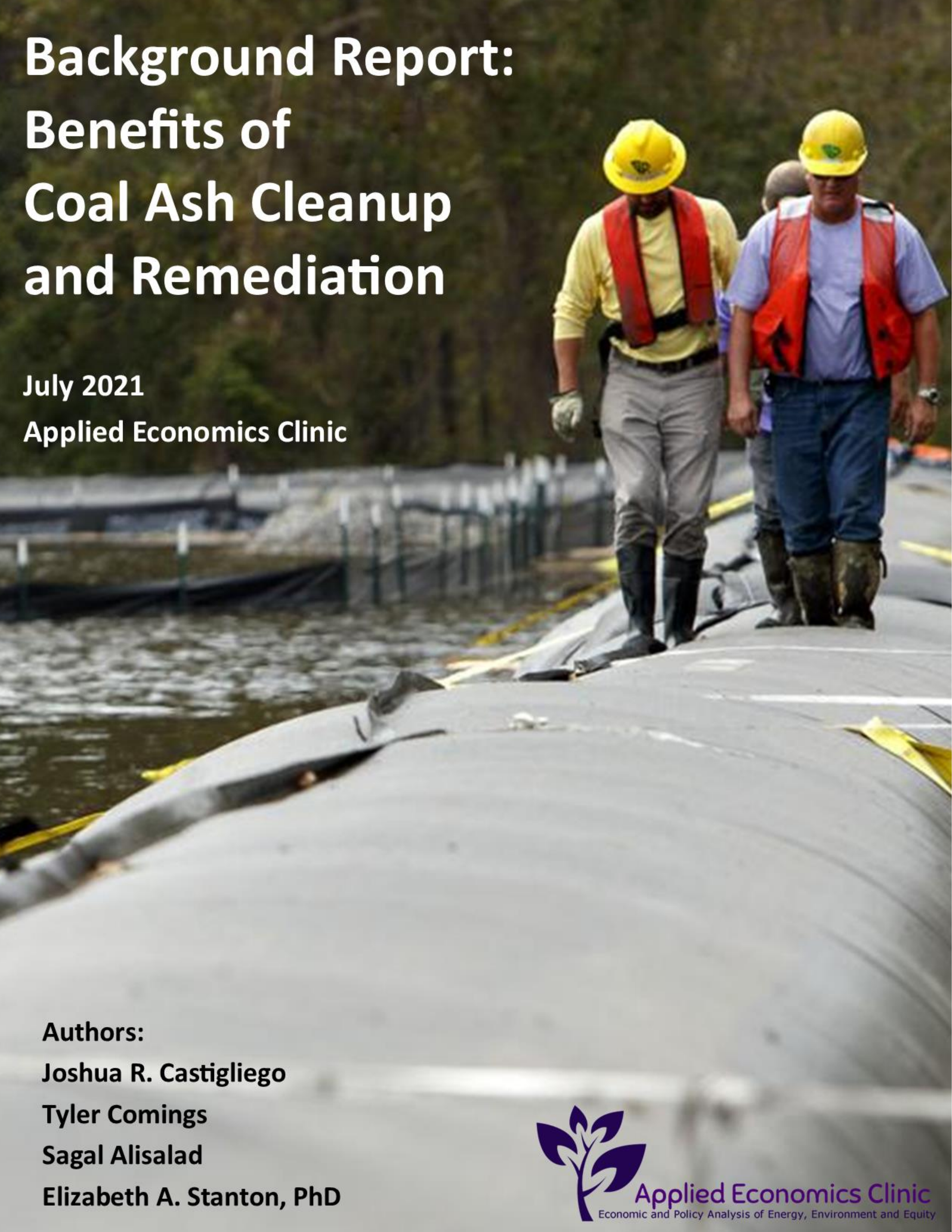

Background Report: Benefits of Coal Ash Cleanup and Remediation

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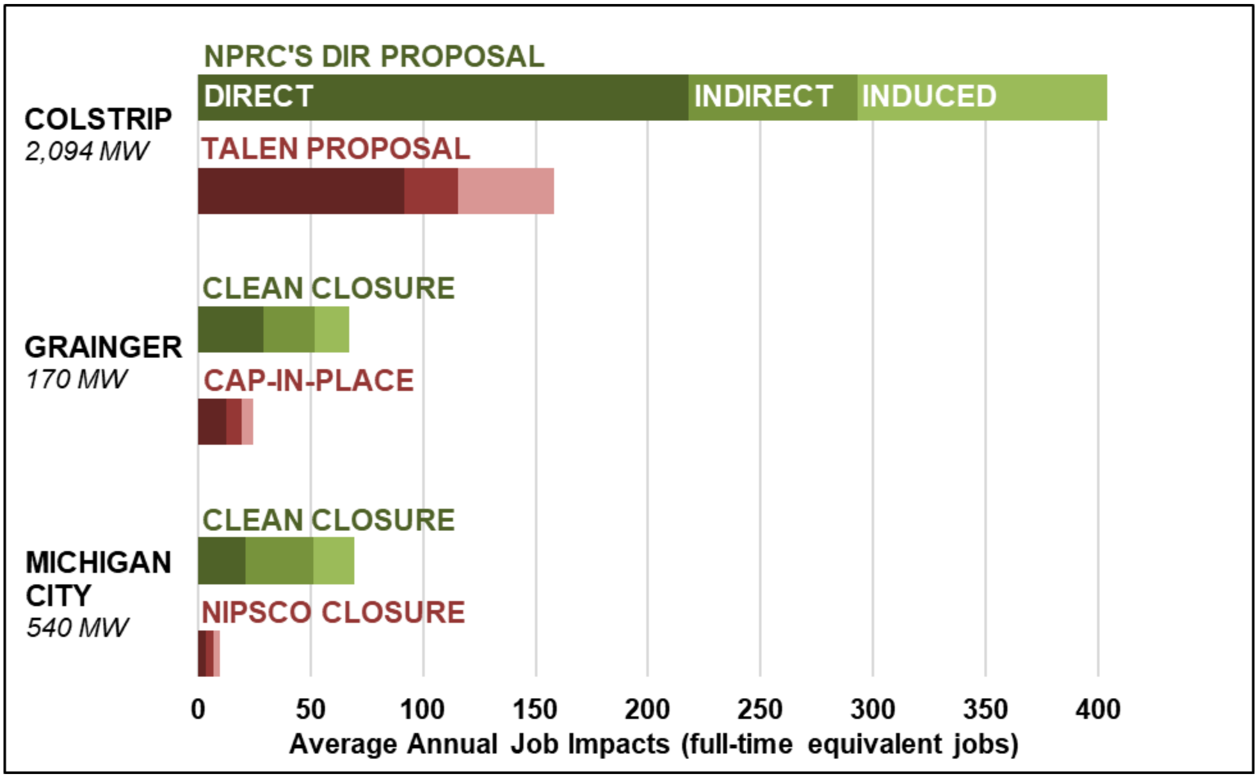
Economic and Policy Analysis of Energy, Environment and Equity

Executive Summary

Coal ash—or coal combustion residuals (CCR)—from electric generation are typically disposed of in landfills or ponds that pose serious risks to the environment and public health. This report estimates the economic benefits associated with coal ash cleanup and remediation at three power plants: Montana's Colstrip Steam Electricity Station, South Carolina's Grainger Generating Station, and Indiana's Michigan City Generating Station. In each case, two scenarios for coal ash cleanup are compared, a more thorough and effective cleanup (shown in green in Figure ES-1) and a less thorough option (shown in red).

Figure ES-1. Average annual job impacts during the active closure phase at three coal ash pond sites



For all three case studies, the more complete and more effective cleanup scenarios with full excavation of coal ash in contact with groundwater and contaminated soils results in more than double the jobs compared to the less effective cleanup plans: two and a half times more for Colstrip, three times more for Grainger, and seven times more for Michigan City. As is discussed in detail in this report, workers' income and local economic activity follow this same pattern: more stringent cleanup protocols result in greater benefits for both workers and the community. While the costs of these projects are typically recovered in customer rates, we found that the impact on ratepayers was minimal—roughly 0.02 to 0.03 cents per kilowatt-hour for residential ratepayers.

These results are consistent with the literature on the benefits of complete coal ash cleanup efforts. However, the economic impacts measured in this report are just one part of the greater economic and social benefits of coal ash cleanup and remediation activities.

Table of Contents

I. Introduction

Coal combustion residuals (CCR), commonly referred to as "coal ash," are a waste byproduct of electric generation at coal-fired power plants that are disposed of in either a landfill or surface impoundment, or transported offsite for reuse.[1] Coal ash contains contaminants that pose various risks to the environment and public health if the proper precautions are not taken during its disposal. Coal ash landfills and surface impoundments can both gradually release these contaminants into the environment by leaking into surface and groundwater supplies and dispersing fugitive dust into the air. Surface impoundments, also called coal ash ponds, pose a greater hazard since they store coal ash along with wastewater from coal-fired power generation, which increases the likelihood of surface and groundwater contamination, and in some cases can fail altogether, resulting in a catastrophic spill.

Recognizing the risks of inadequate coal ash disposal, EPA established the CCR Rule in 2015 to provide requirements for the safe disposal of coal ash from coal-fired power plants.[2] As part of this rule, EPA requires that utilities provide publicly accessible reporting for their coal ash disposal sites. In subsequent years, several revisions and amendments were made to the CCR Rule to allow some flexibility with closure deadlines and compliance requirements.

Since 2015, over 700 U.S. coal ash disposal sites have reported information in compliance with the CCR Rule.[3] Roughly two-thirds of these disposal sites are coal ash ponds—95 percent of which are unlined and pose a significant risk to local communities. Only about one-fifth of these coal ash ponds have been permanently closed in response to the rule, either by "capping" with a cover and leaving the coal ash in place or by excavating the coal ash and transporting it to an alternative site for disposal or reuse.

This report, commissioned by the Center for Applied Environmental Law and Policy, estimates the economic benefits associated with coal ash cleanup and remediation at three power plants, located in Montana, South Carolina, and Indiana. Section II reviews the social and environmental benefits of cleanup and remediation activities at coal ash ponds. Sections III, IV, and V report on the findings of economic impact analyses for Montana's Colstrip Steam Electricity Station, South Carolina's Grainger Generating Station, and Indiana's Michigan City Generating Station, respectively.

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[1] A substantial volume of CCR is beneficially reused as a raw material in products such as concrete or drywall. CCR reused in these types of applications is "encapsulated," meaning it is bound with other materials that limit the exposure to and leaching potential of contaminants contained in the CCR. Not all coal ash is suitable for reuse, but it can be very cost-effective for a utility if they can sell the ash for beneficial reuse. It is important to note that encapsulated coal ash is the safest and most environmentally sound method of reuse. Unencapsulated reuse of CCRs has led to water, air, and soil contamination in many communities, posing a major threat to human and environmental health.

[2] U.S. EPA. EPA–HQ–RCRA–2009–0640; FRL–9919–44–OSWER. April 2015. *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities*. Document Citation: 80 FR 21301. Available at: https://www.federalregister.gov/documents/2015/04/17/2015-00257/hazardous-and-solid-wast[…]ystem-disposal-of-coal-combustion-residuals-from-electric

[3] EarthJustice. 2020. "Coal Ash Rule Compliance." [Database]. Available at: https://earthjustice.org/coalash/data

II. Benefits of Coal Ash Pond Cleanup and Remediation

Coal ash ponds, also called impoundments or basins, are the least sophisticated and cheapest way for coal-fired plants to manage their waste materials. Coal ash ponds store a toxic slurry of the residual “ash” and wastewater from coal-fired power generation. If poorly constructed or unlined, these toxic ponds are disasters waiting to happen and become more vulnerable with time and in severe weather conditions. Surface and groundwater supplies are threatened as contaminants leach into soil as pond barriers leak or fail entirely. Since coal ash contamination poses several health threats to humans, animals, and entire ecosystems, full cleanup for contaminating ponds often requires excavation of coal ash and contaminated soil to stop pollution at its source followed by remediation of any remaining pollution via water treatment. In addition to excavation, coal ash and contaminated soils must be stored in a stable area to prevent exposure through weather or geologic events. Important economic, environmental, and social benefits of coal ash pond cleanup and remediation (summarized in Table 1) must be considered in decision-making regarding when and how to cleanup these risky waste sites.

