWh of Net Generation
A.B. Brown Units 1 & 2: Coal	929,116 Tons	11,575	11,307
A.B. Brown Units 1 & 2: Natural Gas	183,717 Mcf	1,050	-
A.B. Brown Unit 3: Natural Gas	110,201 Mcf	1,050	13,548
A.B. Brown Unit 3: Oil	5,020 Gallons	139,000	-
A.B. Brown Unit 4: Natural Gas	182,039 Mcf	1,050	13,037
BAGS* 2: Natural Gas	49,566 Mcf	1,050	13,639
F.B. Culley: Coal	854,191 Tons	11,408	10,773
F.B. Culley: Natural Gas	351,014 Mcf	1,050	-
Northeast Turbines (1 & 2): Natural Gas	6,732 Mcf	1,050	19,801
Warrick Unit 4: Coal	362,464 Tons	11,486	10,862
Warrick Unit 4: Natural Gas	96,344 Mcf	1,050	-
Heat rates shown are annual operating heat rates and include start up shutdown and the effects of low load operation. Full load heat rates are better than the annual rates shown.			
* Broadway Avenue Generating Station			

G4-EU12 Transmission & Distribution Losses

Transmission and distribution energy losses were 2.83 percent and 3.65 percent respectively, as a percentage of total available energy for the twelve months ending December 31, 2017.



ENVIRONMENTAL

This section of indicators contains information about our energy conservation initiatives and land and habitat management efforts.

ENERGY

G4-DMA Energy

Vectren actively monitors the consumption of energy, water and fuel to evaluate issues as they arise while simultaneously developing and implementing energy efficient plans. All new utility, corporate and remodeled buildings are designed to meet ENERGY STAR® standards and with the minimization of energy use in mind. Through the implementation of new, relevant fleet vehicle technology, Vectren continuously works towards building a more sustainable fleet with lower overall fuel consumption.

G4-EN6 Energy Efficiency Initiatives

2017 Facility Improvements

In 2017, we made the following improvements to Vectren facilities:

- Replaced the variable speed drives on the HVAC units at our NP Wagner & SSC complexes to provide better control
- Replaced the boilers at the NP Wagner complex which can result in a 760 ton reduction in annual carbon output (Calculations provided by Johnson Controls per the estimated reduction in natural gas usage)
- Replaced numerous older model heaters throughout Vectren's field office garages
- Installed window tinting throughout various areas of the NP Wagner complex to reduce heat from sunlight

2017 Fleet Upgrades

In 2017, the following efficiency upgrades were made to Vectren's vehicle fleet:

- Purchased 1 plug-in, hybrid electric bucket truck
- Purchased 1 plug-in, electric fork lift
- Replaced 24 light-duty vehicles with E85-complaint vehicles
- Replaced 30 medium-duty vehicles with E85-complaint vehicles
- Overall, fuel economy increased by ~0.86%

G4-EN8 Water Usage

Please see the following table for information for water withdrawal by source. At A.B. Brown, water withdrawal is calculated using circulating water flows, outside temperature, percentage of evaporation loss, cooling tower cycles and generating hours. At F.B. Culley, water withdrawal is calculated using circulating temperature and flow data.

Surface & Ground Water Usage (2017)

	Surface Water*	Ground Water
A.B. Brown	2,039.6 million gallons	348.6 million gallons
F.B. Culley	77,454.2 million gallons	127.1 million gallons
Total	79,493.8 million gallons	475.7 million gallons

* Surface Water includes water from wetlands, rivers, lakes and oceans.

G4-EN10 Water Recycling & Reuse

Water Recycling & Reuse (2017)

	Water Recycled or Reused
A.B. Brown	125,481.4 million gallons
F.B. Culley	0.2 million gallons
Total	125,481.6 million gallons
The variance between plants is primarily attributable to recirculation in the cooling towers; in addition to the ability to reuse ash pond water at the A.B. Brown plant.	

G4-EN21 Air Emissions

All emission tonnage measured data from EPA's certified Continuous Emission Monitoring System (CEMS) and are as reported for the various emissions allowance programs. CEMS are the utility industry standard emission measurement process.

Annual System Emissions (2015-2017)

	2015 (Tons)	2016 (Tons)	2017 (Tons)
Sulfur Oxide (SO ₂)	12,894	6,004	5,559
Nitrogen Oxide (NO _x)	4,639	4,325	3,908
Particulate Matter (PM)*	219	279	238
Total	17,752	10,608	9,705
* Totals include Vectren's share (50 percent) of total Warrick Unit 4 emissions.			

G4-EN25 Transported Hazardous Waste

None

G4-EN34 Environmental Grievances Filed, Addressed & Resolved Through Formal Grievance Mechanisms

None

G4-EN33 Significant Negative Environmental Impacts in the Supply Chain

Vectren strives to reduce the consumption of new materials and the waste streams resulting from its extensive supply chain. Our robust reuse and recycle program for hazardous and non-hazardous waste has diverted more than a half million tons of waste from the landfill each year, reducing the need to purchase new materials and generating new revenue streams which help offset disposal costs. This program has been effective in reducing environmental impacts while utilizing materials already in our supply chain.

For more about Vectren's recycling programs, please see Environmental DMA Effluents and waste indicator and Environmental indicator G4-EN23.



EMISSIONS

G4-DMA Emissions

Vectren is dedicated to environmental stewardship. Our employees and their families live and work in the same cities and towns, breathe the same air and utilize the same natural resources as our customers. We are committed to fully complying with all environmental regulations and providing energy products and services that not only meet customer needs, but also enhance the quality of life in each of our communities.

Vectren's power system is one of the best controlled in the Midwest. By investing millions of dollars in new emissions control technology, we have been able to dramatically reduce emissions at existing facilities.

- Since 2005 and through 2017, we have achieved reduced emissions of CO₂ of 30% (on a tonnage basis). With a three year average emission reduction for the period of 2015 to 2017 is 35% from 2005 levels.
- SO₂ emissions are down more than 90% since 1970. All units in the Vectren system are equipped with scrubbers for SO₂ control.
- NO_x emissions are down 80% since 1970. All units in the Vectren system are controlled for NO_x, with four of the five units having selective catalytic reduction technology for advanced NO_x control.
- All units in Vectren's system have advanced controls for particulate matter, with two units having state-of-the-art fabric filters which remove 99% of soot and dust.

Current initiatives to increase conservation and reduce emissions include:

- Implementing conservation initiatives in Vectren's Indiana & Ohio natural gas utility service territories
- Implementing conservation and demand side management initiatives in our electric service territory
- Adding to a renewable energy portfolio to complement base load generation in advance of mandated renewable energy portfolio standards
- Evaluating potential carbon requirements with regard to new generation, other fuel supply sources & future environmental compliance plans
- Reducing Vectren's carbon footprint by utilizing hybrid vehicles & optimizing generation efficiencies through dense pack technology
- Reducing methane emissions through the continued replacement of bare steel & cast iron gas distribution pipeline & other actions such as implementing distribution integrity management measures, installing more excess flow & remote control valves on service lines & transmission systems & enhancing damage prevention programs

G4-EN15 Direct Greenhouse Gas (GHG) Emissions

Electric generation data measurement is made by Certified Continuous Emission Monitors as required by federal rule. These numbers are reported to EPA via the Clean Air Market Division. Natural gas peaking turbines are calculated using the engineering calculation and air emission factor. CO₂ emissions from natural gas LDC operations are determined using emission factors and calculations as required by the EPA mandatory greenhouse gas reporting rule.

