The Coal Refuse Reclamation to Energy Industry

A Public Benefit in Jeopardy

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ECONSULT SOLUTIONS INC.

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1435 Walnut Street, 4th Floor | Philadelphia, PA 19102 | econsultsolutions.com | 215-717-2777

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Private Activity, Public Benefit

Pennsylvania's coal mining legacy has left the Commonwealth with significant environmental liabilities, including more than 770 coal refuse piles. For decades, Pennsylvania's coal refuse reclamation to energy industry has addressed these liabilities by **removing coal refuse, using it as fuel to generate energy, and rehabilitating mining-affected lands.**

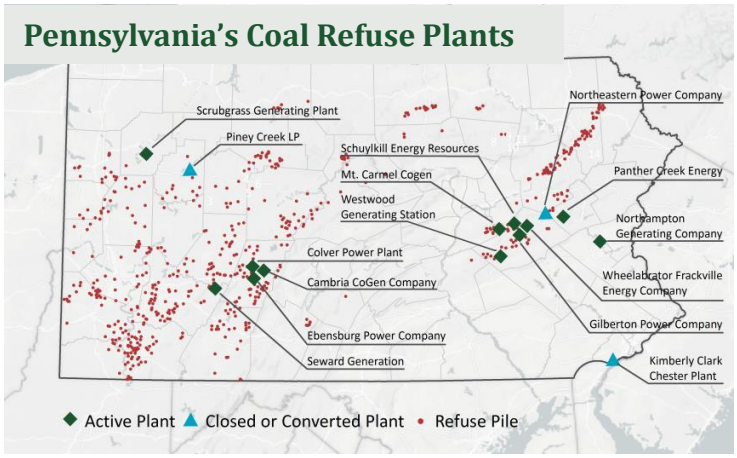
Focused Upon Environmental Remediation

> 225 million tons of refuse consumed to date

> 1,200 miles of polluted streams restored

> 7,200 acres of land restored

Pennsylvania's Coal Refuse Plants



770 identified coal refuse piles covering 8,300 acres and containing more than 220 million tons remain unaddressed, creating a variety of environmental issues for Pennsylvania's legacy coal communities.

Seanor Reclamation Site

Industry reclamation of the Seanor site restored the area to an unmanaged natural habitat adjacent to the Westmoreland Heritage Trail. The project received a Governor's Excellence Award in 2014, one of numerous environmental awards bestowed on the industry.

A Reclamation Solution in Crisis

Market and regulatory challenges, including low-cost natural gas supply from the Marcellus Shale formation and other regulatory and policy initiatives, have altered the economics of the industry. In recent years, **wholesale energy prices have often been below the "breakeven" point required for coal refuse reclamation to energy plants to simply recover their cost of production.** In addition, capacity payments received by plants for the year commencing June 2019 fell significantly and will remain well below recent levels for a two-year period.

The mismatch between revenue and costs has led to the closure or conversion of 3 of 15 Pennsylvania plants to date, and to seasonal idling for others, resulting in a significant decline in annual benefits to Pennsylvania. **The current economics of the industry are unsustainable, and without some intervention will lead to further plant closures and to a permanent loss of their public benefits.**

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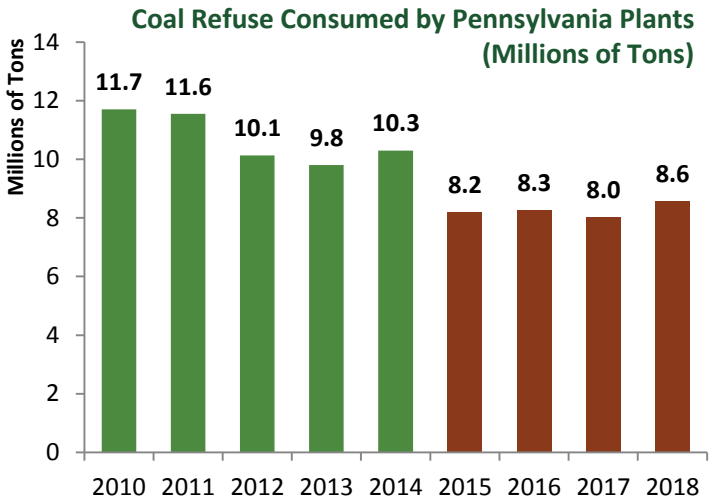
A Simple Business Model

The industry operates on a simple business model in which **revenue from the sale of electricity pays for environmental benefits in the form of the reclamation and restoration** of mining-affected sites. This privately funded activity has "positive externalities" for Pennsylvania, delivering benefits to the environment, the Commonwealth and the general public. When plants are forced by pricing realities to operate seasonally or to cease operations, the volume of coal refuse the industry consumes falls, and the public benefits are reduced or lost.