Table 1. Benefits of coal ash pond cleanup and remediation

Benefits	Description
Job Creation	Environmental remediation projects can stimulate the economy by providing job opportunities that raise incomes and local spending.
Improved Public Health	Contamination from coal ash ponds has substantial public health risks, but remediation reduces both exposure levels and healthcare costs.
Better Environmental Conditions	Remediation activities can greatly limit the effects of coal ash contamination on ecological conditions, protecting ecosystem health.
Avoided Impoundment Failures	Cleaning up coal ash ponds *before* catastrophic failures reduces exposure to toxins, healthcare costs, and other economic damages.
Greater Productivity	Remediation can counteract the negative economic effect of site contamination by improving business development and productivity.
Enhanced Tourism and Recreation	Cleanup can restore natural amenities and prevent future damage, which prevents closures of and lost spending on recreational and tourist industries.
Higher Property Values	Removing coal ash contamination positively impacts property values.
New Local Tax Revenues	Cleanup programs can also create new local tax revenues.
Reduced Litigation Impacts	Cleaning up coal ash ponds can reduce the number of lawsuits and lower the cost of litigation.
Reduction of Stigma	Remediation can reverse or eliminate the effects of stigma on economic investment by reducing public fears of contamination.
Reuse	Reuse of excavated coal ash, primarily as construction materials, prevents this waste from polluting other sites and the manufacture of substitute materials.

*Notes: **Greater Productivity:** This includes agricultural productivity in the area which relies on access to clean, uncontaminated groundwater and/or surface water; **New Local Tax Revenues:** These revenues can be generated from redevelopment on the actual site, or from nearby developments that are more likely to be located in the area if all environmental contamination is thoroughly addressed; **Reduced Litigation Impacts:** These lawsuits are usually filed against the company, so the utility will be reducing the risk of future litigation if they close impoundments via clean closure (wherein all ash is removed from contact with groundwater and from dangerously sited locations). Oftentimes, a company will pass on the cost of litigation to their ratepayers, so by extension, this risk reduction can also be a benefit to future ratepayers; **Reduction of Stigma:** This reduction of stigma can also help stabilize property values in the area; and **Reuse:** Substituting coal ash for other materials (in construction products or concrete manufacturing) can prevent pollution from the extraction and processing of virgin materials.*

Job Creation

Environmental remediation programs can stimulate the local economy by providing **job opportunities** and increasing individual income and commercial revenue.[4] A 2009 study commissioned by Montana's Department of Labor and Industry—focused primarily on the cleanup of sites contaminated by industrial

[4] Raimi, Daniel. 2020. "Environmental Remediation and Infrastructure Policies Supporting Workers and Communities in Transition." *Environmental Defense Fund and Resources for the Future.* Available at: https://media.rff.org/documents/RFF_Report_20-11_Fairness_for_Workers.pdf

activities—showed that approximately 11 jobs are created for every $1 million spent on restoration activities associated with returning a contaminated site to its original state.[5] Although these job creation estimates are for contamination cleanups in general, coal ash cleanup efforts can be inferred to have a similar impact. The number of jobs for a given project depends on the degree of remediation needed. Compared to "cap-in-place" strategies where the ash remains in place, complete excavation of coal ash ponds and building/operating water treatment facilities[6] tend to require a larger workforce with a diverse set of skills, and can create more openings for specialized, long-term positions.[7]

Improved Public Health

Coal ash is toxic and carries a high risk to **public health**. Some contaminants in coal ash, such as arsenic and cadmium, are carcinogenic and cause damage to major organs in the human body—which can ultimately cause severe illness or death.[8] Coal ash stored in ponds or impoundments gradually leaches these contaminants into both surface and groundwater supplies, degrading water quality and posing a health hazard to families that rely on these water resources for drinking, cooking, bathing, and irrigation for garden vegetables.[9, 10] People are also at risk of exposure by eating contaminated fish from affected aquatic ecosystems and from fugitive dust near coal ash sites. Reducing communities' exposure to these contaminants through intensive cleaning and remediation of coal ash ponds is essential to reducing human health risks, healthcare costs, and losses in income.[11] For instance, the February 2014 Dan River coal ash spill in North Carolina (the third largest coal ash spill in the last 15 years in the United States), overwhelmed the river's natural flow with 39,000 tons of coal ash and roughly 27 million gallons of untreated plant wastewater. This environmental disaster was estimated to have a total six-month health damage cost of over $75 million, and after including costs from ecological, recreational, real estate, and aesthetic impacts—total costs rose to over $295 million.[12]

Better Environmental Conditions

Since coal ash ponds contain heavy metals and contaminants that can leach into water, wetlands, and soil resources, a lack of remediation can result in serious **environmental and ecological harm**. Exposure to coal ash contaminants is linked to reduced growth and survival of aquatic life, habitat alteration,

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[5] Montana Department of Labor and Industry. 2009. *An Estimation of Montana's Restoration Economy.* Available at: https://deq.mt.gov/Portals/112/Land/FedSuperFund/Documents/sst/RestorationEconomyRPT9-17-09.pdf p.8

[6] Not all clean closures require water treatment facilities to remediate groundwater.

[7] Northern Plains Resource Council. 2018. *Doing it Right: Colstrip's Bright Future with Cleanup.* Available at: https://northernplains.org/wp-content/uploads/2018/07/DoingItRight_FullStudy_FNL_WEB.pdf p. 70

[8] Zierold, KM, et al. 2020. "Health symptoms among adults living near a coal-burning power plant." *Arch Environ Occup Health. 75(5):289-296.* Available at: https://pubmed.ncbi.nlm.nih.gov/31267832/

[9] Kravchenko J. and H.K. Lyerly. 2018. "The Impact of Coal-Powered Electrical Plants and Coal Ash Impoundments on the Health of Residential Communities." *North Carolina Medical Journal.* 79(5) 289-300. Available at: https://www.ncmedicaljournal.com/content/79/5/289

[10] Environmental Integrity Project and Earthjustice. 2019. *Coal's Poisonous Legacy.* Available at: https://earthjustice.org/sites/default/files/files/national-coal-ash-report-7.11.19.pdf

[11] U.S. EPA. 2015. p. 2-3

[12] Lemly, D. 2015. "Damage cost of the Dan River coal ash spill". *Environmental Pollution.* 197: 55-61. Available at: https://ecojusticecollaborative.org/wp-content/uploads/2017/10/Lemly-Damage-Cost-of-Dan-River-Coal-Ash-Spill.pdf. p. 59

bioaccumulation/biomagnification of toxins, and physiological effects on wildlife.[13,14] Coal ash pond cleanup efforts can greatly improve ecological conditions and reduce impacts on local ecosystems. A 2010 paper prepared for the EPA estimated the monetary cost of ecological damage from coal ash contamination at 22 sites—and revealed total costs of poisoned fish and wildlife ranging from $1.5 million to almost $665 million ($2010) each.[15]

Avoided Impoundment Failures

The environmental, economic, and human health impacts of coal ash **impoundment failures** can be quite severe: Coal pond containment barriers can break allowing large volumes of contaminated material to flood downstream. When coal ash slurry and other waste products breach their barriers and are released into the surrounding environment, local communities and ecosystems are exposed to toxic contaminants. Accidental, catastrophic failures of coal ash ponds have extensive economic consequences, including: cleanup costs, compensation for damages to property and livelihoods, and additional transaction costs such as litigation and negotiation expenses.[16] For example, Tennessee Valley Authority experienced a containment wall breach at their Kingston plant in 2008, where over 1.1 billion gallons of contaminated slurry were released—affecting nearby residential properties, utility services, and the Emory and Clinch Rivers. This catastrophic spill impacted a total 300 acres of land, resulting in $1.4 billion in damages. By cleaning up (and shutting down) coal ash ponds prior to catastrophic failures, the substantial economic and social costs of these disasters can be reduced or avoided entirely.[17]

Greater Productivity and Potential Redevelopment

Contamination can discourage new commercial investment in an area, but site remediation can successfully counteract these negative economic impacts. After remediation, contaminated sites can be redeveloped and offer opportunities for improved **business productivity**.[18,19] In Western Massachusetts, the City of Pittsfield once held a large General Electric (GE) facility, which used polychlorinated biphenyls (PCBs) for decades to make electric transformers. As a result, land around the GE site and the nearby Housatonic River were severely contaminated by PCBs—which were eventually found to be carcinogenic and federally

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[13] Id. p. 2

[14] Vengosh, A. et al. 2009. *Survey of the Potential Environmental and Health Impacts in the Immediate Aftermath of the Coal Ash Spill in Kingston, Tennessee.* Environmental Science and Technology 43: 6326-6333. Available at: https://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/6943/Ruhl_EST_2009.pdf;jsessionid=170A96659DB64F28D1C8623EF1FBC20A?sequence=1.

[15] Lemly, D. 2010. *A White Paper on Environmental Damage from Coal Combustion Waste: The Cost of Poisoned Fish and Wildlife.* Prepared for U.S. EPA. Docket ID No. EPA–HQ–RCRA–2009–0640. Available at: https://prairierivers.org/wp-content/uploads/2012/03/Lemly-2010-Environmental-Damage-from-CCW.pdf

[16] U.S. EPA. 2015. Benefit and Cost Analysis for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category. Docket No. EPA-821-R-15-005. Available at: https://www.epa.gov/sites/production/files/2015-10/documents/steam-electric_benefit-cost-analysis_09-29-2015.pdf p. 6-1

[17] Id.

[18] Glaser, M. 1994. "Economic and environmental repair in the shadow of Superfund: local government leadership in building strategic partnerships." Economic Development Quarterly 8, no. 4 (1994): 345-352.

[19] Although not quantified in this report, improving groundwater quality by eliminating ongoing coal ash contamination can also greatly improve agricultural productivity in the nearby area.

banned in 1979.[20] Upon plant closure and remediation, GE-Pittsfield and Housatonic River Superfund sites were reclaimed and redeveloped, and, as of 2019, house 40 businesses with a combined $7 million in annual sales revenue.[21]

Enhanced Tourism and Recreation

Water quality is closely linked with revenues and nonmarket benefits of **tourism and recreation**, and contamination of local waterways can bring all water-related activities to a halt. Since the impacts of coal ash pond pollution on water quality are highly localized, areas with contaminated surface or groundwater may have no option but to ban any activities that could place residents and tourists at risk of exposure.[22] Coal ash pond cleanup and groundwater remediation can prevent widespread disinvestment and sharp drops in tourism and recreation due to closures of waterways.[23] Immediately after the coal ash spill in North Carolina's Dan River, the state's Department of Health and Human Services issued a "high hazard" recreational water and fish/shellfish consumption advisory for the areas downstream of the contaminated site—resulting in an estimated $31 million loss in recreation and fishing revenue in the six months following the spill.[24] In particular, selenium is concentrated in coal ash and other coal combustion waste products, and can accumulate in the food chain—this impacts many types of fish species, and leads to fish consumption advisories in areas adjacent to coal ash sites.[25]

Higher Property Values

Sites contaminated with hazardous substances can have a negative influence on **local property values** due to the contamination they release into the environment. Cleanup and remediation of toxic waste sites like coal ash ponds can have a net positive effect on residential property values.[26] A 2017 article published in the *Journal of Environmental Assessment Policy and Management* found that brownfield cleanup programs increased local property values by 5 to 11 percent.[27] Brownfield site restoration provides a good comparison to the kinds of property value impacts that can occur due to coal ash pond cleanup and remediation.[28]

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[20] Chakrabarti, M and Bologna, J. June 29, 2016. "GE Left Behind A Complex Legacy In Pittsfield." *Radio Boston.* Available at: https://www.wbur.org/radioboston/2016/06/29/ge-and-pittsfield

[21] U.S. EPA. 2019. *Superfund Sites in Reuse in Massachusetts.* Available at: https://www.epa.gov/superfund-redevelopment-initiative/superfund-sites-reuse-massachusetts#lawrence

[22] U.S. EPA. 2015. p. 2-11

[23] Id.

[24] Lemly, D. 2015. p. 58

[25] Id.

[26] Taylor, Laura O., Daniel J. Phaneuf, and Xiangping Liu. "Disentangling property value impacts of environmental contamination from locally undesirable land uses: Implications for measuring post-cleanup stigma." Journal of Urban Economics 93 (2016): 85-98.

[27] Sullivan, K.A. 2017. "Brownfields Remediation: Impact on Local Residential Property Tax Revenue". *Journal of Environmental Assessment Policy and Management.* Available at: https://www.worldscientific.com/doi/pdf/10.1142/S1464333217500132 p. 10

[28] Brownfields remediation provides a useful comparison for evaluating potential impacts of remediation and redevelopment of coal ash sites. Mainly, this is because if coal ash and contaminated soils are removed from the site, in theory, the site would likely not exceed the risk threshold for reuse. According to EPA, "the term 'brownfield site' means real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties protects the environment, reduces blight, and takes development pressures off greenspaces and working lands." [See: www.epa.gov/brownfields/overview-epas-brownfields-program].

New Local Tax Revenue

Environmental remediation of former brownfield sites can also create new **property tax revenues**. A study published in the *Journal of Environmental Assessment Policy and Management,* focusing on the U.S. EPA's Brownfields Program reviewed 48 former brownfield sites across 17 states, found remediation associated with increases in tax revenue ranging from $29 to $97 million per year.[29] Depending on the scale of remediation and location of brownfield sites, tax gains can be substantial—New York City's Brownfield Cleanup Program generated an additional $579 million from 2008 to 2011 in property tax revenue among 185 contaminated sites. These fully redeveloped sites in New York City represent a variety of zoning groups—ranging from apartment buildings, offices, schools, and retail locations.[30] Localities may also see increased tax revenue from nearby developments that are more likely to be located in the area if all environmental contamination is thoroughly addressed.