Annual CO₂ Emissions (2017)

	Metric Tons of CO ₂
Electric Generation	5,229,365
Natural Gas LDC Operations	213,763
Total	5,443,128

EFFLUENTS & WASTE

G4-DMA Effluents & Waste

Vectren continues to seek commercial opportunities to recycle and reuse its waste products wherever possible and has a robust recycling program in place across all business units.

In the Energy Delivery business, the gas distribution operations collect unused and expired natural gas pipeline for plastic recycling. In the Power Supply business, the generating facilities have recycled nearly 90 percent of the fly ash they have generated since 2009 for use by a cement kiln as a replacement for virgin materials. In addition, our F. B. Culley plant has recycled nearly 100 percent of the synthetic gypsum it has produced since 1996. Construction

routing for new gas or electric transmission lines is planned to avoid or minimize disturbance of environmentally sensitive areas. Vectren has engaged in these partnerships with an understanding that a focus on recycling and conservation during the planning and design phase of a project can yield significant savings by limiting the long-term environmental impact.

Additional waste streams diverted from the landfill include paper, aluminum, plastic, cardboard, lamps, batteries, ballasts, electronic waste, scrap metal, oil, wood debris and other items recycled, reused and donated to local charities.

G4-EN22 Water Discharge

Water Discharges (2017)

	Amount Discharged
A.B. Brown Planned Discharge	635.60 million gallons
A.B. Brown Unplanned Discharge	0.00 million gallons
F.B. Culley Planned Discharge	71,700.08 million gallons
Total	72,335.68 million gallons

Volumes derived from flow, measuring and calculations utilized for monthly National Pollutant Discharge Elimination System permit reporting. Thermal discharges included. The variance between plants is primarily attributable to the cooling towers at A.B. Brown. A.B. Brown has the ability to reuse ash pond water. Additionally, F.B. Culley's lowered ash pond levels resulted in higher-than-normal discharge.

G4-EN23 Total Weight of Waste

Total Weight of Waste (2017)

	Hazardous (Tons)	Non-hazardous (Tons)
Power Plant Waste	2.24	473.36
– A.B. Brown Waste	1.64	441.70
– F.B. Culley Waste	0.60	31.66
Energy Supply Waste	6.65	873.06
Total	8.89	1,346.42



Recycling Totals by Type of Waste (2017)

	Pounds Recycled
Paper	525,583
Aluminum	22,041
Plastic	19,873
Cardboard	359,520
Fly Ash	294,876,000
Gypsum	469,096,000
Lamps	2,771
Batteries	950
Electronics	9,334
Scrap Metals	899,800
Transformers	978,067
Oil	11,354
Glycol	37,104
Industrial Plastics	54,890
Wood Pallets and Reels	63,080
Tree Trimmings	780,000
Automotive Batteries	11,450
Tires	68,103
Total	767,815,920

ENVIRONMENTAL COMPLIANCE

G4-DMA Environmental Compliance

Vectren seeks to maintain 100 percent compliance with all environmental regulations. A reportable environmental incidents matrix is used to document and communicate potential environmental concerns. Regular meetings are held with operations, management and engineering staff to review expectations and provide guidance on how to avoid deviations.

G4-EN29 Fines & Sanctions Related to Environmental Laws & Regulations

None

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ENVIRONMENTAL (OVERALL)

G4-DMA Environmental

Vectren strives to protect and preserve the environment which hosts our facilities and carries our pipelines and powerlines. Our environmental policy requires us to operate in full compliance with applicable legal requirements and we hold ourselves and those working on our behalf accountable for this commitment. We constantly seek out ways to improve energy delivery while reducing our impact on the environment. We have made strides to protect air, water and land quality by installing emissions control equipment on our power plants, improving the efficiency of our materials purchasing process,

participating in stewardship projects and substantially reducing our waste streams through reuse and recycle programs (see G4-EN23 for details on waste volumes diverted from the landfill). We work with environmental stakeholders at the national, state and local levels to identify and advance environmental and energy policies which benefit customers, shareholders and communities. We make environmental performance metrics available on an annual basis to reiterate our commitment to transparency in operations, aid in open discussions on environmental issues and build trust in the community.

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G4-EN31 Environmental Protection Expenditures & Investments

Vectren's environmental protection expenditures include annual costs for environmental compliance, ongoing operations and maintenance, chemicals and capital improvements.

Environmental Protection Expenditures & Investments (2017)

Expenditure Type	Expenditure Amount
Manufactured Gas Plant (MGP) Remediation	\$431,119
Air Protection Expenditures	\$30,812,325
Waste and Water Expenditures	\$16,346,966
Permit Expenditures	\$402,677
Total 2017 Environmental Protection Investment	\$47,993,087

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LABOR PRACTICES

This section of indicators contains information about the composition of our workforce, compensation practices and labor relations initiatives.

EMPLOYMENT

G4-DMA Employment

Given the rapidly evolving energy industry in which we operate, Vectren understands investing in its workforce is critical to our future success. We know great companies are made up of great people and we're committed to providing employees the tools and resources necessary for success and safety.

Learning & Development

Vectren fosters a work environment which encourages ongoing learning and development. Online learning programs are offered to employees through a personalized learning and development system, Learn Connection. Learn Connection houses an extensive library of online courses, which cover everything from competency-based training to modules specific to the energy industry. Employees interested in furthering their education may participate in Vectren's tuition reimbursement program for qualifying education expenses. Onsite training sessions are used to meet the unique needs of our workforce. Career development tools and resources help employees grow and develop the right skills to meet their career goals and the changing requirements of the business.

Vectren's Emerging Leaders mentoring program pairs less experienced employees who demonstrate leadership capabilities and a commitment to company values with more experienced employees in leadership roles. The purpose of the program is to develop the leadership skills of emerging talent and ensure Vectren has an appropriate supply of talented leadership and a continuity of culture.

Health & Wellness

Vectren has continually devoted its energy in preserving a culture of health and wellness for all of its employees by offering programs and services to support their physical and emotional well-being. Vectren promotes a positive work-life balance due to the physical and mental demands placed on their workforce by offering paid holidays, vacation days and paid time off for approved volunteer projects. Vectren offers a 401(k) Savings Plan to current and new hire employees.

Employees and eligible family members receive health, dental and vision insurance options as well as long term disability, short term disability and life insurance options. Flexible Pre-Tax Spending Accounts and Health Savings Accounts are also available to employees.

Vectren's Employee Assistance Program (EAP) offers a wide range of employee assistance and well-being services. Employees and eligible family members have access to free and confidential professional care, self-help programs, interactive tools and educational resources addressing life and work issues. The program can help with family support, substance abuse, counseling services, relationships and financial and legal advice. The EAP is available around the clock to support employees with everyday challenges or more serious complex problems.