Piney Creek Plant Demolition

Plants that have been closed are typically demolished and sold for scrap, or disassembled and reassembled in another country. As a result, once plants are shuttered, they are unable to return in the future even if the economics of the industry were to change.

Avoided Tasks

At its current reduced capacity, the industry consumes 8 million tons of coal refuse and remediates 240 acres of land per year. Historically, the industry has removed 225 million tons of coal refuse, restored thousands of acres of land, restored 1,200 miles of polluted streams, and had treated billions of gallons of polluted drainage water each year. **Absent the activities of the industry, the responsibilities and costs for the range of environmental and safety hazards associated with coal refuse falls on the Commonwealth.**

$93 M - $267 M in annual avoided cost to the Commonwealth

Avoided Cost Calculation

State clean-up efforts incur additional costs for disposal not required by the more comprehensive industry efforts. Further, state efforts produce no revenue from energy generation to offset the environmental remediation and reclamation costs. As a result, it is cost prohibitive for the state to remediate sites to the same standard as the industry.

Based on recent project bids, state costs for removal and disposal of coal refuse can run up to $33 per ton (in addition to land remediation costs). Replicating the annual removal of 8 million tons of refuse and remediation of 240 acres would cost the state $93 million annually under the most favorable conditions, and **$267 million annually including typical disposal costs.** Addressing all identified piles across the state would cost $2.6 - $7.4 billion at this rate.

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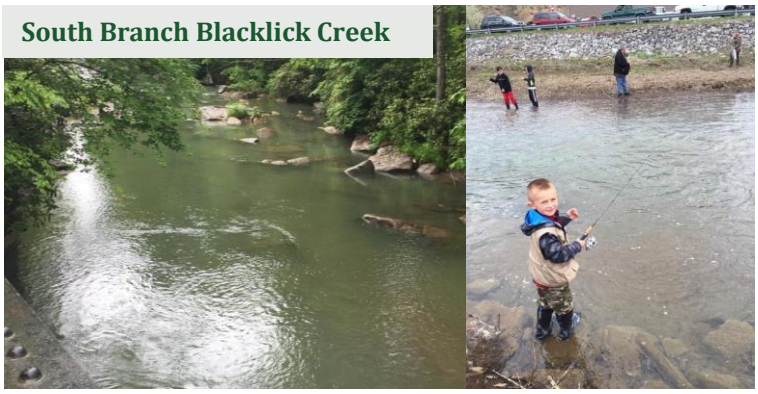
Environmental Benefits

The removal of coal refuse piles and the reclamation of mining-affected lands has demonstrated environmental and public benefits, including water quality, public health and safety, and land value.

$37 M in Annual Enviro / Public Benefits

Water Quality	Public Health and Safety	Land Value

South Branch Blacklick Creek



"We've got fish in the water now. People weren't fishing here before. This is a good news story."
- Cambria County Commissioner Tom Cherinsky

Swoyersville

Addressing Priority Sites

Through a closely regulated and proven process in cooperation with the Pennsylvania Department of Environmental Protection, **industry activities can address high priority sites for the Commonwealth,** including coal refuse piles polluting key waterways and located in densely populated areas.

In cooperation with the federal government, the Commonwealth, environmental groups, and local landholders, an industry plant is leveraging federal AML pilot funds to remediate a 4 million ton pile in heart of Swoyersville. This project will restore the land for community recreation and economic development uses.

The industry also plays an important role in removing burning piles and other piles threatening air quality with fugitive dust particles. This relieves local communities of unanticipated health and safety costs and potential emergency expenditures.

Economic Benefits

The industry also represents a major source of economic activity and family-sustaining employment. The industry produces $615 million in annual economic benefit, supporting 3,000 Full-Time Equivalent (FTE) jobs annually.

These benefits are concentrated in Pennsylvania's coal communities that face existing challenges in generating economic opportunities for residents.

$615 million in annual economic impact

$363M Direct Expenditures	$194M Earnings Supported	$18M State Taxes/Fees

3,000 FTE jobs from economic impact

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Path to Sustaining the Public Benefits

If Pennsylvania seeks to preserve the benefits and retain this strategic environmental resource, the economic and regulatory framework must recognize the value of the positive externalities that the industry delivers. A demonstrated approach to achieving this goal is through **performance based-tax credits**.

- Raise the statutory cap on the PA Coal Refuse Energy and Reclamation Tax Credit to **$45 million** so that funding is sufficient and a bridge to a federal solution.
- Replace the state tax credit with a **federal tax credit** as a long-term solution.