Reduced Litigation Impacts

Failure to remediate coal ash ponds can result not only in severe environmental and health consequences, but also in substantial **litigation** costs in the form of settlements to affected parties, attorney fees, and administrative transactions.[31] For example, in Montana, the owners of Colstrip paid a $25 million settlement in 2008 to 57 residents whose well-water was deemed undrinkable due to ongoing leaching of the plant's coal ash ponds.[32] Cleaning up coal ash ponds may reduce the number of pending lawsuits, lowering or eliminating the cost of litigation to power plant owners. Utilities may seek to pass on the costs of litigation to their customers, which could have a negative economic impact on the communities they serve (potentially including the host community).

Reduction of Stigma

While the existence of pollution can hinder economic investment in a community affected by coal ash pond contamination, the **stigma** associated with this pollution impacts areas perceived to be contaminated.[33] Failures to properly clean and remediate coal ash ponds can directly lower property values and slow commercial investments in the short-term, and public fear and apprehension can persist into the future.[34,35,36] Enforcing coal pond cleanup and increasing environmental standards reduces or eliminates the

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[29] Sullivan, K.A. 2017. "Brownfields Remediation: Impact on Local Residential Property Tax Revenue." *Journal of Environmental Assessment Policy and Management:* 19(03). Available at: https://www.worldscientific.com/doi/pdf/10.1142/S1464333217500132

[30] Savchenko, Olesya M., and John B. Braden. "Do Public Benefits of Voluntary Cleanup Programs Justify Their Public Costs? Evidence from New York." Land Economics 95, no. 3 (2019): 369-390.

[31] Stanton, E.A. and F. Ackerman. 2010. p. 3

[32] Northern Plains Resource Council. 2018. p. 19

[33] Northern Plains Resource Council. 2018. p. 9

[34] Stanton, E.A. and F. Ackerman. 2010. *Hazardous and solid waste management system; identification and listing of special wastes; disposal of coal combustion residuals from electric utilities*. Testimony on EPA Coal Ash Proposed Rule. Docket ID EPA-HQ-RCRA-2009-6040. Available at: https://static1.squarespace.com/static/5936d98f6a4963bcd1ed94d3/t/596cd2e1d7bdce3643e74f54/1500304097900/Comments_Earthjustice_2010.pdf. p. 20

[35] Savchencko, O. and Braden, J. 2019. "Do Public Benefits of Voluntary Cleanup Programs Justify Their Public Costs? Evidence from New York." *Land Economics* 95:3. 369-390. Available at: https://muse.jhu.edu/article/729186.

effects of stigma on property values and new business development.[37]

Reuse

The **recycling** of coal ash excavated from coal ash ponds as a substitute for Portland cement in concrete eliminates the need to dispose of the ash in landfills and avoids the extraction impacts and CO_2 and pollutant generation from cement production. The encapsulation of fly ash in the solid substrate of concrete minimizes the threat of leaching.

III. Colstrip Analysis

Montana's Colstrip Steam Electricity Station is a coal-fired plant consisting of: Units 1 and 2 (together, 614 MW), which began operations in 1975 and 1976 and were retired in January 2020; and Units 3 and 4 (1,480 MW) added in 1984 and 1986.[38] Colstrip Station includes several coal ash ponds that cover roughly 837 acres.[39] Talen Energy, the current plant manager, co-owns Colstrip Station along with five public utility companies: Puget Sound Energy, Portland General Electric, Avista Corporation, PacificCorp, and NorthWestern Energy. The plant owners are required by the Montana Department of Environmental Quality to have closure and remediation plans for each coal ash pond when units retire.

In 2018 and 2019, the Northern Plains Resource Council (NPRC) conducted research[40] into the job creation and economic impact potential of two cleanup and remediation scenarios for Colstrip's coal ash ponds (see Table 2): Talen Energy's proposed cleanup and remediation strategy (referred to here as the Talen proposal) and NPRC's alternative "Doing It Right" proposal.[41]

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[36] In addition to depressing commercial development, contamination stigma can also discourage new workers and residents from moving to the area.

[37] Stanton, E.A. and F. Ackerman. 2010. *Hazardous and solid waste management system; identification and listing of special wastes; disposal of coal combustion residuals from electric utilities*. Testimony on EPA Coal Ash Proposed Rule. Docket ID EPA-HQ-RCRA-2009-6040. Available at: https://static1.squarespace.com/static/5936d98f6a4963bcd1ed94d3/t/596cd2e1d7bdce3643e74f54/1500304097900/Comments_Earthjustice_2010.pdf. p. 19-20

[38] Talen Energy. 2020. *Colstrip Steam Electric Station - Colstrip, Montana*. Available at: https://www.talenenergy.com/plant/colstrip-units-3-4/

[39] Northern Plains Resource Council. 2018. p. 13

[40] Northern Plains Resource Council. 2019. *Doing it Right II: Job creation through Colstrip Cleanup*. Available at: https://northernplains.org/wp-content/uploads/2019/04/DIRTII_FINAL_WEB.pdf

[41] Bioeconomics LLC conducted the economic analysis for the NPRC Colstrip analysis using IMPLAN modeling, the same model used by the AEC team to analyze the Grainger and Michigan City closures for this report.

Table 2. Coal ash pond cleanup and remediation scenarios for Colstrip

NPRC'S DIR PROPOSAL	TALEN PROPOSAL
➢ Full dewatering and excavation of coal ash at Units 1 and 2 (SOEP/ STEP) and selected Plant Site ponds	➢ Limited pond dewatering ➢ Allow some ponds to drain into the aquifer
➢ Aggressive pond and soil dewatering and capping at Units 3 and 4 (EHP)	➢ Cap-in-place closure for all ponds
➢ Groundwater treatment	➢ Limited groundwater treatment

To remove contamination at the source, the Talen proposal plans to excavate only a handful of small ponds;[42] partially dewater and cap ash ponds; continue pumping back contaminated groundwater (with the possibility of adding injection wells for fresh water); and either leave the harder-to-treat water near the bottom of the pond or to allow the water to drain slowly into the aquifer.[43] Alternatively, NPRC's "Doing It Right" proposal recommends full dewatering and excavation of all ponds in contact with groundwater, which would require active removal of all pond water and waste materials.[44]

To address groundwater contamination, the Talen proposal would continue the current approach of pumping contaminated groundwater back into the ponds for storage, or treating it for reuse in plant operations—beyond this, no additional water treatment is proposed.[45] In contrast, NPRC recommends continuing the groundwater pumpback system and reutilizing water in the plant, but also recommends building a new water treatment facility to process contaminated pond and groundwater to remove heavy metals and other pollutants.[46]

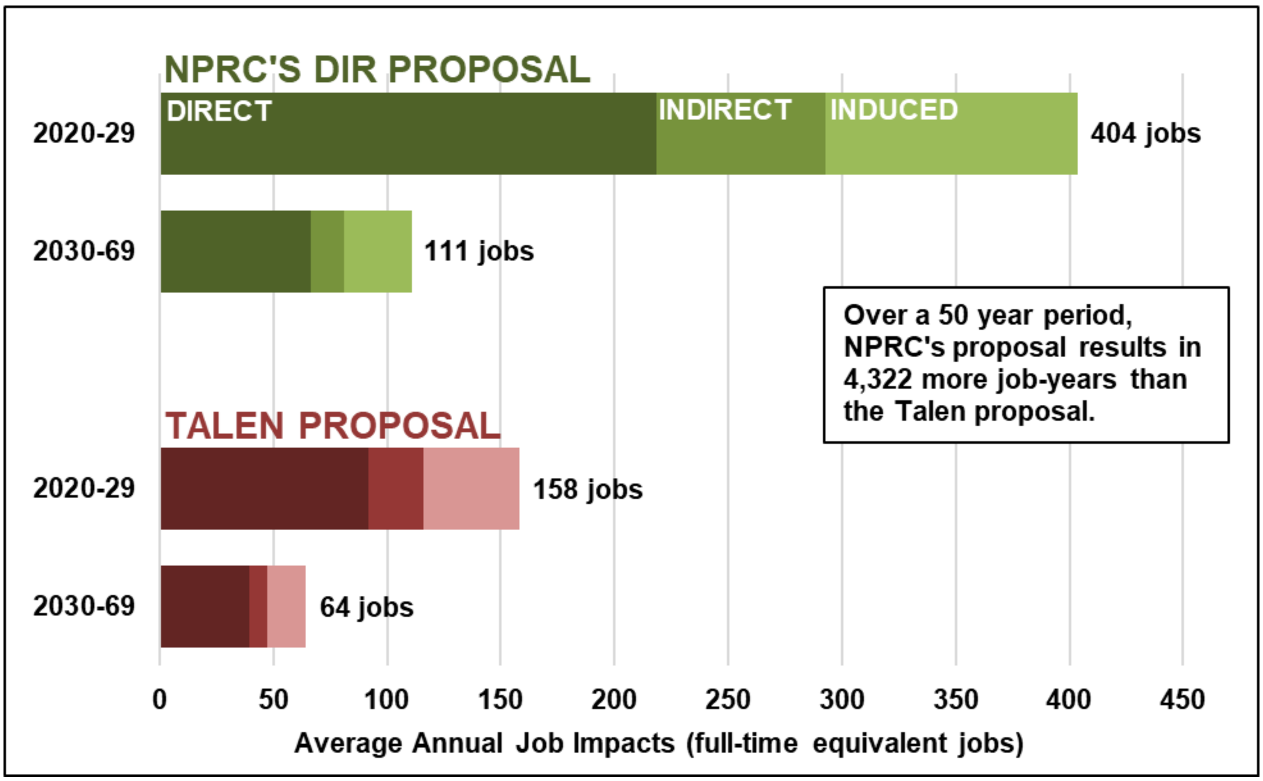
On behalf of NPRC, in December 2018, KirK Engineering & Natural Resources Inc., along with Apex Engineering PLLC, evaluated the direct costs and jobs associated with each cleanup scenario at Colstrip.[47] The NPRC-sponsored analysis continued in March 2019, when the economic impact of each cleanup and remediation scenario at Colstrip were estimated by Bioeconomics, Inc.[48] Bioeconomics used IMPLAN[49] (a regional economic impact model) to calculate total impacts on employment and personal income resulting from KirK's direct spending estimates.

[42] Northern Plains Resource Council. 2018. p. 24
[43] Id, p.23
[44] Northern Plains Resource Council. 2019. p. 9
[45] Northern Plains Resource Council. 2018. p.23
[46] Id. p.74
[47] KirK Engineering & Natural Resources Inc. 2018. *Power Cleanup Jobs Study Remediation Alternatives Analysis.* Prepared for Northern Plains Resource Council. Available at: https://northernplains.org/wp-content/uploads/2019/03/Engineer-Report-_-Colstrip-POWER-Cleanup-Jobs.pdf
[48] Bioeconomics, Inc. 2019. *Estimated Regional Economic Impact of Colstrip Site Cleanup and Remediation and Groundwater Treatment Alternatives*. Prepared for Northern Plains Resource Council. Available at: https://northernplains.org/wp-content/uploads/2019/03/Economic-Impact-Analysis-POWER-Cleanup-Jobs.pdf
[49] IMPLAN. 2020. "Application". Available at: https://www.implan.com/application/

Economic Impacts

Based on Bioeconomics findings, NPRC's "Doing It Right" proposal would create 4,322 more job-years[50] (an average of 86 jobs per year) than the Talen proposal over the 50-year period between 2020 and 2069 (see Figure 1 and Table 3). NPRC's proposal will create two and a half times more jobs per year from 2020 to 2029 than the Talen proposal, and a little less than double the Talen proposal jobs per year from 2030 to 2069. Between 2020 and 2029, NPRC's proposal creates 127 more direct jobs per year than the Talen proposal, as well as 50 more indirect jobs per year and 68 more induced jobs per year. Direct jobs are created as a direct result of a project or investment (e.g., on-site construction workers, engineers, etc.). Indirect jobs support the project or investment (e.g., equipment rental and manufacturing jobs) and induced jobs are created when workers spend their income in the community (e.g., grocery store clerks, bankers, etc.).

Figure 1. Average annual job impacts for coal ash pond cleanup and remediation at Colstrip



Source: Bioeconomics, Inc. 2019. Estimated Regional Economic Impact of Colstrip Site Cleanup and Remediation and Groundwater Treatment Alternatives. Prepared for Northern Plains Resource Council. Available at: https://northernplains.org/wp-content/uploads/2019/03/Economic-Impact-Analysis-POWER-Cleanup-Jobs.pdf

[50] A "job-year" is used when adding up "jobs per year" across multiple years (i.e., one job-year is the equivalent of one person working full-time for one year). For instance, a worker that has the same full-time job for 5 years represents a single ongoing job but is equivalent to 5 job-years.