Vectren offers numerous established wellness programs to support employees. Participation in wellness programs have achieved high levels of participation and continue to increase primarily due to upper management involvement and support, two comprehensive worksite health and wellness centers staffed with a physician, nurse practitioners, licensed practical nurses, wellness nurse, health specialist, health coach and a dietitian, an established wellness committee with wellness Champions for our outlying area and incentives for health achievements and participation in programs.

Vectren offers employees onsite biometric screenings, including cholesterol, blood pressure, blood sugar, tobacco usage and body mass index checks, with simultaneous online Health Risk Appraisals for employees and spouses and influenza vaccinations to employees. An extensive wellness portal with exercise and calorie trackers, health articles and various behavior modification courses such as weight loss, nutrition, exercise, tobacco cessation, stress management and alcohol abuse is available to help employees reach their health goals. Lunch and learn webinars focusing on important wellness topics are offered as well as healthy cooking classes and healthy nutrition stations for food sampling. Fitness and self-defense classes, wellness walks and basketball leagues help employees stay active. Challenges such as a Maintain Don't Gain, a pedometer challenge and an annual Get Down campaign entices employees to focus on wellness to achieve wellness incentives. Each month, Vectren recognizes a Wellness Person of the Month that highlights employees that have overcome a health challenge or maintained a healthy lifestyle. Vectren's approach of positive reinforcement continues to drive positive results as evidenced in our biometric screening results.

As a result of creating a culture of Wellness, Vectren was awarded the American Heart Association's Fit Friendly Platinum award in April 2016 and achieved the Gold Wellness Council of America "Well Workplace" Award in May 2014.

Safety

We have gained considerable momentum in terms of safety culture improvement and injury prevention in recent years by increasing collaboration, communication and engagement with employees at all levels of the organization.

Safety – Collaboration

Vectren continues to empower our Safety Culture Teams at the grassroots level and provide two-way communication between the local teams and the jointly-led safety culture advisory team. The advisory team, which is a mix of executive, operations and union leadership, meets quarterly to review any over-arching concerns that surface from guidance teams and provides guidance and support of the strategic vision to improve culture and keep our employees, contractors and the public safe.

To help the local teams improve processes and solve problems autonomously, the advisory team has been working with Vectren’s performance management and continuous improvement department to provide formal training and continuous improvement events that enable cross-functional process mapping, root cause analysis and structured problem solving so issues can be addressed by those involved with the work. These tools are inspiring and enabling our workforce to promote changes necessary to enhance safety.

Safety – Communication

Based on feedback from the safety culture advisory team and a safety culture assessment completed in 2013, we decided to focus our attention on improving communication and employee recognition in 2015. We send routine and formal communication including weekly Near Misses and Lessons Learned, safety reports, the Safety Buzz newsletter, as well as monthly motor vehicle incident summary with preventative measures and an injury prevention update. We communicate less content more frequently and leverage technology to its fullest potential since all field employees now have email and mobile devices.

Safety – Engagement

The growth of our Safety Management System continues to help employees protect our workforce, assets and the public from risk while aligning us with future regulation. The Safety Management System Vision is to empower others to live safely by actively reducing risks, aligning priorities throughout the organization and focusing on the everyday journey to zero incidents.

Our long-term vision for colleague engagement includes continued growth of current safety initiatives relative to collaboration, communication and continuous improvement. We believe by involving our workforce in activities that support the mission and vision of our organization, we can learn from the past and work together toward a more effective, safe and efficient future for all.

G4-LA1 New Employee Hires & Employee Turnover

New Employee Hires by Gender (2015-2017)

	2015	2016	2017
Male External Hires	146	99	127
Female External Hires	68	68	58
Total External Hires	214	167	185
– Total Female External Hires (% of total)	31.8%	40.7%	31.4%



New Employee Hires by Age Group (2015-2017)

	2015	2016	2017
Under 25	24	20	24
25-30	50	38	34
30-35	47	29	41
35-40	33	24	25
40-45	18	20	16
45-50	19	14	15
50-55	13	9	14
55-60	9	7	13
60-65	1	6	3
Total External Hires	214	167	185

New Employee Minority Hires (2015-2017)

	2015	2016	2017
Total Minority External Hires	42	21	27
<i>– Total Minority External Hires (% of total)</i>	<i>19.6%</i>	<i>12.6%</i>	<i>14.6%</i>

Turnover (2015-2017)

	2015	2016	2017
Voluntary Separations	120	106	114
<i>– Voluntary Retirements</i>	<i>52</i>	<i>52</i>	<i>56</i>
<i>– Voluntary Resignations</i>	<i>68</i>	<i>54</i>	<i>58</i>
Involuntary Separations	15	15	26
Total Separations (Voluntary and Involuntary)	135	121	140

Retirements & Resignations by Gender (2015-2017)

	2015	2016	2017
Retirements	52	52	56
<i>– Male Retirements</i>	<i>38</i>	<i>37</i>	<i>38</i>
<i>– Female Retirements</i>	<i>14</i>	<i>15</i>	<i>18</i>
Resignations	68	54	58
<i>– Male Resignations</i>	<i>41</i>	<i>26</i>	<i>35</i>
<i>– Female Resignations</i>	<i>27</i>	<i>28</i>	<i>23</i>

Retirements & Resignations by Age (2015-2017)

	2015	2016	2017
Retirements	52	52	56
– 50-54 Retirements	0	0	3
– 55-64 Retirements	33	36	42
– 65 and Over Retirements	19	16	11
Resignations	68	54	58
– Under 25 Resignations	5	2	3
– 25-34 Resignations	33	18	19
– 35-44 Resignations	14	16	18
– 45-54 Resignations	9	9	12
– 55-64 Resignations	5	6	6
– 65 and Over Resignations	2	3	0

G4-LA2 Benefits Provided to Full-Time Employees That Are Not Provided to Temporary or Part-Time Employees

Vectren does not provide benefits to temporary or part-time employees. Please see the Benefits & Compensation page on Vectren.com for more information on our employee benefits (www.vectren.com/careers/compensation).

G4-EU15 Employees Eligible for Retirement

As of December 31, 2017:

- 473 (or 25%) of employees are eligible for retirement
- 666 (or 35%) of employees will be eligible for retirement in five years
- 978 (or 52%) of employees will be eligible for retirement in 10 years

OCCUPATIONAL HEALTH & SAFETY

G4-DMA Occupational Health & Safety

Vectren is dedicated to providing a safe and healthy workplace and to conducting business with the utmost regard for the health and safety of our employees, customers and the public. This philosophy is in accordance with our mission to integrate a strong focus on safety and health into day-to-day business management and process design. No aspect of operations is more important than the health and safety of our stakeholders.

Vectren is committed to complying with all applicable government regulations and internal health and safety requirements and maintaining management systems designed to ensure compliance. We commit to continual improvements of these health and safety management systems and strive for best-in-class performance within the energy industry. In order to accomplish this, we establish health and safety objectives and targets, conduct regular management system and performance evaluations and frequently report the results to employees, customers and the public for accountability.

We encourage interested parties, including employees and the public, to voice safety concerns and suggestions. To promote transparency, we openly communicate and share information regarding our health and safety systems and the impacts of our activities, services and products.