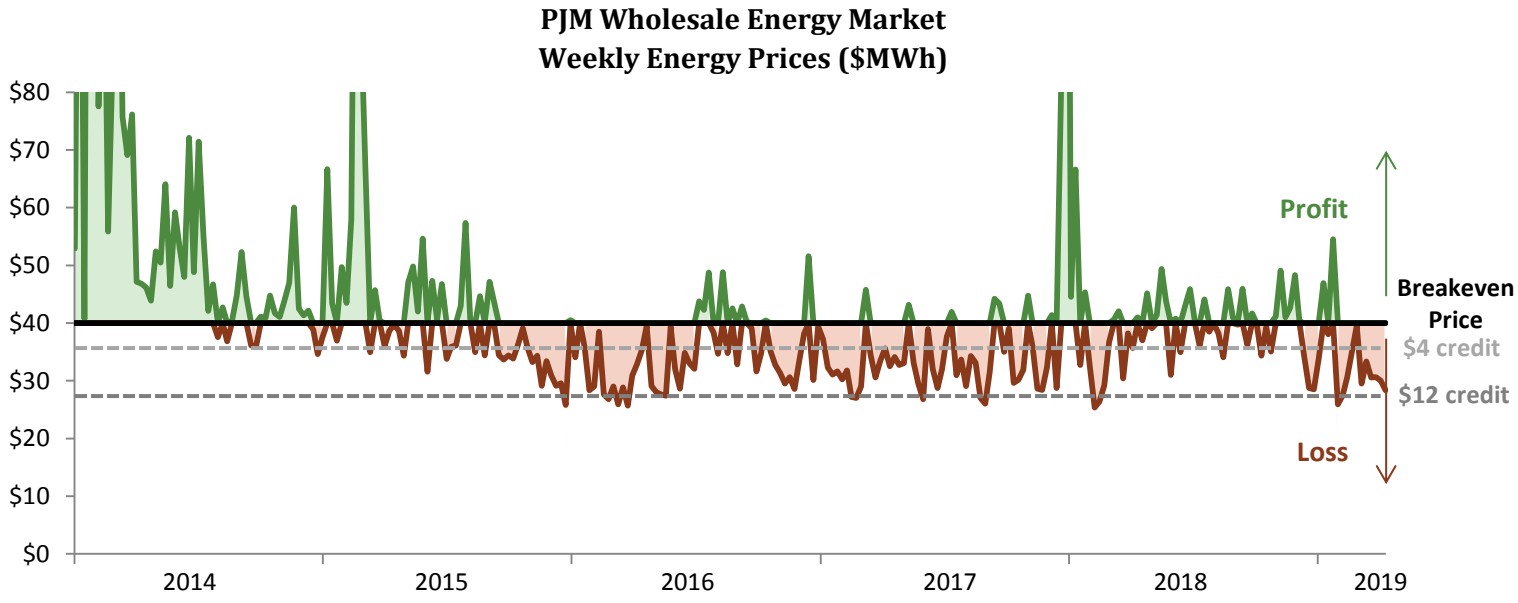
Changing the Pricing Dynamics

Government can assist the industry either through enhanced performance-based tax credit support, or through a restructuring of the regulatory framework that reflects the environmental externalities of the industry. Either approach would recognize and assign a financial value to the public benefits that are not currently realized within the economics of industry operations.

The Pennsylvania legislature and Governor Wolf acknowledged these benefits in enacting the Coal Refuse Energy and Reclamation Tax Credit in 2016. This program provides a $4 credit per ton of coal refuse used to generate electricity. However, due to the total program cap of $10 million, awards are scaled down proportionally, with a realized yield per plant of around $1.20 per ton. This yield is insufficient to close the gap between industry production costs and revenues, meaning that **the current funding level is insufficient to achieve the program goal.**

At a statewide allocation of $45 million, as originally envisioned, plants would be able to realize the allowable $4 per ton credit. This would have the effect of lowering the "breakeven price" needed to cover the cost of generation, increasing the duration of periods in which plants could operate economically.

This mechanism could serve as a bridge to a federal tax credit as a long-term solution. **A federal credit of $12 per ton would reduce the "breakeven price" to a point where plants could operate continuously**, maximizing the environmental benefits that the industry delivers at far less cost than the monetized benefits provided.



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About Econsult Solutions, Inc.

This report was produced by Econsult Solutions, Inc. ("ESI"). ESI is a Philadelphia-based economic consulting firm that provides businesses and public policy makers with economic consulting services in urban economics, real estate economics, transportation, public infrastructure, development, public policy and finance, community and neighborhood development, planning, as well as expert witness services for litigation support. Its principals are nationally recognized experts in urban development, real estate, government and public policy, planning, transportation, non-profit management, business strategy and administration, as well as litigation and commercial damages. Staff members have outstanding professional and academic credentials, including active positions at the university level, wide experience at the highest levels of the public policy process and extensive consulting experience.