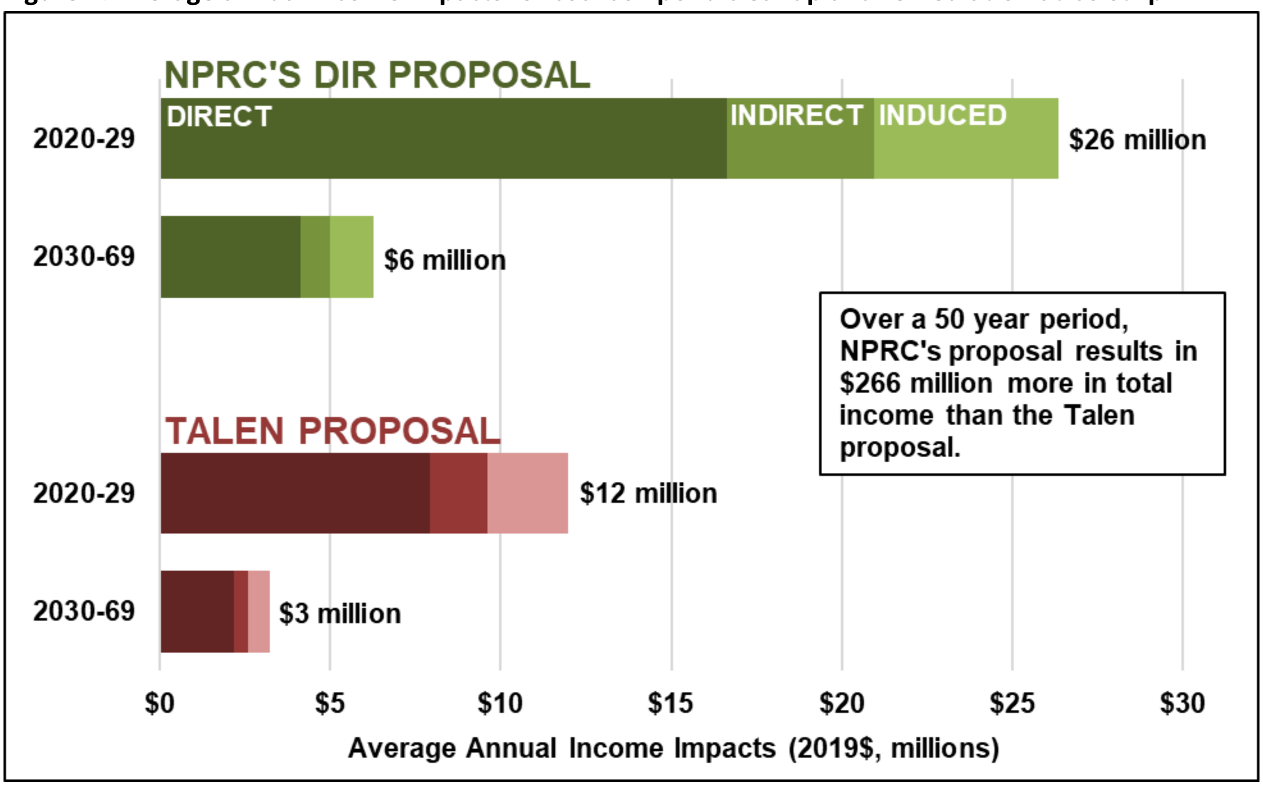
Table 3. Average annual direct, indirect, and induced job impacts for coal ash cleanup at Colstrip

Average Annual Job Impacts		Full-time equivalents (FTEs)			
		Direct	Indirect	Induced	TOTAL
2020-2029	NPRC's DIR Proposal	218	75	111	**404**
	Talen Proposal	92	24	43	**158**
	Difference	127	50	68	**245**
2030-2069	NPRC's DIR Proposal	66	15	30	**111**
	Talen Proposal	40	8	17	**64**
	Difference	27	7	13	**47**

Note: Values may not sum to totals due to rounding

In addition to job creation, NPRC's "Doing It Right" proposal would also result in an estimated $266 million more in total income than the Talen proposal over the 50-year period between 2020 and 2069 (see Figure 2 and Table 4).[51] NPRC's proposal will create a little more than double the income per year from 2020 to 2029 than the Talen proposal, and twice the income per year from 2030 to 2069.

Figure 2. Average annual income impacts for coal ash pond cleanup and remediation at Colstrip



Source: Bioeconomics, Inc. 2019. Estimated Regional Economic Impact of Colstrip Site Cleanup and Remediation and Groundwater

[51] All dollar figures in this report are in real 2019 dollars.

Treatment Alternatives. Prepared for Northern Plains Resource Council. Available at: https://northernplains.org/wp-content/uploads/2019/03/Economic-Impact-Analysis-POWER-Cleanup-Jobs.pdf

Table 4. Average annual direct, indirect, and induced income impacts for coal ash cleanup at Colstrip

Average Annual Income Impacts		2019$, millions			
		Direct	Indirect	Induced	TOTAL
2020-2029	NPRC's DIR Proposal	$16.6	$4.3	$5.4	**$26.3**
	Talen Proposal	$7.9	$1.7	$2.4	**$12.0**
	Difference	$8.7	$2.6	$3.0	**$14.4**
2030-2069	NPRC's DIR Proposal	$4.1	$0.9	$1.3	**$6.3**
	Talen Proposal	$2.2	$0.4	$0.6	**$3.2**
	Difference	$2.0	$0.5	$0.6	**$3.1**

Note: Values may not sum to totals due to rounding

Through additional cleanup and remediation efforts—including excavation of all coal ash ponds in contact with groundwater,[52] capture and treatment of existing contaminated groundwater, and construction and operation of a water treatment plant—NPRC's proposal results in more jobs and money in the local economy than the Talen proposal. More thorough remediation of coal ash ponds provides greater community benefits.

Colstrip Methodology

Bioeconomics used the combined region of Rosebud and Yellowstone Counties to estimate the economic impact of each cleanup and remediation scenario. The total economic impact was estimated in three separate categories: direct, indirect, and induced impacts (see Appendix: Methodology for more details).

Using KirK's engineering study of costs, Bioeconomics mapped the direct spending associated with the cleanup and remediation efforts into the most appropriate of 536 predefined IMPLAN 2017 economic sectors. KirK's analysis indicated that a majority of project spending would occur within the first decade to deal with the closure phase of the coal ash ponds. To account for this, Bioeconomics divided the spending into two phases: the "closure phase" from 2020 to 2029, and the "long term remediation and O&M phase" from 2030 to 2069.[53] Bioeconomics' employment impacts were presented in full-time job equivalents.

Bioeconomics noted limitations to its analysis that stem from IMPLAN's static nature: The model does not account for further changes in the local economy outside of scenarios being modeled. Although the analysis period spans 50 years, the economic impact estimates were based on a single year of economic data in the

[52] It should be noted that the Montana DEQ had already approved the closure plan for the ponds in one part of the complex—the smaller ponds located right next to the generating units—before NPRC conducted their analysis of the various closure approaches at the larger ponds within the complex (the Stage Two Evaporation Ponds (STEP), and Effluent Holding Ponds (EHP)). The smaller ponds located next to the plant are likely also in contact with the groundwater, but because the closure plan was already approved by the agency, NPRC chose to focus on the much larger units for which a closure plan had not yet been approved.
[53] Bioeconomics, Inc. 2019. p.5.

region—2017 data, the most recently available at the time. If the economic region of Rosebud and Yellowstone Counties were to grow or diversify over the analysis period, then the indirect and induced impact estimates based on the 2017 data could be undervalued.

Another limitation pointed out by Bioeconomics is that its analysis contains a large degree of uncertainty in the final composition of cleanup and remediation efforts that are employed as well as the timing of those efforts. Since the analysis period spans 50 years, the cleanup and remediation efforts may not occur as planned, which would affect the job and income impacts estimated in this analysis. Bioeconomics noted that its estimates do not consider the differential impacts of timing across years and the associated "time value of monies".[54]

In subsequent sections, we discuss AEC's economic impact analyses, and methodology, conducted for two coal ash sites: Grainger Station in South Carolina and Michigan City Station in Indiana.

IV.Grainger Analysis

South Carolina's Grainger Generating Station was a coal-fired power plant owned by Santee Cooper (also known as the South Carolina Public Service Authority) which began operations in 1966 and was decommissioned in 2012. Grainger had two coal ash ponds with a combined area of 80 acres and a total ash weight of approximately 1.4 million tons. To initiate pond closures while complying with the South Carolina Pollution Control Act, Santee Cooper hired a technical consultant to evaluate eight different closure alternatives in 2013. Of these alternatives, Santee Cooper initially proposed to close the ash ponds by capping them in place with an impermeable liner ("Cap-in-Place"), but later amended their closure plan to focus on excavating ash and transporting waste materials offsite ("Clean Closure") with the addition of beneficial reuse.

This analysis presents the economic impacts of these two options (Cap-in-Place and Clean Closure) estimated using (1) descriptions and costs of cleanup and remediation activities developed by KirK Engineering & Natural Resources Inc. and (2) AEC custom analysis using the IMPLAN model, an industry standard economic impact software. The cost estimates developed by KirK Engineering & Natural Resources Inc. for the Clean Closure scenario were scaled to match the actual spending reported by Santee Cooper.[55] AEC allocated spending on the types of labor and materials required for coal ash remediation under the two scenarios. We then applied this spending using IMPLAN data for the three-county area (Georgetown, Horry, and Marion Counties). The total economic impacts were developed in terms of job-years, labor income, and GDP. These impacts are composed of work being done on-site ("direct"), supplies needed to support that work ("indirect"), and re-spending of workers' wages locally ("induced").

Economic Impacts

The impacts (additional jobs, labor income, and GDP) of Clean Closure are substantially higher than those for Cap-in-Place. The Clean Closure scenario at Grainger was estimated to generate an average of 43 more

[54] Bioeconomics, Inc. 2019. p. 12.

[55] Personal communication with KirK Engineering & Natural Resources Inc.

jobs per year than the Cap-in-Place scenario over the eight-year period between 2013 and 2020, referred to here as the "closure phase" (see Figure 3). The Clean Closure scenario creates nearly three times more jobs per year than the Cap-in-Place scenario in the closure phase. During this eight-year period, Clean Closure creates 16 more direct jobs per year than the Cap-in-Place scenario, as well as 16 more indirect jobs per year and 10 more induced jobs per year (see Table 5). Most of the jobs generated from Clean Closure are from the heavy equipment leasing (e.g., excavators), waste management, and construction industries, while Cap-in-Place generated most jobs in the construction, engineering, and environmental consulting industries.

Figure 3. Average annual job impacts for "closure phase" of coal ash pond cleanup at Grainger