Within Vectren, departmental leadership is primarily responsible for implementing our Health and Safety Policy and allocating resources to establish and support health and safety programs. Management, at all levels, will take actions to ensure all employees understand the meaning and importance of the policy.

While management must provide the leadership and support essential to maintaining a safe and healthy work environment, it is the responsibility of every Vectren employee to make safety an integral part of his or her daily work. Each employee will be held accountable for his/her individual safety performance in alignment with our health and safety procedures and programs.



G4-LA5 Workforce Representation in Formal Joint Management-Worker Health & Safety Committees

Vectren emphasizes a commitment to safety across all of our utility operations. A safety team comprised of senior leaders, safety personnel and key members of operations meets regularly to discuss safety strategy. At the director level, we have formal safety committees which are spearheaded by operations personnel and include both bargaining unit and non-bargaining unit employees. Approximately 11 percent of the workforce is involved in these formal safety committees.

G4-LA6 Injuries, Occupational Diseases, Absenteeism & Work-Related Fatalities

Rules for Reporting Accident Statistics & Definitions

Vectren reports and records safety statistics in accordance with the Occupational Safety and Health Administration (OSHA) recordkeeping standards. Please see Recording and Reporting Occupational Injuries and Illness to review the OSHA standards related to recordkeeping. (Source: OSHA Recordkeeping Standard 1904)

- **OSHA Recordable Cases:** Definition of “Recordable” per OSHA Recordkeeping Standard 1904 (i.e., “a work-related injury or illness resulting in medical treatment beyond first aid”)
Calculation: Total OSHA Cases YTD
- **OSHA Recordable Rate:** Incidence Rate of OSHA Recordables Based on Number of Man-Hours
Calculation: Number of OSHA Recordables x 200,000/Man-Hours
- **DART Cases:** OSHA Recordable Resulting in Days Away, Restricted or Transferred
Calculation: Total DART Cases YTD
- **DART (Incidence) Rate:** Incidence Rate of DART Cases Based on Number of Man-Hours
Calculation: Number of DART Cases x 200,000/Man-Hours
- **DART Severity Rate:** Severity Rate of DART Cases Based on Lost Time (more days away = more severe cases)
Calculation: Number of DART Days x 200,000/Man-Hours

Injury Tracking

We track first-aid injuries requiring on-site first-aid intervention and first-aid medical injuries which require treatment at a medical facility but does not result in an OSHA recordable case (based on the OSHA Recordkeeping Standard describing the difference between first-aid and cases – 29CFR1904). In addition, we track near miss events which could have resulted in an injury.

Injury Time

Per the OSHA recordkeeping standard, “days away” means calendar days, and the count begins on the first day after the illness or injury.

Injury Rate for Total Workforce

The Injury Rate for Total Workforce is equivalent to the “OSHA Rate” on Vectren reports. See the following chart:

OSHA Recordables & Rate (2017)

Group/Location	OSHA Recordables	OSHA Rate
Energy Delivery	29	3.87
Power Supply	5	2.94
Utility Support	0	0.00
Corporate	0	0.00
Total	34	1.96

Injury Rate by Gender

Vectren does not currently track Injury Rate, or OSHA Rate, by gender.

Injury Rate for Independent Contractors

A portion of Injury Rate data for independent contractors is tracked by the Coalition for Construction Safety, Inc. (CCS), to manage our contractor’s safety pre-qualification. Contractors must be certified before they can work for Vectren. CCS data is not available for this report as its database is shared amongst many companies and the data is not aggregated to exclusively include contractors hired by Vectren.

Occupational Diseases Rate

The Occupational Diseases Rate (ODR) for total workforce (total employees plus supervised workers) is zero. This rate is not tracked for independent contractors.

Lost Day Rate

The Lost Day Rate is equivalent to the "DART Rate" on Vectren reports. The DART data in the following chart does not include independent contractors.

Fatalities

No workforce fatalities were recorded during the reporting period. This is not tracked for independent contractors.

DART Rate & DART Severity Rate (2017)

Group/Location	DART Rate	DART Severity Rate
Energy Delivery	2.67	32.27
Power Supply	1.18	54.11
Corporate	0.00	0.00
Total	1.27	69.69

G4-LA8 Health & Safety Topics Covered in Formal Agreements with Trade Unions

Topics covered in formal labor agreements related to safety include:

- Membership support of a safe working environment
- Provision to provide personal protective equipment/uniforms
- Formation of safety committees
- Additional benefits for employees who suffer work related injuries beyond state workers compensation provisions
- Implementation of safety rules

determine performance gaps and mitigating measures necessary to meet workforce needs.

Vectren's Operator Qualification (OQ) Program and training materials are reviewed on an annual basis. In addition, Technical Training continually monitors triggers that may necessitate additional reviews of the OQ Program and/or training materials. These triggers include modifications to policies or procedures, changes in state or federal regulations, individual performance problems and the use of new equipment, technology and information from equipment or product manufacturers.

Technical training is typically conducted in one of three locations – Evansville, Indiana for both gas and electric operations, Franklin, Indiana and Centerville, Ohio for gas operations. Training is also provided at each of Vectren's local operating centers. Field employees receive initial training through the apprenticeship programs and receive subsequent training based on the type of work being performed. To meet Vectren's OQ requirements, employees demonstrate task-specific competencies by successfully completing the required performance evaluations, which are pass/fail.

TRAINING & EDUCATION

G4-DMA Training & Education

Vectren provides training to ensure employees have the knowledge and skills necessary to perform their work safely and efficiently. Training is a requirement for all field employees to acquire the knowledge and skills to perform job functions, improve upon existing competencies, capitalize on increased efficiencies and ensure a safer work environment.

Vectren's Technical Training Department develops, coordinates and provides instruction on job-specific training and qualifications, including (but not limited to) designing, constructing, operating and maintaining Vectren's

gas and electric infrastructure. The training and qualifications are tracked and reported by the Technical Training Department and are evaluated to

In 2017, we completed construction of the Yankee Learning Center in Ohio and plans are underway for construction of a new learning center in Evansville. These two new learning centers will join our existing training center in Franklin, Ind. to drive a consistent approach to formalized hands-on learning in a controlled environment and will continue to drive success for years to come.

Vectren currently has 170 apprentices enrolled in one of our ten apprenticeship programs. Total headcount for field employees in 2017 was approximately 590, approximately 1/3 are in apprenticeship programs.



G4-LA10 Skills Management & Lifelong Learning Programs

Vectren is committed to providing colleagues with the tools and resources needed to meet their career goals and the changing requirements of the business. This begins with Vectren's online talent management system, Talent Connection, which houses a robust collection of free online courses as well as a career planning tool that helps colleagues gain a better understanding of the competencies and experience required for various positions throughout the company so that they may develop a career path that's right for them.

Colleagues may take advantage of Vectren's tuition reimbursement program, which helps cover qualifying educational expenses, or attend one of the many onsite training sessions scheduled throughout the year. In addition, Vectren's leadership development program - "Leading with Energy" - is designed to help the company's leaders meet the unique challenges they face in today's workplace.