1. Assessing Pennsylvania's Coal Refuse Problem

CHAPTER SUMMARY:

- **Pennsylvania's coal mining legacy has left the Commonwealth with significant environmental liabilities, including more than 220 million tons of coal refuse piles identified by PA DEP.**
- **For three decades, the coal refuse reclamation to energy industry has helped the state address these liabilities by removing piles, reusing the coal refuse to generate energy, and restoring mining affected lands.**
- **Industry activities are undertaken through a closely regulated and proven process, and give the PA DEP a tool to help address sites of significance to communities.**
- **These public benefits are in jeopardy due to market and regulatory challenges.**

Liabilities from a Coal Mining Legacy

Pennsylvania's coal mining industry helped to power the economic and military might of the United States over more than a century. The Commonwealth has produced more than 17 billion tons of coal from the bituminous region in central and western Pennsylvania and the anthracite region in the northeast.[1] However, the legacy of this national resource has been left to the current citizens of Pennsylvania, who must cope with the myriad of issues posed by abandoned mine lands and millions of tons of coal refuse strewn across the landscape of the Commonwealth.

Coal refuse piles are mounds of "waste coal" and other mining refuse that was discarded during the mining and coal cleaning processes over the course of more than a century. An inventory maintained by the Pennsylvania Department of Environmental Protection (PA DEP) currently identifies more than 770 coal refuse piles across Pennsylvania, containing over 220 million identified tons of coal refuse.[2] PA DEP acknowledges that this database is incomplete, and other estimates of the total volume range higher.[3]

PA Coal Refuse Inventory

772 refuse piles

45 currently burning uncontrolled

8,300 acres covered

> 220 million identified tons of refuse
(based on PA DEP inventory)

Numerous threats to safety

Source: PA DEP

The prevalence of these piles is due to the fact that the bulk of the state's mining activities occurred prior to comprehensive environmental regulation of mining activities. Accordingly, the responsibility and costs from the range of environmental and safety hazards associated with coal refuse falls to the current residents of Pennsylvania.

Many coal refuse piles across Pennsylvania sit in or near populated communities, representing both an environmental hazard and a blighting influence. Pictured above is "Coal Hill" on the outskirts of Treverton, in Central Pennsylvania. (Image source: WHYY)

While PA DEP and its Bureau of Abandoned Mine Reclamation (BAMR) receive federal grants through the Abandoned Mine Lands (AML) program funded by current mining industry operations, coal refuse piles compete for these and other funds along with a wide range of legacy and current environmental issues.[4] BAMR is required to focus its AML program funds on the sites that pose the highest immediate human and environmental health threats, which include dangerous highwalls, mine subsidence, open shafts, fires, and other hazards. Given these competing needs, PA DEP can only focus on a small portion of its AML remediation resources on coal refuse piles and related issues.

An Industry Addressing a Public Concern

The Coal Refuse Reclamation to Energy industry is a comprised of privately financed and operated power plants that remove coal refuse to use as fuel to generate energy and then remediate and reclaim the formerly blighted sites. Plants were built in the 1980s and 1990s with new circulating fluidized bed (CFB) boiler technology that allows for the use of lower heating value waste coal as fuel to generate energy, and the industry serves as a demonstrated solution to the public impacts and liabilities associated with coal refuse.

In 1989, members of the industry formed the Anthracite Region Independent Power Producers Association, now known as the

Appalachian Region Independent Power Producers Association (ARIPPA), as a non-profit trade association. Due to a legacy of strong bi-partisan support for the industry in the Commonwealth, the majority of the nation's coal refuse reclamation to energy plants are located in Pennsylvania.

Over the course of more than three decades, ARIPPA's Pennsylvania members have removed 225 million tons of coal refuse, improved or restored more than 1,200 miles of polluted streams, and reclaimed more than 7,200 acres of mining-affected lands.[5] Additionally, the facilities have removed and treated billions of gallons of mine affected water, which is used for plant cooling.

The industry achieves both economic and environmental benefits through a complete "fuel cycle," utilizing coal refuse to produce and sell energy, and producing "beneficial use ash" as part of the energy generation process, which is then used to remediate and reclaim mining-affected lands.