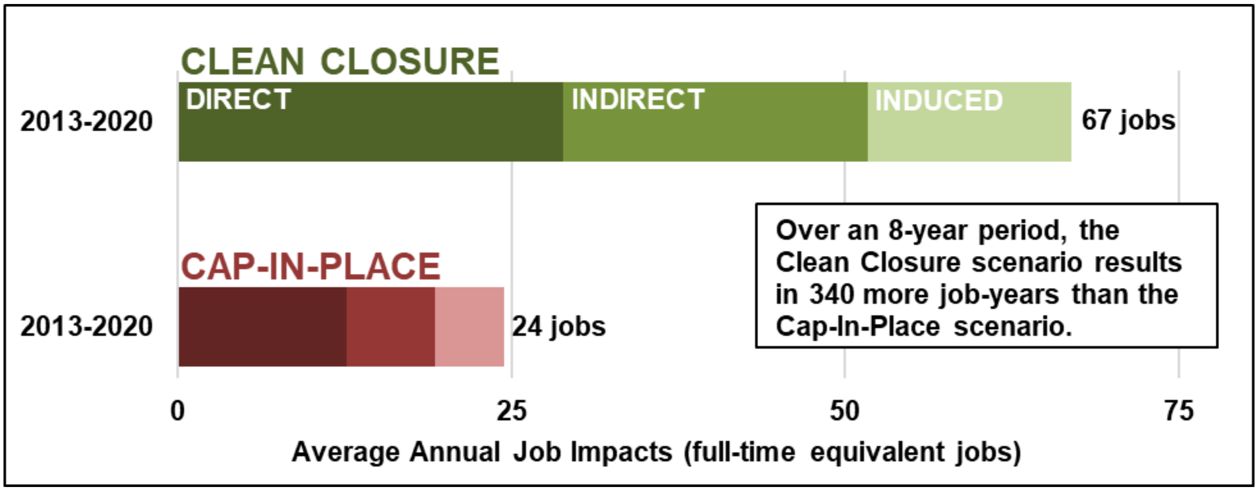


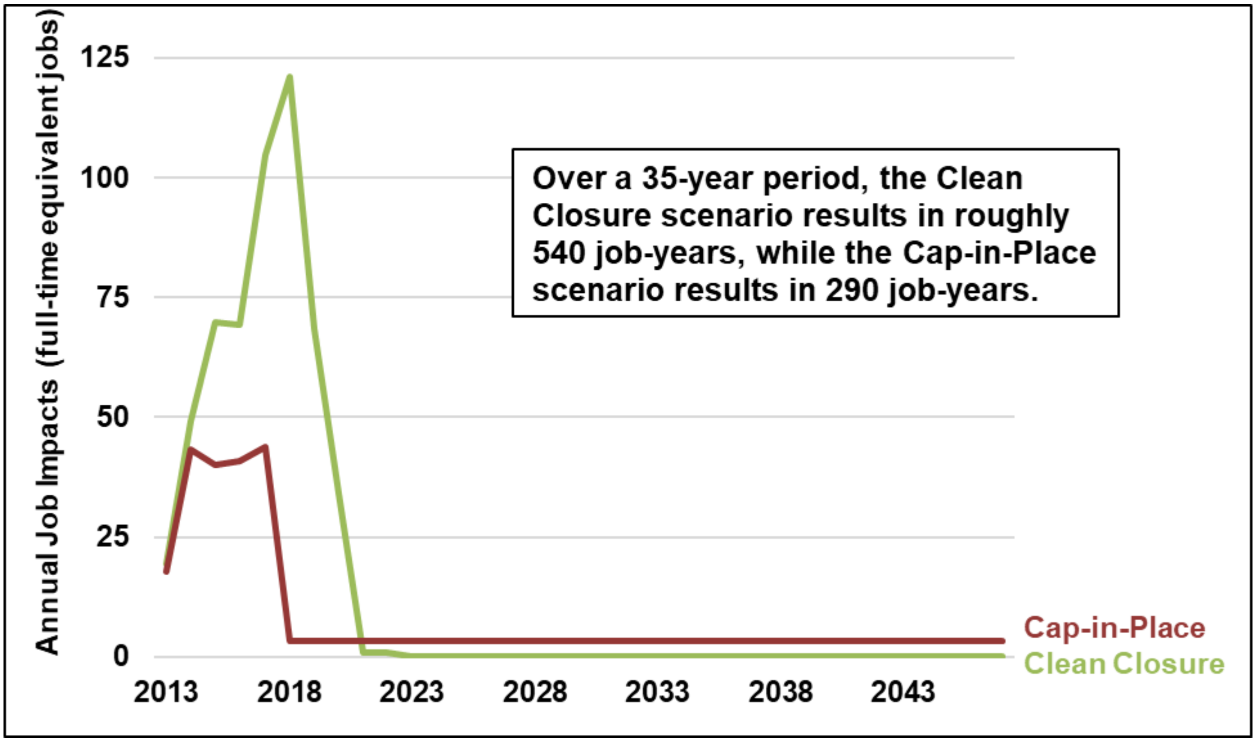
Table 5. Average annual direct, indirect, and induced job impacts for "closure phase" at Grainger

Average Annual Job Impacts	Full-time equivalents (FTEs)			
	Direct	Indirect	Induced	TOTAL
Clean Closure (2013-2020)	29	23	15	**67**
Cap-in-Place (2013-2020)	13	7	5	**24**
Difference	16	16	10	**43**

Note: Values may not sum to totals due to rounding

Over the analysis period of 2013 through 2047, we estimate that the Clean Closure scenario would generate approximately 540 job-years, compared to 290 job-years under Cap-in-Place. The annual jobs under both scenarios are shown below in Figure 4. The Clean Closure scenario involves more remediation and, as a result, more spending on-site than Cap-in-Place: $62.7 million compared to $26.3 million, respectively, over the period of 2013 through 2020. However, Cap-in-Place requires some long-term spending after 2022, whereas Clean Closure does not because the site would be fully cleaned of contamination and returned to wetlands. The Cap-in-Place scenario creates an average of 3 jobs per year long-term, to cover maintenance activities associated with the capped coal ash pond.

Figure 4. Annual job impacts for Clean Closure and Cap-in-Place at Grainger



The labor income associated with jobs in the Clean Closure scenario was an estimated $20 million (an average of $2.5 million per year) more than Cap-in-Place over the eight-year closure phase (see Figure 5). Overall, Clean Closure generates three times more labor income per year than the Cap-in-Place in this initial phase. Between 2013 and 2020, Clean Closure creates more in labor income per year than Cap-in-Place in all three impact categories: $1.0 million in direct labor income per year, as well as $1.2 million more in indirect labor income per year, and $0.4 million more in induced labor income per year (see Table 6).

Figure 5. Average annual income impacts for "closure phase" of coal ash pond cleanup at Grainger

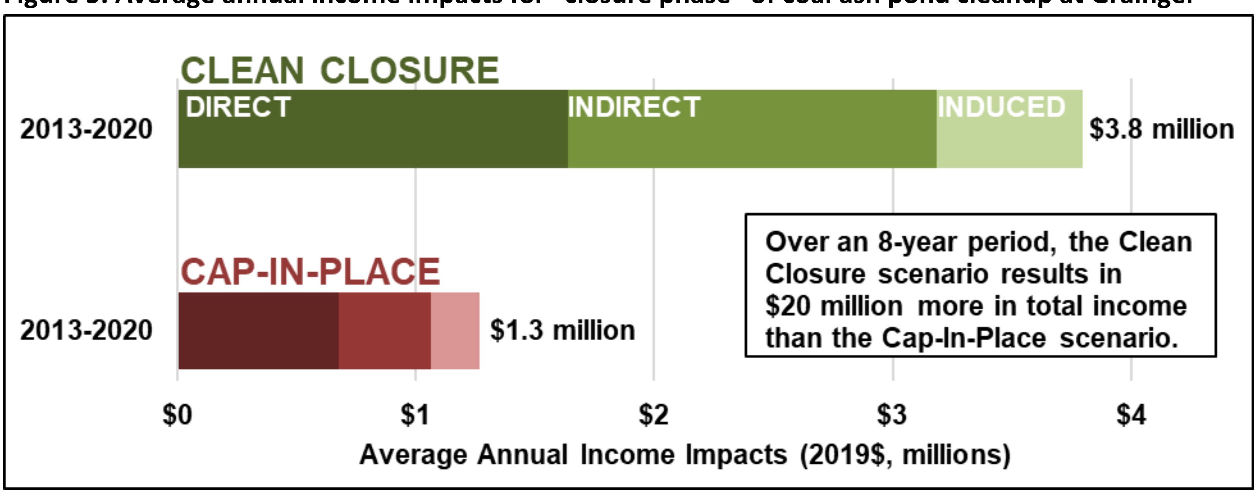


Table 6. Average annual direct, indirect, and induced income impacts for "closure phase" at Grainger

Average Annual Income Impacts	2019$, millions			
	Direct	Indirect	Induced	TOTAL
Clean Closure (2013-2020)	$1.6	$1.5	$0.6	**$3.8**
Cap-in-Place (2013-2020)	$0.7	$0.4	$0.2	**$1.3**
Difference	$1.0	$1.2	$0.4	**$2.5**

Note: Values may not sum to totals due to rounding

In terms of South Carolina GDP (which includes labor income, profits and taxes), Clean Closure results in an estimated $41 million more (an average of $5.1 million per year) than Cap-in-Place over the eight-year closure phase (see Figure 6 below). Clean Closure is responsible for nearly three times more in state GDP per year than Cap-in-Place in the closure phase. In the initial eight-year period, Clean Closure creates $1.3 million more in direct state GDP per year than the Cap-in-Place, as well as $3.0 million more in indirect GDP per year, and $0.8 million more in induced GDP per year (see Table 7).

Figure 6. Average annual state GDP impacts for "closure phase" of coal ash pond cleanup at Grainger

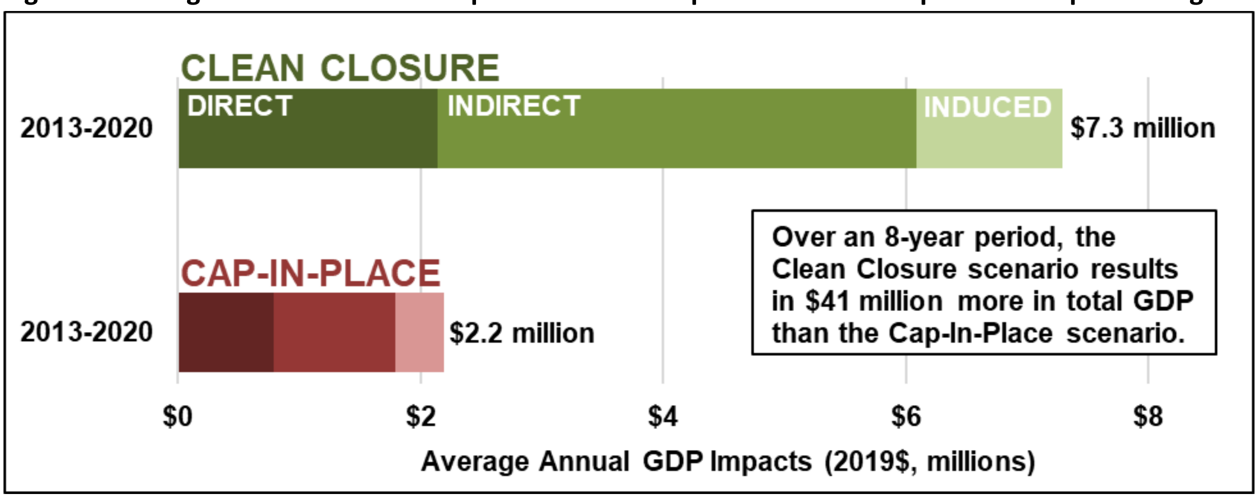


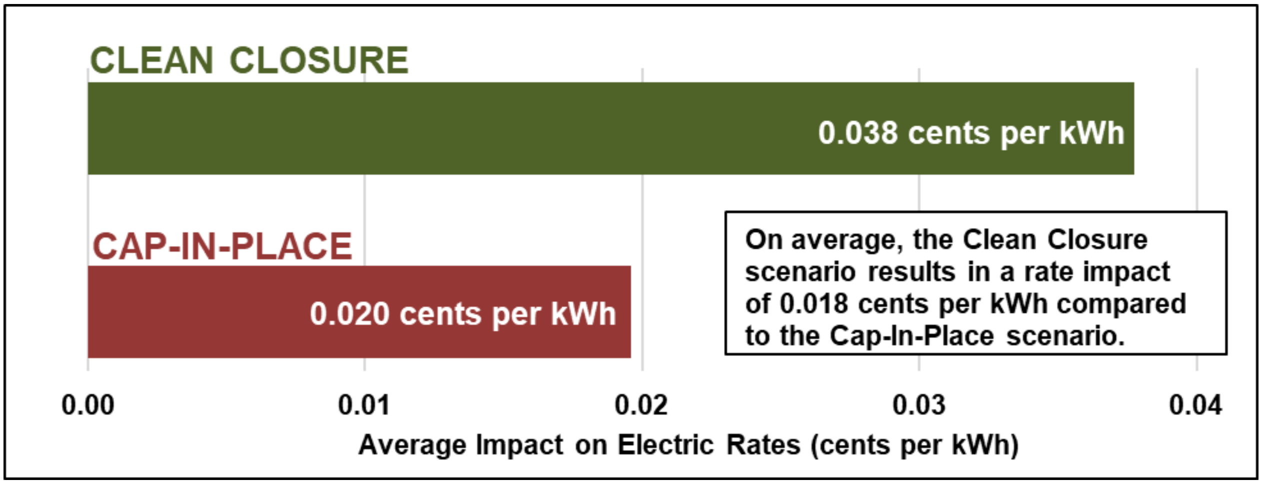
Table 7. Average annual direct, indirect, and induced state GDP impacts for "closure phase" at Grainger

Average Annual GDP Impacts	2019$, millions			
	Direct	Indirect	Induced	TOTAL
Clean Closure (2013-2020)	$2.1	$3.9	$1.2	**$7.3**
Cap-in-Place (2013-2020)	$0.8	$1.0	$0.4	**$2.2**
Difference	$1.3	$3.0	$0.8	**$5.1**

Note: Values may not sum to totals due to rounding

The economic impacts presented above do not include changes in local spending due to increased electric bills from these projects—to the extent those would apply. Under both scenarios, Santee Cooper would recover the costs of either investment from customers[56] which could lead to reduced consumer spending and business activity elsewhere in the economy. However, such impacts arise only from the assumption that there is an impact on electric bills and by extension other spending is foregone. This effect, which we modeled separately, is also muted because the impact on Santee Cooper customers' electric bill for coal ash remediation is quite small.[57] We estimate a cost impact of $0.00018 per kilowatt hour (kWh), on average, for the entire analysis period (shown in Figure 7 below)—an impact that is likely too small to affect rates.[58]

Figure 7. Average impact on electric rates due to coal ash cleanup at Grainger



Impacts from electric bills are the most difficult type of economic effect to measure because such small changes in electric rates and bills may or may not impact on ratepayers' other spending. For instance, for Clean Closure, we estimate an average bill impact of approximately 18 cents per month for residential

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[56] Utilities may wish to pay for coal ash closure and cleanup costs by recovering the costs from ratepayers. It is important to note that the rate impacts reported here reflect cost recovery for a single site. In some cases, however, a utility must close many sites at once and this is where the issue of cost recovery from ratepayers becomes more concerning for the public. Where total costs of closure and cleanup of multiple sites have proven large, state regulatory agencies and utility commissions have sometimes limited the amount that utilities can recover from ratepayers for ash pond closures and cleanups and have required assistance to low-income ratepayers [see: Dominion Energy in Virginia (https://www.utilitydive.com/news/virginia-rejects-dominion-bid-to-recover-environmental-spending-on-coal-uni/560374/) and Duke Energy in North Carolina (https://www.spglobal.com/marketintelligence/en/news-insights/blog/state-and-federal-policy-roundtable-a-green-administration)]. The costs of coal ash closure and cleanup also become problematic when a utility goes bankrupt; however, some states have enacted policies that address this issue. For example, Illinois passed the Coal Ash Pollution Prevention Act in 2019 which requires owners of coal ash lagoons to set aside money for cleanup and closure in the form of performance bonds or financial assurances. This ensures a utility's ability to pay for closure/cleanup activities and ultimately protects taxpayers from potentially paying for abandoned coal ash impoundment closures.