Vectren also has a formal mentoring program that pairs less experienced employees who demonstrate leadership capabilities and a commitment to company values with more experienced employees in leadership roles. The purpose of the program is to develop the leadership skills of emerging talent and ensure Vectren has an appropriate supply of talented leadership and a continuity of culture.

Please see the Careers page on Vectren.com for additional information on skills and learning opportunities for employees (www.vectren.com/careers).

G4-LA11 Percentage of Employees Receiving Regular Performance & Career Development Reviews

Our philosophy and expectations are that all non-bargaining employees receive an evaluation of their skills and/or performance on an annual basis.

The required shift starts from the top down, with all our senior executives leading the way and supporting Vectren's Human Equity Vision. The D,I, & HE strategy is divided into four key focus areas. Each area focuses on defined strategic initiatives, projects and programs to drive our transformation and are led by our executive team.

The 4 Focus Areas Are:

- **Talent Attraction & Retention** – Enabling the organization to identify, attract, recruit, develop & retain the best talent is key to a successful human equity strategy. This area focuses on Vectren becoming a talent magnet & an employer of choice for all.
- **Culture & Environment** – Culture includes Vectren's Vision, Mission, Core Values, norms, working language, systems, symbols, beliefs & habits. This area focuses on the collective behaviors of our leadership & associates & the meanings that they attach to their actions. "Culture is what individuals do when no one is looking".
- **Customer Focus, Supplier Diversity & Recognition** – Understand & recognize that the diversity of our clients and suppliers enable Vectren to improve customer satisfaction & enhance economic opportunity. This area also focuses on the external recognition for being an employer & supplier of choice and an advocate for human equity with our various external stakeholders.
- **Leadership Development** – Leadership behavior is key to achieving human equity within Vectren. This area focuses on ensuring Vectren leaders exhibit Equitable Leader competencies & are engaged in the execution of the human equity strategy & plans.

DIVERSITY & EQUAL OPPORTUNITY

G4-DMA Diversity & Equal Opportunity

Over the past year and a half, the Human Resources Advisory Committee (HRAC) has been working to ensure that our diversity and inclusion initiatives continue to support our corporate goal of being a leader in diversity and inclusion. At Vectren, we recognize that people are what differentiate a high performing company resulting in better communities, customer service, innovative energy solutions and financial outperformance relative to our peers. In order to be successful as a company, it is our people that drive that differentiation and success.

What sets us apart is how intentional and deliberate our efforts and actions are in this area, driven by our Human Equity Strategy. We believe that moving from "Diversity" to "Inclusion" and, ultimately, "Human Equity" (D,I & HE) is a required shift. Our strategy aims to ensure that each employee feels valued, included and is an integral part of our organization's success. This positions us to leverage the unique skills, attributes and talents of each individual.



Human Equity is about organizational effectiveness not just the right thing to do. A culture of human equity drives how we assess talent, evaluate organizational/departmental needs, and align employees with positions and roles that align with their skills, knowledge and intangibles. Organizations that have a sustainable, strong, productive culture have something that endures beyond any specific leader. Human Equity will positively affect Vectren's culture, engagement, empowerment and sustainability.

G4-LA12 Composition & Diversity of Governance Bodies & Workforce

The following tables detail the gender and ethnicity breakdown of our total workforce. Please see response to Standard Disclosures indicator G4-38 for a breakdown of the Board.

Gender Analysis (2017)

	Female (% of Total Females)	Male (% of Total Males)	Total (Female % of Total)
Senior Executive	1 (0.2%)	6 (0.5%)	7 (14.3%)
Vice President/Director	19 (3.3%)	39 (3.0%)	58 (32.8%)
Manager/Supervisor	81 (14.0%)	222 (16.8%)	303 (26.7%)
Customer Service	116 (20.1%)	17 (1.3%)	133 (87.2%)
Office and Clerical	146 (25.3%)	19 (1.4%)	165 (88.5%)
Other Non-bargaining	178 (30.9%)	343 (26.0%)	521 (34.2%)
Bargaining	36 (6.2%)	672 (51.0%)	708 (5.1%)
Total	577 (100.0%)	1,318 (100.0%)	1,895 (30.4%)

Minority Analysis (2017)

	Minority (% of Total Minorities)	Non-minority (% of Total Non-minorities)	Total (Minority % of Total)
Senior Executive	0 (0.0%)	7 (0.4%)	7 (0.0%)
Vice President/Director	7 (3.3%)	51 (3.0%)	58 (12.1%)
Manager/Supervisor	19 (8.9%)	284 (17.0%)	303 (6.3%)
Customer Service	31 (14.5%)	102 (6.1%)	133 (23.3%)
Office and Clerical	33 (15.4%)	132 (7.9%)	165 (20.0%)
Other Non-bargaining	57 (26.6%)	459 (27.4%)	516 (11.0%)
Bargaining	67 (31.3%)	639 (38.2%)	706 (9.5%)
Total	214 (100.0%)*	1,674 (100.0%)*	1,888 (11.3%)*

* Seven employees in 2017 did not specify an ethnicity.



Females & Minorities as Percentage of Workforce (2015-2017)

	2015	2016	2017
Regular Headcount	1,823	1,864	1895
– Regular Headcount - Female	554	572	577
– Regular Headcount - Minority	194*	206*	214*
– % Female	30.4%	30.7%	30.4%
– % Minority	10.6%*	11.1%*	11.3%

* Five, four and seven employees in 2015, 2016 and 2017, respectively, did not specify an ethnicity.

Ethnicity as Percentage of Employee Group (2015-2017)

	2015	2016	2017
White	1,624	1,654	1,674
– % White	89.3%	88.9%	88.7%
Black/African-American	132	138	142
– % Black/African-American	7.3%	7.4%	7.5%
Hispanic/Latino	22	24	23
– % Hispanic/Latino	1.2%	1.3%	1.2%
Asian	13	16	17
– % Asian	0.7%	0.9%	0.9%
American Indian/Alaska Native	5	4	5
– % American Indian/Alaska Native	0.3%	0.2%	0.2%
Native Hawaiian/Other Pacific Islander	1	1	1
– % Native Hawaiian/Other Pacific Islander	0.1%	0.1%	0.1%
Two or More Races (Not Hispanic or Latino)	21	23	26
– % Two or More Races (Not Hispanic or Latino)	1.2%	1.2%	1.4%
Total	1,818*	1,860*	1,888*

* Five, four and seven employees in 2015, 2016 and 2017, respectively, did not specify an ethnicity.

HUMAN RIGHTS

This section of indicators contains information regarding our non-discrimination policies and provides insight into incidents of discrimination.

NON-DISCRIMINATION

G4-DMA Non-Discrimination

The purpose of Vectren's Anti-Harassment and Non-Discrimination Policy is to establish a work environment in which all individuals are treated with respect and dignity by spreading awareness as to the definition and various forms of discrimination and harassment.

Each individual has the right to work in a professional atmosphere which promotes equal opportunity and prohibits discrimination and harassment. Therefore, we expect all relationships among persons in the workplace will be business-like and free of bias, prejudice and discrimination.

Vectren prohibits discrimination and harassment by fellow employees, whether it be a supervisor, manager, supervised employee, or a third party who does business with the company (e.g., an outside vendor, consultant or customer).