Historic Industry Activity

225 million tons of refuse consumed

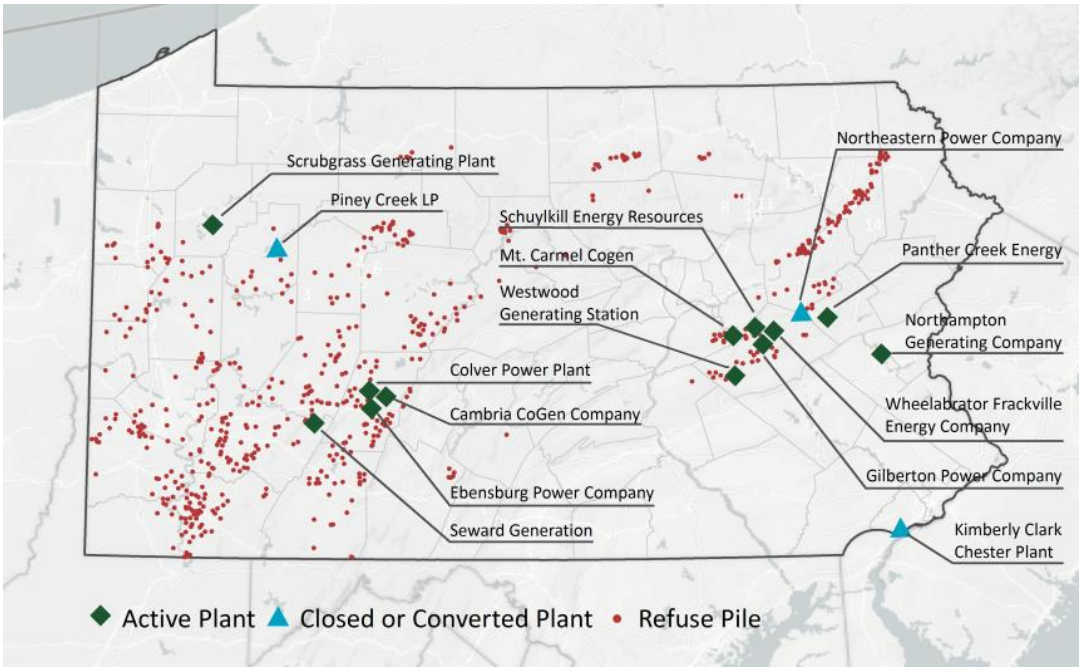
200 million tons of beneficial use ash

> 1,200 miles of polluted streams restored

> 7,200 acres of land restored

Source: PA DEP, ARIPPA

This approach produces documented environmental restoration benefits, produces economic activity and employment across the fuel cycle, and addresses coal refuse piles without the need for costly landfills or other disposal methods.



ARPPA plants are located in rural areas of the state with significant concentrations of legacy environmental issues from mining. Twelve active plants have a total generation capacity of around 1,300 megawatts. Two plants (Piney Creek and Northeastern Power) have recently closed, and one (Kimberly Clark) is transitioning to natural gas, due to the financial challenges faced by the industry, Additional closures are on the horizon under the current economic trajectory.

Reclamation projects undertaken by the industry not only remove coal refuse piles but include extensive efforts to rehabilitate sites. Pictured above is the Loomis Bank site in Luzerne County, which was the site of millions of tons of anthracite coal refuse, a portion of which was on fire. The site was cleared and remediated by the Northampton Generating Company plant, which was awarded the "Excellence in Surface Coal Mining Reclamation" National Award for this work by the federal Office of Surface Mining Reclamation and Enforcement in 2016. Other industry members have been awarded this honor as well as other awards from government and environmental groups in recognition of their reclamation efforts. (Image source: ARIPPA)

The Seanor site is located in Loyalhanna Township in Westmoreland County on a tributary to Getty Run and Loyalhanna Creek. The refuse on the site was removed by Robindale Energy and used by Seward Generation, which restored the area to an unmanaged natural habitat, providing enhancement to the adjacent Westmoreland Heritage Trail. The project received a Governor's Excellence Award in 2014. (Image source: ARIPPA)

A Public Benefit in Jeopardy

The remediation efforts of the industry are the product of a long-standing collaboration with the Commonwealth, which closely monitors these "remining" sites. Unfortunately, the industry is not fully compensated for the positive externalities resulting from its work which addresses public environmental liabilities. In recent years, market and regulatory forces have rendered revenues insufficient to cover costs for many plants. These forces have already resulted in the closure of multiple plants, and they threaten the sustainability of the environmental and economic benefits that the industry provides.