[57] Overall electric rates are typically calculated from multiple capital projects made over decades and expenses incurred in that year. These overall rates can go up or down depending on the all costs recovered in rates--but those individual costs fluctuate. Thus, the rate impact of one particular investment (e.g. coal ash remediation) can be positive even if overall electric rates stay the same or decrease.

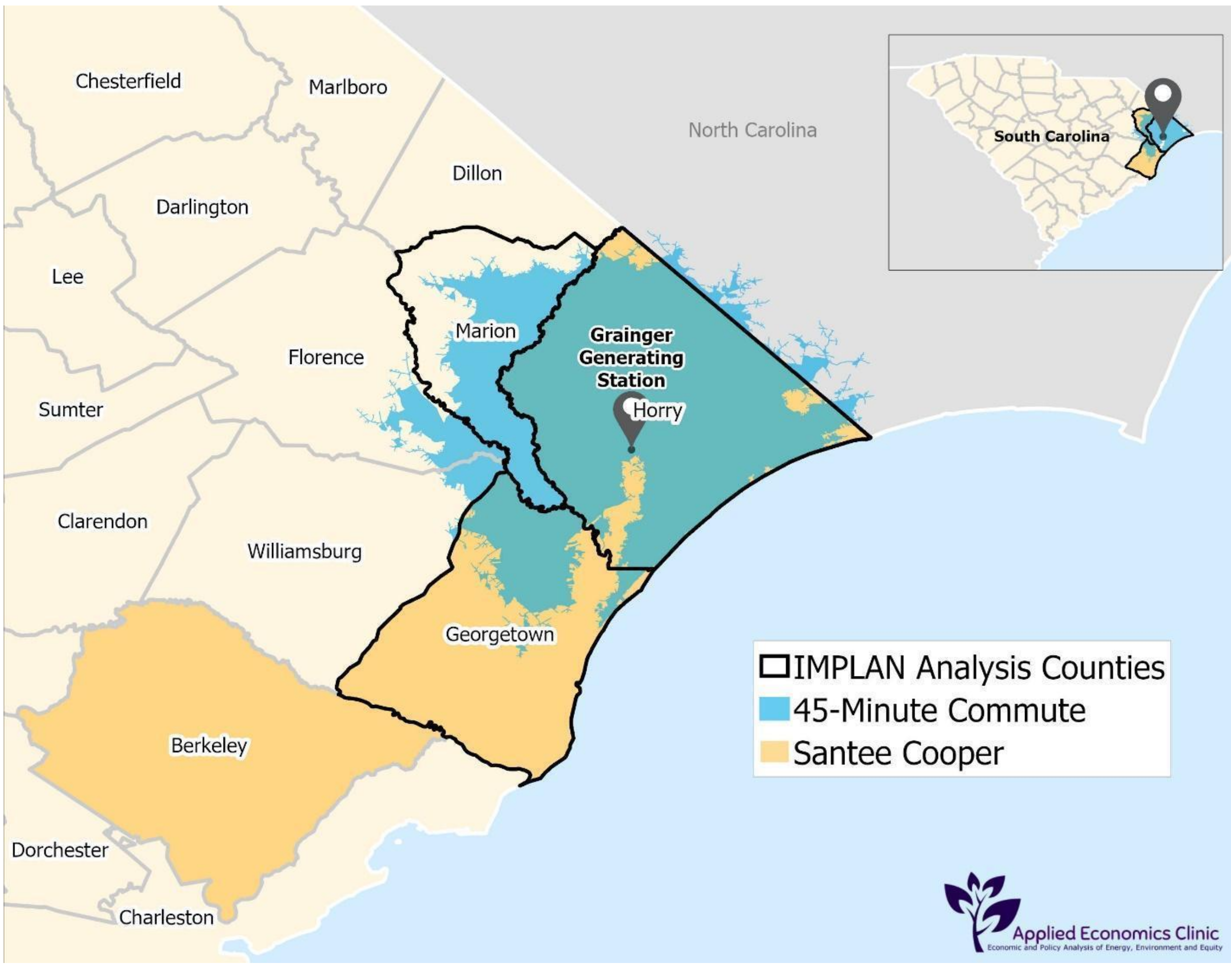
[58] An article published in Greenville News in 2014—a year after clean up began—stated that Santee Cooper's agreement to clean up coal ash ponds and contaminated soils at Grainger station have not resulted in an increase in electricity rates. [see: Connor, Eric. April 28, 2014. "Coal ash cleanup: Someone will pay; will it be customers?" Greenville News. Available at: https://www.greenvilleonline.com/story/news/local/2014/04/28/question-dukes-numbers-cost-cleanup/8350057/] According to the Southern Environmental Law Center (SELC), no increase in electric rates resulted at the conclusion of the cleanup activities at Grainger in 2020. [source: Email communication with Frank Holleman at SELC to Lisa Evans at Earthjustice on July 21, 2021.]

customers relative to Cap-in-Place over the analysis period. To the extent that residents are unlikely to notice that difference they are, therefore, unlikely to reduce their spending by 18 cents per month on other goods and services.

Grainger Methodology

We modeled a combined region of Horry, Georgetown, and Marion Counties in South Carolina to estimate the economic impacts of the two coal ash remediation scenarios (see Figure 8 on the next page). The study area (outlined in black) was determined by taking the overlap between counties in Santee Cooper's service area (shown in yellow) and a labor market area—which we defined as a 45-minute drive time, modeled using ArcPro GIS software (shown in light blue).

Figure 8. Map of Grainger study area



Sources: <u>State and County Boundaries:</u> US Census. 2018. "Cartographic Boundary Files – Shapefile." Available at: https://www.census.gov/geographies/mapping-files/time-series/geo/carto-boundary-file.html; <u>Commute Area:</u> ESRI. "ArcGIS Network Analyst - An extension for ArcGIS Pro, ArcMap." Available at: https://www.esri.com/en-us/arcgis/products/arcgis-network-analyst/overview

The study area was estimated to include 65 percent of the Santee Cooper customers, based on county populations that are in overlap with Santee Cooper service territory, that is the population of the study area (Horry and Georgetown) divided by the population of all three counties in Santee Cooper service territory (Horry, Georgetown, and Berkeley).

For the Grainger analysis, the "closure phase" was chosen to be the eight-year period from 2013 to 2020, while the "O&M phase" was chosen to be the 27-year period from 2021 to 2047.

A detailed discussion of AEC's methodology can be found in the Appendix below.

V. Michigan City Analysis

Indiana's Michigan City Generating Station is a coal-fired power plant owned by the Northern Indiana Public Service Company (NIPSCO) that was constructed in 1931 and is still in operation today. Currently, NIPSCO plans to operate the Michigan City facility through 2028, by which time the Company plans to retire its entire 2,100 MW coal-fired generation fleet.[59] Bordering the shore of Lake Michigan and separated from the lake by steel barriers, Michigan City's coal ash ponds are excavated once full and the ash is sent for recycling or disposal at the R.M. Schahfer Generating Station (RMSGS) landfill in Jasper County, Indiana. In 2015, NIPSCO initiated procedures to close the Michigan City's five coal ash ponds to comply with the Environmental Protection Agency's CCR rule by excavating coal ash material for off-site transport and disposal at the RMSGS landfill and replacing it with clean fill ("NIPSCO Closure"). Originally set to start cleanup activities in 2020, NIPSCO announced that they would delay excavation of the ponds until 2021 to prevent an additional health hazard in the midst of the ongoing COVID-19 pandemic.[60] Alternatively, NIPSCO could decide to choose a more aggressive cleanup strategy that would include dredging and passive dewatering[61] of all underlying coal ash materials in addition to the activities planned for NIPSCO Closure as well as removal of barriers along the Lake Michigan shoreline ("Clean Closure").

Similar to our analysis of Grainger Station, our analysis presents the economic impacts of two cleanup options (NIPSCO Closure and Clean Closure) estimated using (1) descriptions and costs of cleanup and remediation activities developed by KirK Engineering & Natural Resources Inc. and (2) AEC custom analysis using the IMPLAN model. AEC allocated spending on the types of labor and materials required for coal ash remediation under the two scenarios. We then applied this spending using IMPLAN data for the four-county area (Lake, Porter, LaPorte, and St. Joseph Counties). The total economic impacts were developed in terms of job-years, labor income, and GDP. These impacts are composed of work being done on-site ("direct"), supplies needed to support that work ("indirect"), and re-spending of workers' wages locally ("induced").

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[59] Tsarouhis, F. 21 April 2020. "NIPSCO to close coal ash ponds at Michigan City plant". *S&P Global Market Intelligence.* Available at: https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/nipsco-to-close-coal-ash-ponds-at-michigan-city-plant-58130657

[60] Hoosier Environmental Council. 26 June 2020. *Michigan City Coal Ash Closure.* Available at: https://www.hecweb.org/issues/environmental-health-justice/coal-ash/michigan-city-coal-ash/

[61] "Passive dewatering" entails stockpiling excavated materials to allow it to drain free of water prior to loading onto trucks. Alternatively, "active dewatering" drains water from excavated materials with the use of pumps and trenches.

Economic Impacts

The impacts (additional jobs, labor income, and GDP) of Clean Closure are substantially higher than those for NIPSCO Closure. The Clean Closure scenario at Michigan City was estimated to generate an average of seven times more (60 more jobs) per year than the NIPSCO Closure scenario over the 14-year period between 2021 and 2034, referred to here as the "closure phase" (see Figure 9). During this 14-year period, Clean Closure creates 17 more direct jobs per year than the NIPSCO scenario, as well as 27 more indirect jobs per year and 16 more induced jobs per year (see Table 8). Most of the jobs generated from Clean Closure are from the heavy equipment leasing (e.g., excavators), waste management, and construction industries, while NIPSCO Closure generated most jobs in the heavy equipment leasing, environmental consulting, and waste management industries.