According to our policy, discriminatory conduct is prohibited in the workplace, on company property and in any work-related setting outside the workplace, such as during business travel, meetings and business-related social events. All employees are expected to refrain from discrimination and harassment of others.

The company prohibits retaliation against any individual who, in good faith, reports discrimination or harassment or participates in an investigation of such reports.

G4-HR3 Incidents of Discrimination & Corrective Actions Taken

Vectren had no substantiated legal claims of discrimination in 2017.

SOCIETY

This section of indicators contains information about our impact on the communities we serve, how we mitigate the risk of bribery and corruption in our operations and our approach to public policy.

LOCAL COMMUNITIES

G4-DMA Local Communities

One of Vectren's core values is a commitment to the communities in which we live and serve. Our commitment to community is demonstrated by our financial and human resource contributions.

Vectren Foundation

The Vectren Foundation was established in 2000 to provide support for the many nonprofit organizations in the communities served by our utility operations. Annually, Vectren allocates a percentage of a 3-year trailing average of pre-tax income to fund the Foundation and corporate contributions. This percentage grew from 1 percent in 2015, to 1.2 percent in 2017, and growth is targeting 1.5 percent by 2020. In 2017, Vectren and the Vectren Foundation contributed \$4.1 million to 418 organizations in three primary areas of focus: access to and advancement in education, energy conservation and environmental stewardship and community revitalization and sustainability.

In 2017, Vectren funded the Vectren Foundation from earnings as the result of recent tax reform. The \$70 million infusion will be used to help local communities grow in their quality of life and take place over a 10-year period.

Community Catalyst, a key program initiated by the Vectren Foundation, uses an asset-based community development model to focus resources on revitalizing high-stress neighborhoods. Through this effort, Vectren partners and collaborates with like-minded entities across a number of fields including education, healthcare, faith and non-profit, as well as neighborhood residents. In 2017, the Foundation collaborated with the following communities in Vectren's service territory: Anderson, Dayton, Evansville, Lafayette, Marion, Muncie and Terre Haute. An estimated 9,500 homes were impacted.



Ongoing Community Catalyst Initiatives (2017)

Location	Organize <i>Build relationships, identify partners</i>	Decide <i>Visioning, working groups, action planning, early actions</i>	Act <i>Action plan, implementation, evaluation</i>
Anderson, IN	✓	(Current Stage)	
Dayton, OH	✓	(Current Stage)	
Lafayette, IN	✓	(Current Stage)	
Terre Haute, IN	✓	✓	(Current Stage)
Evansville, IN	✓	✓	(Current Stage)
Marion, IN	✓	✓	(Current Stage)
Muncie, IN	✓	✓	(Current Stage)

Relocation Assistance Program

Vectren makes every effort to minimize the impact on property owners in our service territory. However, circumstances arise when relocation is required in order to maintain the integrity of our energy delivery system to ensure safety and reliability for neighboring property owners and customers.

Vectren's Relocation Assistance Program is designed to help minimize any hardships residential or commercial property owners may experience when relocation is required. All property owners displaced by a pipeline or similar utility project undertaken by Vectren are offered relocation assistance services for the purpose of locating a suitable replacement property. **A relocation agent is available for each impacted property owner and has the ability to assist with the following:**

- Determine any special needs & requirements
- Explain the relocation process & entitlements
- Offer relocation advisory assistance
- Ensure the availability of a comparable property in advance of displacement
- Provide referrals to comparable properties
- Provide the amount of maximum replacement housing entitlement in writing 90 days or more before the required vacate date
- Inspect replacement homes for decent, safe & sanitary (DSS) standards
- Supply information about other federal, state & local programs offering assistance to displaced persons
- Provide assistance to minimize hardships

Human Resources

Vectren employees share in the commitment to community by volunteering their time and talents, whether by serving on a nonprofit board, contributing personal funding to a local charity, or spending a day volunteering at a local agency. Our employees are community-minded and highly engaged. Volunteer hours continue to increase annually—approaching nearly 57,000 hours (combined on-the-clock and off-the-clock) in 2017. The Vectren Foundation provides matching programs for hours invested by employees as well as contributions made to colleges and universities. These programs accounted for \$85,737 dollars in 2017. Finally, a matching program also exists for contributions to local United Way organizations within Vectren's service territory. The 2017 United Way campaign generated \$710,300 in employee giving and Foundation matching.

Employees are also encouraged to engage in leadership positions in the communities we serve. In 2017, Vectren officers, directors and managers held board and committee positions in 200 community-minded organizations.

G4-S01 Operations with Local Community Engagement, Assessments & Development Programs

Each of our operating units employs a system for handling community concerns on a local level. We also share issues among units and develop shared solutions where appropriate.

G4-EU22 Individuals Physically or Economically Displaced & Compensation

There were no physically or economically displaced persons in 2017.

G4-DMA Disaster/Emergency Planning & Response

Disaster/Emergency Preparedness & Response

Vectren has comprehensive emergency management and response plans designed to ensure we react timely and appropriately to disasters, maintain or resume critical business functions, and communicate effectively with internal and external stakeholders. Disaster/emergency preparedness and response are key components of Vectren's risk management and business continuity programs. Our personnel are trained to identify, evaluate, and manage a wide variety of hazards including, but not be limited to, those caused by fires, earthquakes, floods, storms, tornadoes, acts of civil unrest or workplace violence, pandemic/infectious disease, physical attacks, cyber-attacks, or other similar occurrences that adversely affect our stakeholders. Vectren also participates in industry groups to develop preparedness, monitoring, and response protocols for emerging hazards in our industry, including electromagnetic pulses and geomagnetic disturbances.

Our plans are tested by conducting drills, tabletop exercises, and educational sessions internally and with local, regional, and national organizations in the areas of operations, communications, and corporate support. These exercises include participation by our senior leadership, emergency responders, and operational stakeholders. Lessons learned and best practices are reviewed in incorporated into the plans as part of our continuous improvement exercises. As an example, Vectren participates in the North American Electric Reliability Corporation's biennial Grid Exercise, which simulates a cyber/physical attack on critical infrastructure across North America. The exercise includes internal participants across the organization, including, but not limited to operations, engineering, information technology, cybersecurity, physical security, communications, compliance, enterprise risk, government affairs, and our executive team.

Physical & Cybersecurity

Vectren is committed to operational security and compliance. Resilience is necessary to reliably deliver energy in today's world of ever-evolving threats. Vectren relies on our highly capable and trained workforce, technology, best practices and processes to align with the core security activities – Identify, Protect, Detect, Respond, and Recover. Vectren has dedicated internal and third-party physical and cybersecurity teams to identify, protect and detect both physical and cyber-attacks. These events could include attacks on company facilities, malicious cyber-attacks, data breaches, or other activities which impact operations or disclose customer, employee, or company sensitive data. Vectren assess plans and controls when new threats are identified.

Vectren participates in local, state and national information sharing programs to share and receive indicators of compromises and lessons learned. In addition, Vectren has joined the national level Cyber Mutual Assistance program where utilities across the country provide aid to member utilities during a cybersecurity event.