ARIPPA member plants work closely with the PA DEP, as well as local watershed associations and conservation districts throughout the state, at each step of their activities. The removal of coal refuse is considered mining activity, and requires plants to issue bonds against future energy revenues to ensure that projects are completed. Energy generation activity is regulated based upon discharge and emissions standards, and plants add limestone to the coal refuse to reduce the pollution impacts of emissions. In addition, remediation activities are regulated, with repeated groundwater testing over the course of ten years to document the beneficial impacts of reclamation.[6] These regulated and careful processes produce demonstrated environmental benefits in the high-quality reclamation of sites and nearby waterways (documented in this report and in numerous studies and examples). Importantly, this benefit is achieved with a much lower financial commitment than the state could possibly achieve on its own. State clean-up efforts incur additional costs for disposal not required in industry efforts, and produce no revenue from energy generation to offset the environmental remediation and reclamation costs. As a result, it is generally cost-prohibitive for the state to remediate sites to the same standards as the industry.

These dynamics make the industry a valuable tool available to the state to address sites of public or environmental importance. In instances where state remediation efforts are infeasible given resource constraints, limited state resources can be used to close the gap between revenues and costs to enable sites to be addressed by the industry. A recently launched project in Swoyersville leveraged available grant funding from a federal pilot program to enable industry partners to address a 4 million ton coal refuse site located in a residential community, leveraging funds at a fraction of the actual clean-up cost.

Market and regulatory forces have made revenues insufficient to cover costs for many plants. Action is required if the state is to preserve the benefits delivered by the industry and to retain this strategic environmental resource for Pennsylvania.

The Coal Refuse Reclamation to Energy industry thus represents a valuable and cost-effective public environmental resource opportunity. However, private market economics do not allow the industry to generate sufficient revenues to cover all of their costs given current energy prices and regulations. Action is required if the state is to preserve the environmental and economic benefits delivered by the industry and its plants and to retain this strategic environmental remediation resource for Pennsylvania.

CASE STUDY

Swoyersville Refuse Pile

The recently launched Swoyersville Culm Bank Removal Project is leveraging industry and federal resources to remediate a site of public significance located in the heart of the town of Swoyersville. But for this partnership, the cleanup of the 4 million ton coal refuse pile on 55 acres of land near homes and playing fields would not be feasible under current market conditions.

The Project is enabled by a partnership between the US Department of Interior Office of Surface Mining (OSM), PADEP's BAMR office, the Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR), the industry and private landholders:

- Olympus Power, which operates Panther Creek Energy and Northampton Generating Facility, has committed $8 million for the cleanup, including removal of the refuse and remediating the land, and will convert the waste coal into energy.
- PA DEP is contributing $4 million in federal grant funding awarded to the nonprofit Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR) under the AML Pilot Program. State contributions cover the additional transportation costs required to make the project feasible.
- In 2020, an initial 7 acre portion of land near the playing fields will be transferred to Swoyersville Borough, and will be developed as community recreation facilities. Further portions of the site will be provided the opportunity for reuse and economic development, and remove significant blight for neighboring homes.

The project will have wide ranging environmental benefits, including improving water quality in the Abrahams Creek Watershed.

2. An Existential Crisis for the Coal Refuse Reclamation to Energy Industry

CHAPTER SUMMARY:

- **Economic conditions for the industry have severely worsened due to market disruptions stemming in large part from renewable subsidies and to the abundant availability of natural gas generation from the Marcellus Shale formation.**
- **For large portions of the year, wholesale energy prices do not allow the industry to recover its cost of production for each unit of energy. These pricing realities have already led to seasonal idlings and plant closures, reducing the industry's level of production and therefore its environmental and economic benefits to the Commonwealth.**
- **These economics are not sustainable over the long run, and are exacerbated by a significant drop in capacity revenue commencing as of June 2019. Without intervention, more plants will be forced to close, resulting in a permanent loss of their public benefits.**

Market Challenges

There are two main revenue streams for coal refuse reclamation to energy plants:

1) *Wholesale Energy* revenue from selling energy generated by a plant; and
2) *Capacity Payment* revenue from a plant's commitment to serve as an on-call source of energy supply.

When wholesale prices are above the variable costs to generate each unit of energy, operators are incentivized to maximize their energy production. Meanwhile, capacity payments are set years in advance of the delivery date in order to provide an incentive for investments in plant assets and fixed costs.

This structure seeks to bring a sufficient level of supply into the marketplace to meet the anticipated demand, ensuring the reliability of power provision throughout the year.

Current conditions in the PJM Interconnection market serving Pennsylvania do not provide these incentives for most ARIPPA plants.

Variable Operating Costs

While exact revenues and costs vary by region, by plant, and by project, basic economics dictate that the revenue received for each MWh of energy must be sufficient to cover the costs of production in order for that unit to be produced. Current market conditions often fail to meet this standard for the coal refuse reclamation to energy industry, which has elevated operating costs due to the fuel source used and the costly remediation and bonding obligations. This dynamic creates an existing crisis for the industry, threatening the environmental and public benefits that it produces.