Figure 9. Average annual job impacts for "closure phase" of coal ash pond cleanup at Michigan City

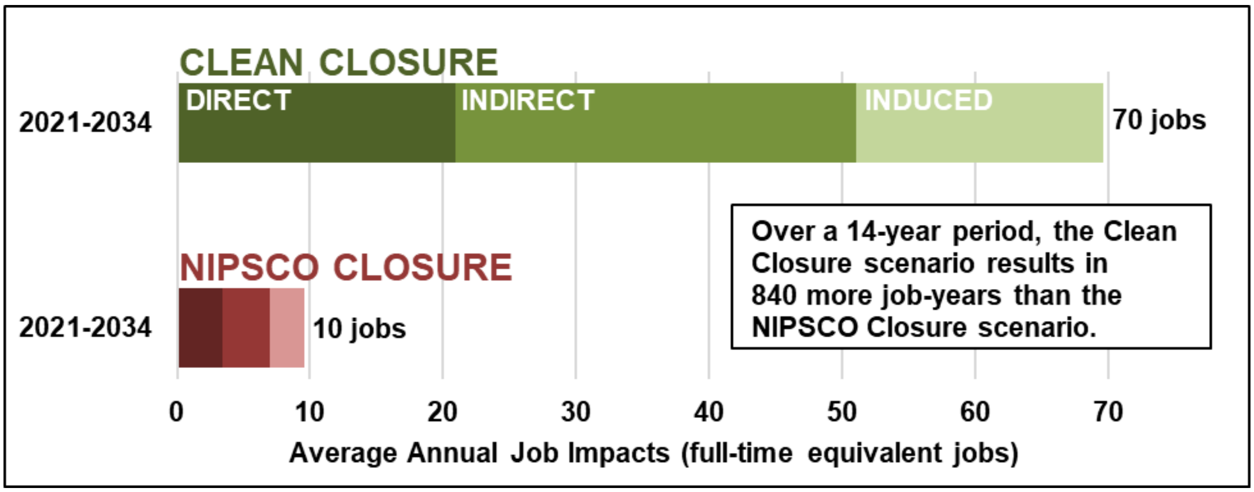


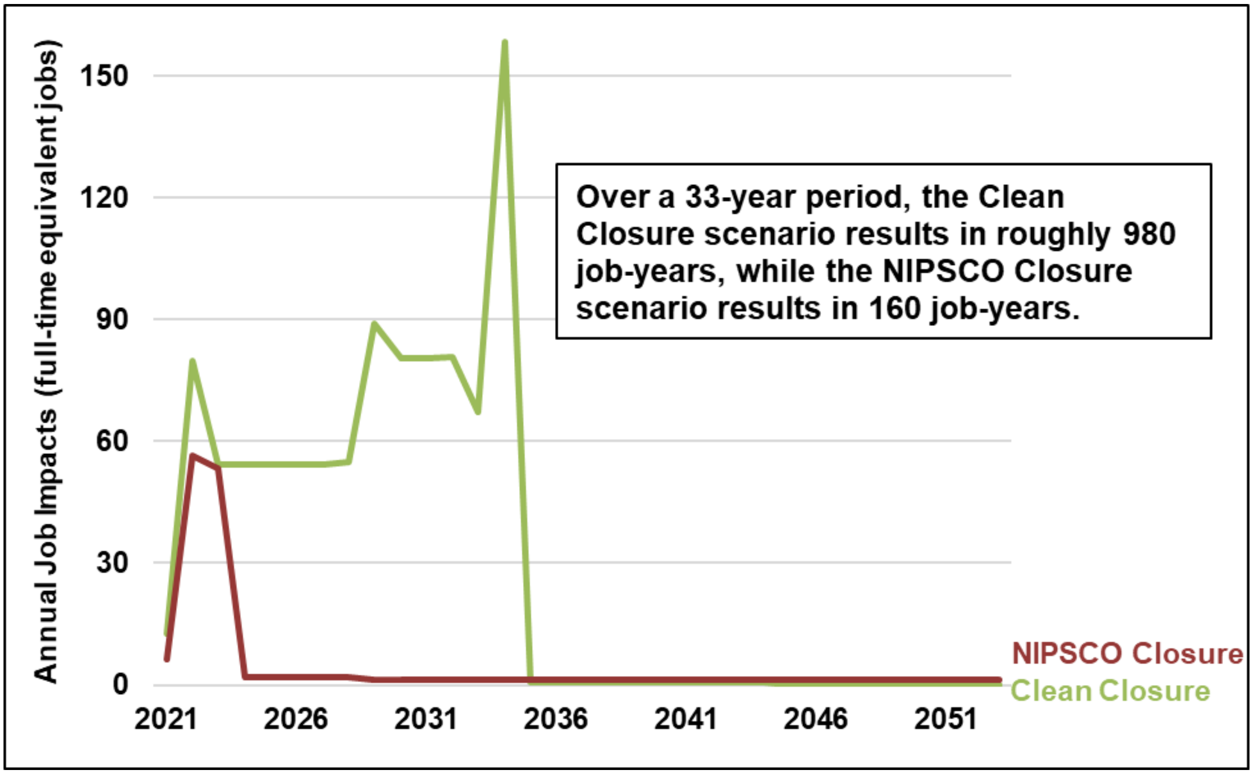
Table 8. Average annual direct, indirect, and induced job impacts for "closure phase" at Michigan City

Average Annual Job Impacts	Full-time equivalents (FTEs)			
	Direct	Indirect	Induced	TOTAL
Clean Closure (2021-2034)	21	30	19	**70**
NIPSCO Closure (2021-2034)	3	4	3	**10**
Difference	17	27	16	**60**

Note: Values may not sum to totals due to rounding

Over the analysis period of 2021 through 2053, we estimate that the Clean Closure scenario would generate approximately 980 job-years, compared to 160 job-years under NIPSCO Closure. The annual jobs under both scenarios are shown below in Figure 10. The Clean Closure scenario involves more remediation and, as a result, more spending on-site than NIPSCO Closure: $151.9 million compared to $20.0 million, respectively, over the period of 2021 through 2034. Both scenarios require some long-term spending after 2035 to cover maintenance activities at the site. However, each scenario creates an average of 1 job per year long-term to cover these maintenance activities.

Figure 10. Annual job impacts for Clean Closure and Cap-in-Place at Michigan City



The labor income associated with jobs in the Clean Closure scenario was an estimated $55 million (an average of $3.9 million per year) more than NIPSCO Closure over the 14-year closure phase (see Figure 11). Overall, Clean Closure generates nearly eight times more labor income per year than NIPSCO Closure in this initial phase. Between 2021 and 2034, Clean Closure creates more in labor income per year than NIPSCO Closure in all three impact categories: $1.4 million in direct labor income per year, as well as $1.8 million more in indirect labor income per year, and $0.8 million more in induced labor income per year (see Table 9).

Figure 11. Average annual income impacts for "closure phase" of coal ash pond cleanup at Michigan City

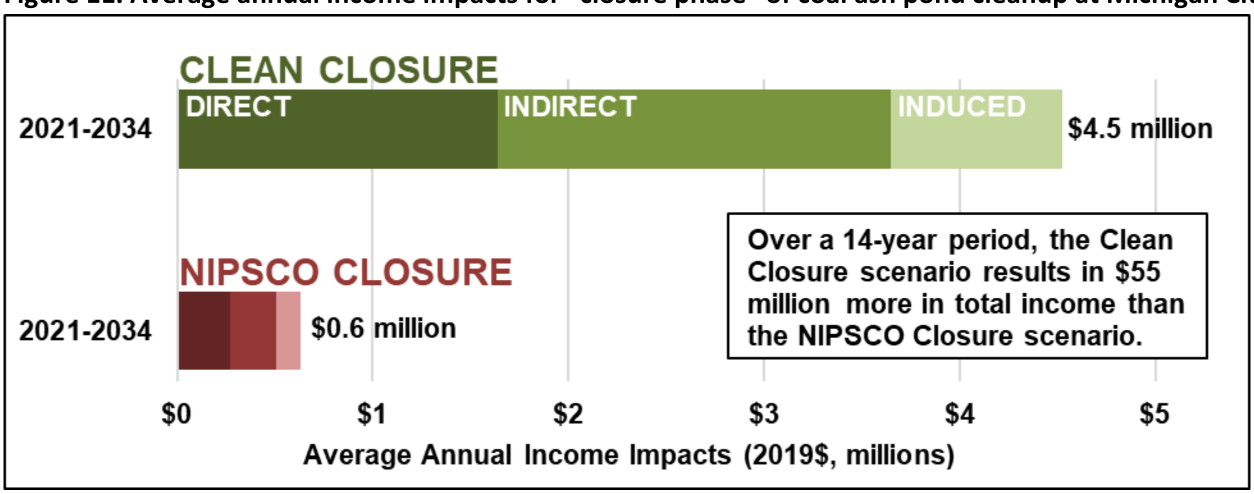


Table 9. Average annual direct, indirect, and induced income impacts for "closure phase" at Michigan City

Average Annual Income Impacts	2019$, millions			
	Direct	Indirect	Induced	TOTAL
Clean Closure (2021-2034)	$1.6	$2.0	$0.9	**$4.5**
NIPSCO Closure (2021-2034)	$0.3	$0.2	$0.1	**$0.6**
Difference	$1.4	$1.8	$0.8	**$3.9**

Note: Values may not sum to totals due to rounding

In terms of Indiana GDP (which includes labor income, profits and taxes), Clean Closure results in an estimated $113 million more (an average of $8.1 million per year) than NIPSCO Closure over the 14-year closure phase (see Figure 12). Clean Closure is responsible for seven times more in state GDP per year than NIPSCO Closure in the closure phase. In the initial 14-year period, Clean Closure creates $1.8 million more in direct state GDP per year than NIPSCO Closure, as well as $5.0 million more in indirect GDP per year, and $1.3 million more in induced GDP per year (see Table 10).

Figure 12. Average annual GDP impacts for "closure phase" of coal ash pond cleanup at Michigan City

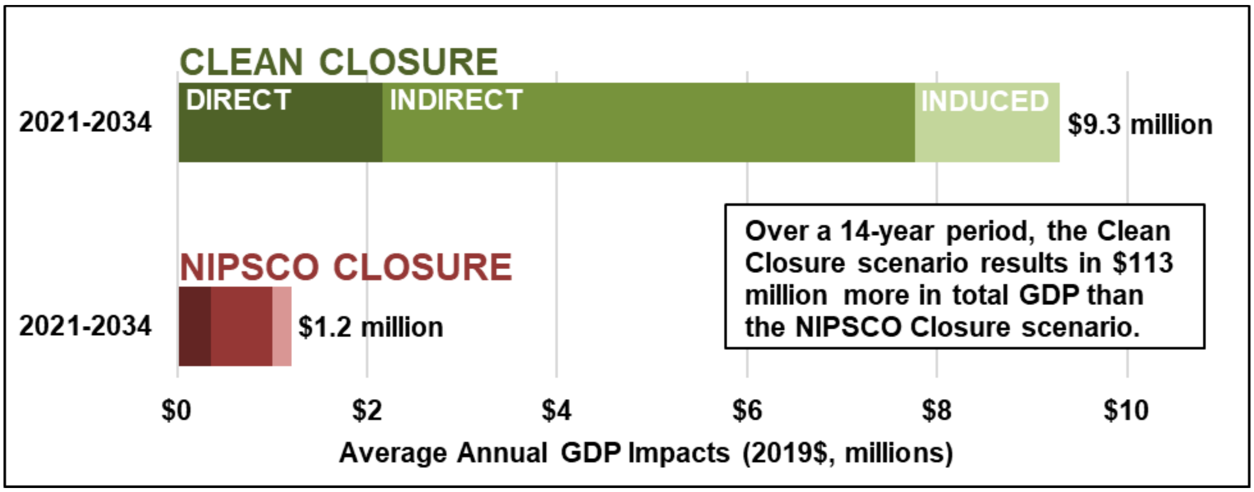


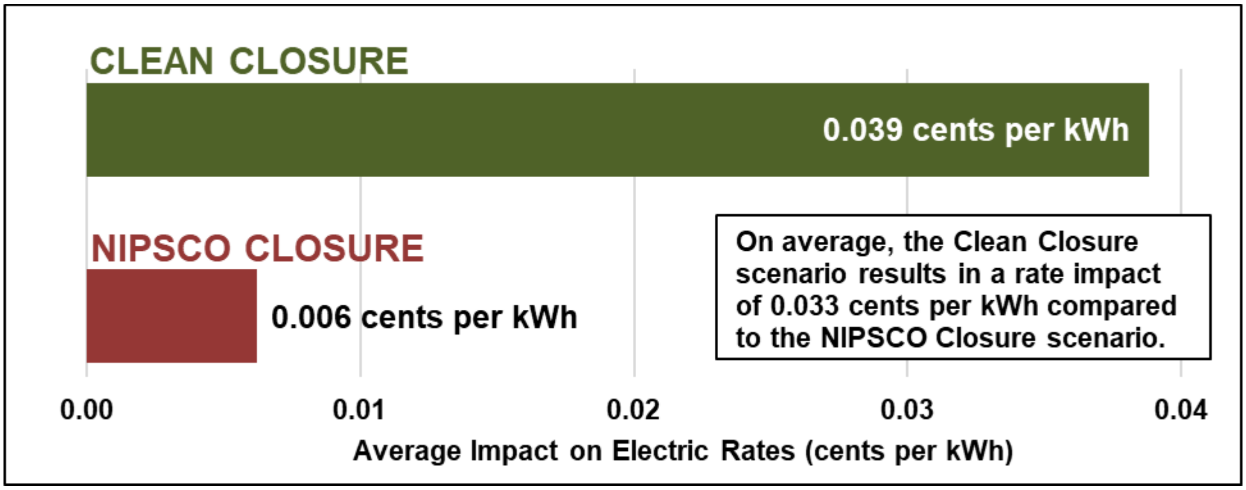
Table 10. Average annual direct, indirect, and induced GDP impacts for "closure phase" at Michigan City

Average Annual GDP Impacts	2019$, millions			
	Direct	Indirect	Induced	TOTAL
Clean Closure (2021-2034)	$2.2	$5.6	$1.5	**$9.3**
NIPSCO Closure (2021-2034)	$0.4	$0.6	$0.2	**$1.2**
Difference	$1.8	$5.0	$1.3	**$8.1**

Note: Values may not sum to totals due to rounding

As with our analysis of Grainger Station, the economic impacts for Michigan City coal ash remediation do not include changes in local spending due to increased electric bills from these projects—to the extent those would apply. Under both scenarios, NIPSCO would likely recover the costs of remediation through customer rates but the day-to-day impact on customers would be negligible. We estimate a cost impact of $0.00033 per kilowatt hour (kWh), on average, for the entire analysis period (shown in Figure 13 below)—an impact that is likely too small to affect rates.