ANTI-CORRUPTION

G4-DMA Anti-Corruption

The vice president of corporate audit oversees Vectren's ethics program and monitors the company's overall adherence to the ethical standards established in our Corporate Code of Conduct. The vice president of corporate audit reports functionally to the Audit Committee of the Board and administratively to the executive vice president and chief legal and external affairs officer. The direct line of communication to the Audit Committee and the executive vice president emphasizes the vice president of corporate audit's governance role within the organization.

Vectren's ethics program employs the following instruments for avoiding and managing corruption:

- Our Corporate Code of Conduct directs employees to avoid relationships with, & financial interest in, business partners & those who are seeking to become business partners. Further, our Code requires employees owning or acquiring a financial interest in a vendor, supplier, or contractor to report such relationships to their immediate supervisor using a prescribed form. If the supervisor determines a conflict exists, the supervisor is required to contact the appropriate executive officer & the corporate audit department for resolution. For information on how conflicts of interest for the highest governance body are avoided & managed, please see response to Standard Disclosures indicator G4-41.
- Our Corporate Code of Conduct prohibits employees from accepting gifts, favors, or entertainment that compromise, or appear to compromise their ability to make objective business decisions. Employees are required to report gifts, business meals or entertainment, services, or anything else from a single business partner, of more than a nominal value, to their immediate supervisor using a prescribed form.
- Significant vendors, suppliers & contractors are kept aware of our Code provisions regarding conflicts of interests & inappropriate gifts, favors & entertainments via an annual letter.
- Vectren provides various methods for employees to seek advice or report compliance issues. For more information on the internal & external mechanisms for seeking advice or reporting concerns about unethical or unlawful behavior, please see responses to Standard Disclosures indicators G4-57 & G4-58.
- Vectren has adopted a fraud & misconduct reporting framework to ensure Code violations are investigated & questions are addressed in a timely, consistent manner. This framework ensures communication channels are known among the business units, subsidiaries & the corporate office. The framework affirms theft & corruption of any size violates trust is not tolerated & will be dealt with swiftly.



G4-S04 Anti-Corruption Training, Communication, Policies & Procedures

Employees receive Code of Conduct training as part of new hire orientation. On an annual basis officers and Board members, utility bargaining, and non-bargaining, with a minor exception regarding job classification, complete Code of Conduct acknowledgments. Vectren's intranet provides information related to our Code of Conduct and how to report issues and seek advice. Issues may be reported by contacting a manager or the vice president of corporate audit, and can also be reported anonymously by email, internet, or hotline. Any deliberate failure to disclose violations may result in disciplinary action.

We voluntarily prohibit corporate dollars from being used to directly benefit a candidate or party. We also do not make corporate expenditures, as authorized by the Citizens United decision, and do not have any plans to do so at this time.

As part of our commitment to contemporary governance practices, we regularly report our corporate political activities to the Board's Corporate Responsibility and Sustainability Committee.

PUBLIC POLICY

G4-DMA Public Policy

Public policy decisions can affect businesses, and at Vectren we believe engaging in the political process is in the best interest of our company, employees and stakeholders. We track proposed legislation at the federal, state and local level and advocate our positions when appropriate. We strive to educate public officials about our businesses, the impacts of potential policy decisions and participate in industry trade associations to assist in developing industry-wide positions, including memberships in the Edison Electric Institute, American Gas Association, Indiana Energy Association and Ohio Gas Association.

As part of our commitment to contemporary governance practices, we regularly report our corporate political activities to the Board's Corporate Responsibility and Sustainability Committee.

PRODUCT RESPONSIBILITY

This section of indicators contains information on how we measure customer satisfaction, improve the customer experience and protect customer data.

CUSTOMER HEALTH & SAFETY

G4-DMA Customer Health & Safety

The safety of our customers, employees and the public is our highest concern, and Vectren maintains industry-leading energy safety outreach and education programs which engage and educate the public, emergency-responders and excavators.

We actively engage to educate contractors and municipalities on the importance of marking the underground locations of natural gas pipeline and other utilities. Additionally, we clarify safe digging laws and regulations and promote contact with the state's One-Call contact center. Permitting packets containing "811" and "Call Before You Dig" materials are distributed to city permitting offices, which provide the packets to individuals requesting work permits.

Across our service territory, we invite local excavators, emergency responders, locators and Vectren employees to "Safety Days" featuring pipeline safety resources and opportunities to interact with local damage prevention specialists. Additionally, we host annual emergency responder group meetings to help ensure emergency responders are prepared to respond to related incidents.

Each fall, we offer the Energy Safe Kids program to area fourth-grade classrooms across our service territory. This program provides valuable electric and natural gas safety information, including demonstrations on how to detect a natural gas leak and what to do if a natural gas leak is suspected.

G4-S05 Confirmed Incidents of Corruption & Actions Taken

The corporate audit department monitored the completion of 28 investigations or allegations made anonymously and/or through the ethics hotline. Upon conclusion of the investigations by corporate audit, no confirmed incidents of corruption were identified.

G4-S06 Political Contributions

The Vectren Corporation Federal Employees' Political Action Committee (Vectren PAC) provides our employees a voice in the political process. The Vectren PAC is a voluntary employee political action committee and, through the Vectren PAC, we make bipartisan political contributions where permitted by law. We comply with all Federal Election Commission and state regulations, and Vectren PAC contributions are publicly disclosed in our filings with state and federal election commissions and agencies. In recognition of various stakeholder interests, all Vectren PAC activities are overseen by the Vectren PAC Board.

G4-PR1 Significant Product Categories for Which Health & Safety Impacts Are Assessed for Improvement

Health and safety impacts are assessed for improvement across all product and services.

G4-EU25 Injuries & Fatalities to the Public Involving Company Assets

Vectren does not disclose information that may relate to potential litigation.

PRODUCT & SERVICE LABELING

G4-DMA Product & Service Labeling

Vectren's third party vendor for customer satisfaction research follows the Council of American Survey Research Organizations Code of Standards and Ethics for Survey Research, which has long been the benchmark for the research industry. Monthly phone surveys are conducted by our vendor to gauge customers' overall perception of Vectren and satisfaction with their recent experience. In 2017 our vendor conducted two studies, perception and contact, speaking with approximately 7,000 customers. The perception survey is given to a random sample of residential, commercial and key account customers, while the contact study is a transaction based survey used to rate the customer experience for power outages, gas leaks and customer move-ins.

Additionally, our market research department conducts over 4,000 residential email surveys annually to identify specific areas of improvement within customer touch points (e.g., billing, communications, customer service, etc.). Residential customers are randomly selected to participate in this survey using known email addresses.

G4-PR5 Results of Surveys Measuring Customer Satisfaction

Vectren is committed to continuously improving the customer experience and 2017 was another successful year for Vectren's Improving Customer Experience (ICE) initiatives, which included updating the company's website and Automated Telephone System to enhance communications and automated processes for customers. Led by the Senior Vice President, Customer Experience, the ICE team meets regularly to discuss progress on projects aimed at improving the customer experience and evaluates and prioritizes new projects. Vectren continues to include ICE initiatives in business plans throughout the company. Two significant projects launched in 2017 to benefit customers by improving energy reliability and restoration was the Advanced Metering Infrastructure Technology Smart Meter deployment and the new Outage Management System.