Coal refuse to energy plants have a range of variable operating costs associated with each MW of energy they generate. While each plant utilizes a different mix of contracted and in-house services, the process of generating energy from coal refuse is labor and material intensive. Cost drivers include:

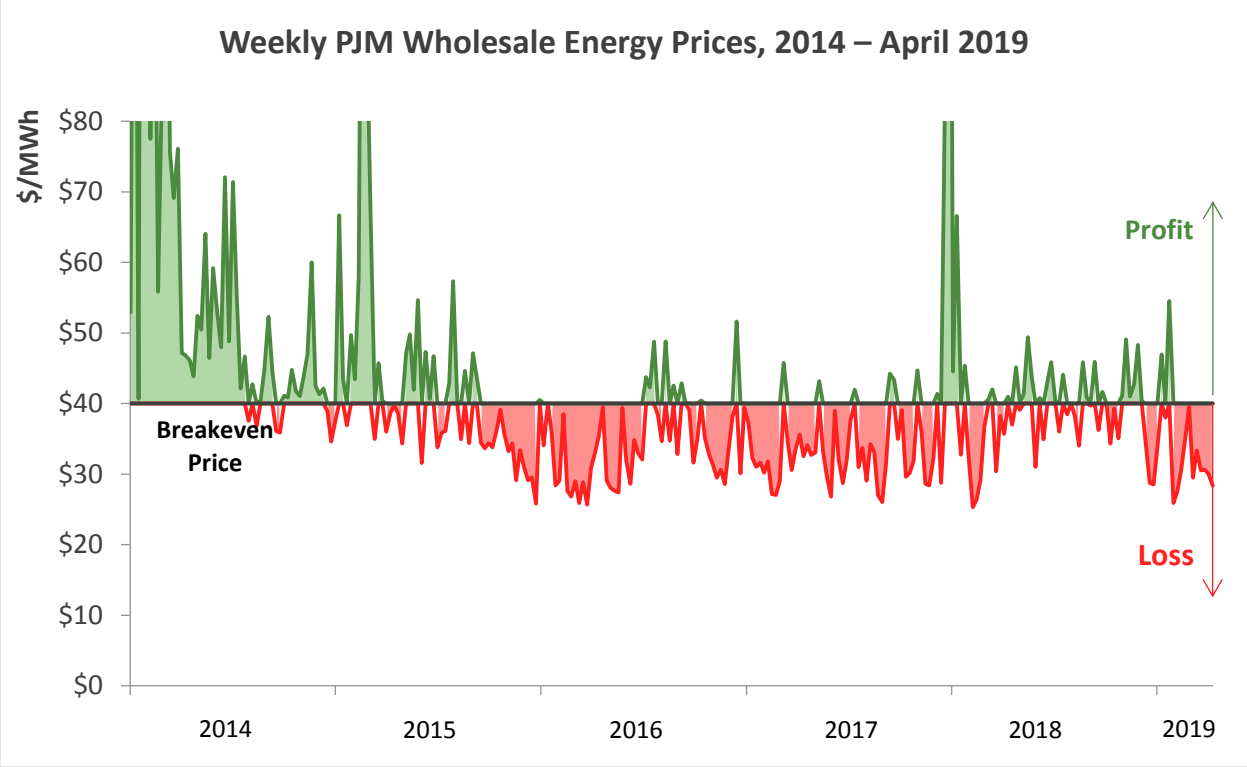
- *Employee costs* which support average salaries in excess of $75,000[7];
- *Re-mining costs* for the extraction of coal refuse from piles;
- *Limestone costs* for the key material mixed in with coal refuse to produce alkaline ash as a byproduct with beneficial environmental uses;
- *Transportation costs* for coal refuse, limestone and beneficial use ash, which have increased as plants have consumed the historic piles closest to their locations;
- *Maintenance costs* to ensure the safe operations of the facilities; and
- *Reclamation costs* to complete the fuel cycle with the restoration of mining sites to productive and beneficial uses, including managing ash and water monitoring efforts necessary to recover bonds.

Wholesale Energy Pricing

New development and extraction techniques have turned the natural gas in the Marcellus Shale formation into an abundant low-cost fuel source, significantly lowering the price of natural gas in the Mid-Atlantic region and beyond. Public policies of neighboring states to restrict or prevent the transportation of Marcellus Shale gas to regional and international markets has only exacerbated the problem of natural gas trapped in Pennsylvania at below market prices. This increased supply, along with electricity supply from legislatively and market favored renewable and alternative energy sources, has contributed to significant reductions in wholesale energy prices and capacity payments in the PJM market. This dynamic has caused widespread disruptions across the general electricity market.