Figure 13. Average impact on electric rates due to coal ash cleanup at Michigan City



For Clean Closure, we estimate a bill impact of approximately 22 cents per month for residential customers over the analysis period relative to NIPSCO Closure. To the extent that residents are unlikely to notice that difference they are, therefore, unlikely to reduce their spending by 22 cents per month on other expenses.

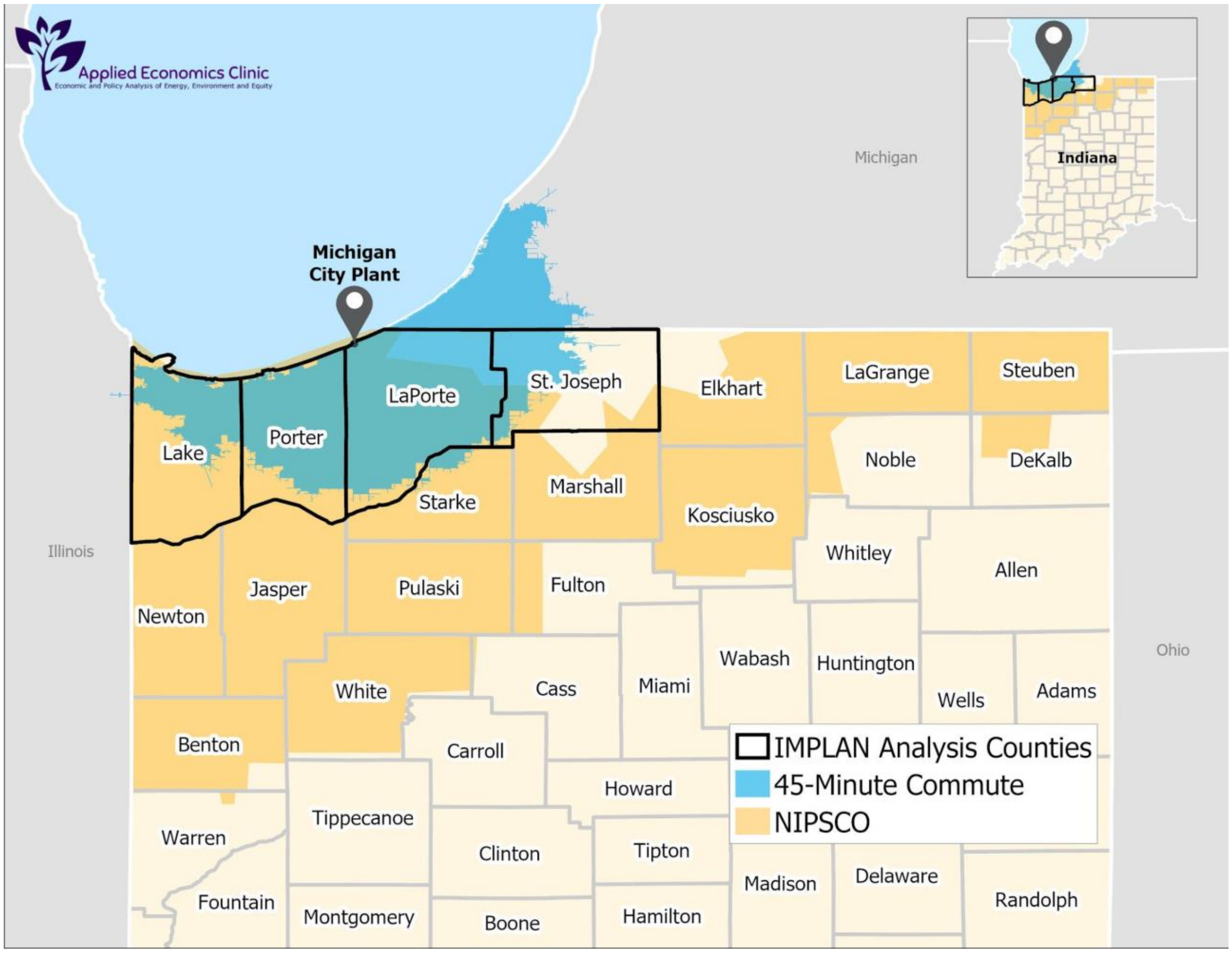
Michigan City Methodology

We modeled a combined region of Lake, Porter, LaPorte, and St. Joseph Counties in Indiana to estimate the economic impacts of the two coal ash remediation scenarios (see Figure 14 on the next page). The study area (outlined in black) was determined by taking the overlap between counties in NIPSCO's service area (shown in yellow) and a labor market area—which we defined as a 45-minute drive time, modeled using ArcPro GIS software (shown in light blue).

The study area was estimated to include 60 percent of the NIPSCO customers, based on county populations that are in overlap with NIPSCO service territory, that is the population of the study area (Lake, Porter, and Laporte) divided by the population of all fourteen counties in NIPSCO service territory (Lake, Porter, Laporte, Benton, Elkhart, Jasper, Kosciusko, LaGrange, Marshall, Newton, Pulaski, Starke, Steuben, and White).[62] Although St. Joseph county is included in the study area, it was excluded from this population proportion calculation since its population center (i.e., South Bend, Indiana) is located outside of NIPSCO's service territory.

[62] Please note that this calculation excludes counties that are only partially covered by NIPSCO's service territory, such as DeKalb, Fulton, Noble, St. Joseph, and Warren counties.

Figure 14. Map of Michigan City study area



Sources: State and County Boundaries: US Census. 2018. "Cartographic Boundary Files – Shapefile." Available at: https://www.census.gov/geographies/mapping-files/time-series/geo/carto-boundary-file.html; Commute Area: ESRI. "ArcGIS Network Analyst - An extension for ArcGIS Pro, ArcMap." Available at: https://www.esri.com/en-us/arcgis/products/arcgis-network-analyst/overview

For the Michigan City analysis, the "closure phase" was chosen to be the 14-year period from 2021 to 2034, while the "O&M phase" was chosen to be the 19-year period from 2035 to 2053.

A detailed discussion of AEC's methodology can be found in the Appendix below.

VI. Appendix: Methodology

AEC used IMPLAN[63], a regional economic impact model, to estimate the total impacts to employment, labor income, and state GDP of all activities associated with the two remediation scenarios.[64] IMPLAN provides key economic data for 546 industries for a customized region (in this case the three-county study area), and models the interactions between these industries based on the flow of goods, services, and workers in and out of that region as well as how each of the industries rely on one another. The model then produces customized "multipliers" which estimate the spin-off or ripple effects of spending on a given industry in the user-specified study area. For instance, the cleanup of coal ash ponds is primarily performed by an engineering/construction firm but relies on other industries for supplies,[65] and the firm's workers spend their wages at local businesses.

KirK Engineering & Natural Resources Inc. evaluated the direct spending associated with each cleanup scenario at the coal ash site. These direct spending estimates are separated into construction and operations and maintenance (O&M) spending and organized by activity for each scenario.[66] To calculate the economic impact of these scenarios, we mapped the activities identified by KirK to IMPLAN industries. Since IMPLAN's pre-set industries do not conform, on their own, to construction or O&M performed during coal ash pond cleanup and remediation efforts, we specified the most appropriate IMPLAN industries for each activity (i.e. excavation) using descriptions of labor and materials provided by KirK. KirK's analysis indicated that a majority of project spending would occur within the first couple of decades during the closure of the coal ash ponds. To account for this, we estimate the impacts in two phases: the "closure phase" and the "O&M phase".

The total economic impact was estimated in three separate categories (see Figure 15 below):

- **Direct impacts:** These represent the jobs at the site of remediation. For instance, the construction workers excavating the contaminated soil at a coal ash pond count as "direct jobs."
- **Indirect impacts:** These represent the jobs from providing supplies and services for the investment. For instance, the workers that lease the excavators and other equipment to the construction firm are classified as "indirect jobs."
- **Induced impacts:** These represent the jobs associated with direct and indirect workers re-spending their wages in the local economy. For instance, jobs at restaurants patronized by construction workers.

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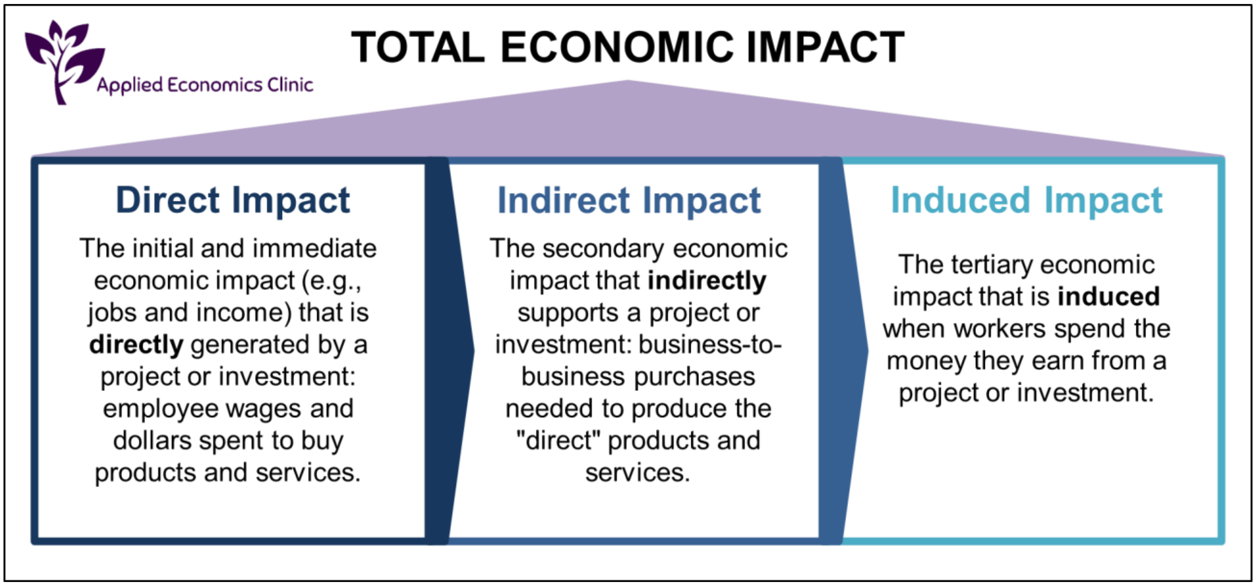
[63] IMPLAN. 2020. "Application". Available at: https://www.implan.com/application/

[64] Employment or jobs in this report are in full-time equivalents (FTEs).

[65] IMPLAN modeling accounts for geographic variability in availability of locally produced and sold materials. So for instance, in an isolated community like Colstrip, there is very little likelihood that the proper pond lining material could be purchased locally, so that spending is not counted in the local economic impact of the project.

[66] (1) KirK Engineering & Natural Resources Inc. December 2020. *Grainger Cost Analysis*. [Excel Document]; and (2) KirK Engineering & Natural Resources Inc. January 2021. *Michigan City Cost Analysis*. [Excel Document]

Figure 15. Types of economic impact



In addition, we modeled the induced impacts from electric bills (referred to here as "bill impacts"), which would result from lost economic activity due to ratepayers' paying higher bills. We estimated bill impacts for each scenario by summing the capital revenue requirements[67,68] with the O&M expenses for each year, allocating these amounts among customer classes (i.e., residential, commercial, and industrial) based on the proportion of retails sales derived from EIA-861, and running impacts of the effects of a change in spending in the IMPLAN model for each customer class.[69] The rate impacts were scaled to the study area by calculating the share of population from the utility's service area that is contained within the analysis region. We also assumed that a portion of any rate increase could be absorbed by commercial and industrial customers.[70]

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[67] A detailed capital revenue requirement calculation was performed including: all capital spending; depreciation and rate of return on the undepreciated balance using a depreciation period of 20 years; a "pre-tax" rate of return of 9 percent for Grainger and 8.2 percent for Michigan City; and an escalation rate of 2 percent.

[68] Indiana Utility Regulatory Commission. December 4, 2019. *Order of the Commission.* Cause No. 45159. Available at: https://iurc.portal.in.gov/_entity/sharepointdocumentlocation/ac4c36e7-ae16-ea11-a997-[…]e64-a444aef13c39?file=45159%20ORDER%2020191204101716836.pdf

[69] For residential customers, we modeled a change in income for a household earning the median household income in the study area IMPLAN model. IMPLAN sectors were grouped into "commercial" and "industrial" categories to represent those customer groups in the study area.

[70] We assume that commercial and industrial customers can absorb 71 percent and 81 percent, respectively, for Grainger, and 68 percent and 86 percent, respectively, for Michigan City. These portions are based on the amount of revenue not allocated to employee compensation for commercial and industrial sectors in the IMPLAN data for each study region. Only the remaining portion that affects wages results in a change in employment.