Vectren values customers' opinions and consistently seeks feedback to help shape customer experience initiatives. Customers are offered opportunities throughout the year to give feedback about Vectren and the services we provide through a variety of channels.

Internal research consists of both quantitative and qualitative feedback collected using several methods. Monthly phone surveys are conducted by a third party vendor to gauge customers' overall perception of Vectren and satisfaction with their recent experience. In 2017, over three-quarters (78.6%) of our customers reported being highly satisfied with Vectren. Additionally, 85.6% of customers were highly satisfied with their recent service experience.

A quarterly online study is also conducted to identify specific areas of improvement within customer touch points (e.g., billing, communications, customer service, etc.). Regardless of survey method, customer comments are monitored to identify any breakdowns in specific processes and reported to managers throughout the company for follow-up.

In 2017, Vectren also subscribed to independent research conducted by firms such as J.D. Power and E Source to track year-over-year improvement and performance relative to other utilities.

G4-DMA Access to Electricity & Customer Support

With a focused effort on keeping low-income customers safe, comfortable and secure, Vectren embraces programs and relationships which maximize federal, state and third-party financial support. We were the first utility in the United States to have a certified Bridges Out of Poverty trainer, which has allowed us to focus on the challenges faced by our most vulnerable customers and how communities can collaborate to break the cycle.

Vectren's Universal Service Program (USP) provides discounts of 15 to 32 percent to Indiana customers receiving Energy Assistance whose household income is 150 percent of the Federal Poverty Level (\$36,900 for a family of four). Identified as a best practice, enrollment in USP is automatic when applying for energy assistance. An additional crisis/hardship component is available to households up to 200 percent of the Federal Poverty Level (\$49,200 for a family of four). Vectren funds 30 percent of the total cost of the program. Special payment arrangements are also available.

Nearly 12,000 customers participated in the Ohio regulated Percentage of Income Payment Plan Plus program. This program allows low-income customers to pay 6 percent of their income toward utility bills while providing a credit for on-time payments.

As a result of continued collaboration with our agency partners, outreach representatives made 175 visits to 48 counties served in 2017. Assistance agencies recognize our agency website as the premiere tool to provide an efficient means to obtain accurate information for assisting customers.

Vectren established Share the Warmth, Inc., as a private foundation to assist income-eligible households with energy conservation measures to reduce their utility bills. Due to growth, Share the Warmth was reclassified as a public charity in 2014. Each year, Vectren matches all public donations up to \$200,000. Funds are distributed to Indiana and Ohio Low Income Weatherization Assistance programs and combined with other funding for a whole house approach. Since 2007, more than \$1,850,000 has been raised to weatherize 758 homes.



G4-EU27 Residential Disconnections for Non-Payment

Time Between Disconnection of Service & Arrangement of Payment

- Less than 48 hours: **23,280 Customers**
- 48 hours to one week: **4,678 Customers**
- One week to one month: **4,168 Customers**
- One month to one year: **16,386 Customers**
- More than one year: **127 Customers**

Time Between Arrangement of Payment & Reconnection of Service

- Less than 24 hours: **20,677 Customers**
- 24 hours to one week: **20,328 Customers**
- More than one week: **59 Customers**

G4-EU28 Power Outage Frequency

In 2017, Vectren recorded a System Average Interruption Frequency Index (SAIFI) of 0.64. The SAIFI score is calculated by dividing the total number of customers interrupted by a power outage by the total number of customers served.

G4-EU29 Average Power Outage Duration

In 2017, Vectren recorded a System Average Interruption Duration Index (SAIDI) score of 58.8. The SAIDI score is calculated by dividing the number of "customer-minutes" (the product of the total number of customers interrupted by a power outage and restoration time) by the total number of customers served.

G4-DMA Provision of Information

Vectren considers the needs of a diverse set of customers and stakeholders when determining important safety and account information. Annually, Vectren provides customers with a complete brochure detailing their utility service. The brochure includes information related to financial assistance programs, gas supplier options, billing/payment, electric outage reporting, natural gas safety, gas piping and safe digging. The documents are available in both English and Spanish via our company website. Throughout the year, Vectren communicates via bill inserts and messages and online content regarding gas and electric safety. In addition, each year we engage nearly 15,000 fourth-grade students in an Energy Safe Kids classroom program, which

teaches natural gas and electricity safety. The program materials are available in both English and Spanish with access to numerous other languages. An interactive demonstration of how a live electric line works is also available for students, the community and emergency response training.

Customer bills are available in both print and online versions. Customers with special visual needs may request a large-font printed bill. Vectren's contact center staffs both English and Spanish-speaking representatives. Through the company's low income programs team, Vectren actively engages community organizations who help address customers' financial needs. They provide information on safety, budget programs, energy efficiency, payment plans and other available assistance options.

CUSTOMER PRIVACY

G4-DMA Customer Privacy

Vectren understands the need to protect our customers' personally identifiable information and has implemented a number of physical and cybersecurity controls to protect customer data. Vectren also has documented response procedures data breaches that are reviewed and tested on a regular basis. To date, there have been no identified instances of misuse, leaks, thefts, or losses of customer data.

Vectren collects information from our users through several methods, including phone, website, email and letter in order to understand how to better serve our customers. Vectren is the sole owner of the information collected and will not sell, share or rent this information to others, as disclosed in our privacy statement. The information will be used to access customer services, respond to or communicate with customers, address issues, improve services, or forward to another agency or entity for appropriate action.

We work with outside companies to process customer billing. These companies do not retain share, store, or use personally identifiable information for any secondary purposes. In the event we partner with another party to provide specific services, we will only share names and contact information of those users who sign up for these services. These parties can only use personally identifiable information for the purpose of providing these specific services.

G4-PR8 Substantiated Customer Privacy & Data Loss Complaints

None

GRI G4 CONTENT INDEX



This report is 'In Accordance' with the Global Reporting Initiative (GRI) G4 Guidelines – Core option. GRI is a sustainability framework aimed at increasing transparency among businesses and organizations worldwide.

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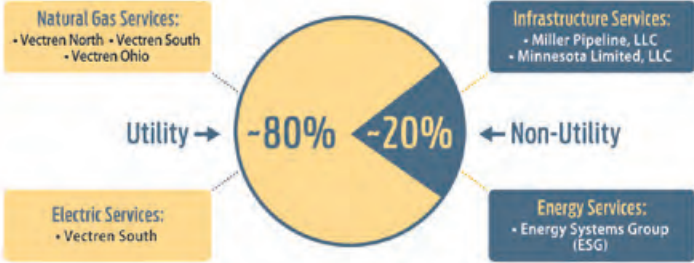
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ABOUT VECTREN

Vectren Corporation is an energy holding company headquartered in Evansville, Ind. Our energy delivery subsidiaries provide gas and/or electricity to more than one million customers in adjoining service territories that cover nearly two-thirds of Indiana and about 20 percent of Ohio, primarily in the west-central area. Our nonutility subsidiaries and affiliates currently offer energy-related products and services to customers throughout the U.S. These include infrastructure services and energy services.

Vectren Earnings Mix



Breakdown of Utility Earnings



Vectren Utility Service Areas





VECTREN
Live Smart