Wholesale prices received for energy generation vary seasonally, responding to demand increases on colder and hotter days and returning to lower levels as demand falls. The figure on the following page shows weekly wholesale prices on the PJM market from 2014 through April 2019.[8]

Assuming that coal refuse reclamation to energy plants require a “breakeven” wholesale price of around $40/MWh in order to cover their costs, energy prices since mid-2015 have been below the costs of production for the majority of the year.[9] Peaks in prices where profits are realized are short in duration, with fewer than 30% of weeks in this time period achieving this benchmark. This creates an unsustainable economic reality, where plants typically do not profit from continuing to produce their core commodity.



Since mid-2015, wholesale energy prices have usually been below the typical "breakeven" point required by coal refuse reclamation to energy plants simply to recover their cost of production. (Data Source: Energy Information Administration)

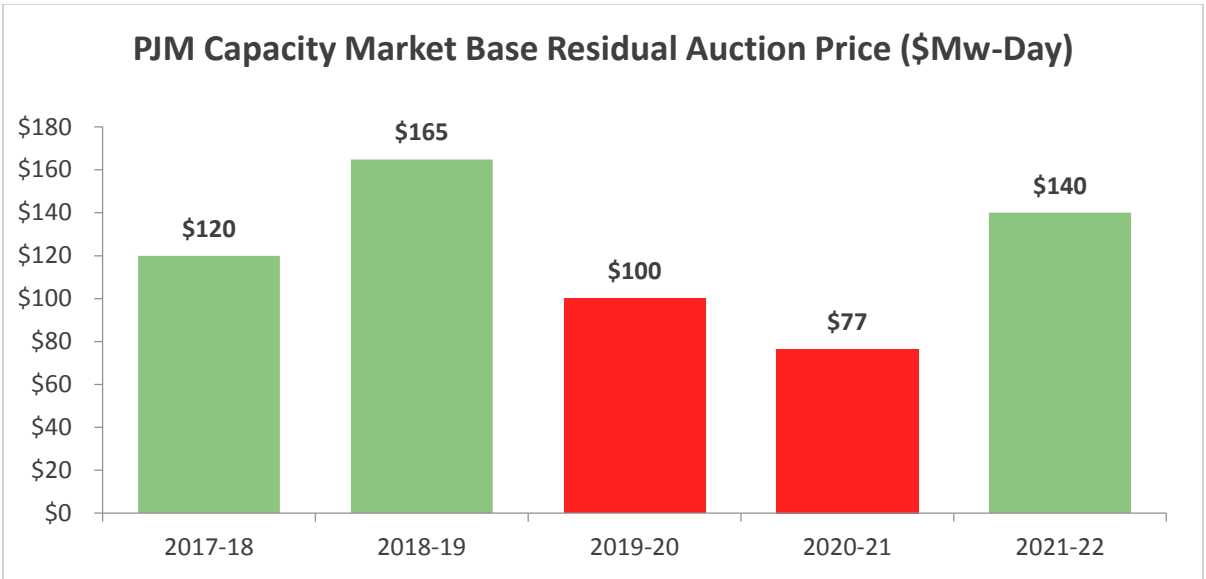
Capacity Pricing

In addition to revenue from energy generation, plants also receive capacity payments for their commitment to serve as an on-call source of supply for the market as needed. Market operators like PJM use capacity markets to incentivize long-term investment in infrastructure and maintenance to ensure that needed supply will be available when demand spikes.

Accordingly, PJM's "base residual auction" for capacity commitments takes place three years in advance of the delivery date, seeking to incentivize sufficient investment far enough in advance to ensure reliable delivery.

PJM base residual auction prices per MW-day fell from $165 in the 2018-19 year ending on May 31, 2019 to $100 for 2019-2020, and further still to $77 for 2020-21.[10] For an 80 MW plant the differential taking effect on June 1, 2019 translates to a revenue loss of around $5,000 per day, or nearly $2 million over the course of a year.

At these levels, capacity payments are insufficient to cover the fixed costs (including capital investments, utilities, insurance, regulatory, compliance, leasing and bonding fees) to allow a coal refuse reclamation to energy plant to be on-call.



PJM's capacity market "Base Residual Auction" for the region covering most of Pennsylvania fell significantly for the period beginning June 1, 2019, and will fall even lower for the following year. This level of payment further erodes the bottom line for plants and threatens reliability when they are forced to defer needed investment and maintenance. (Data Source: PJM Interconnection)

When capacity payments drop, operators are often forced to reduce costs by deferring maintenance and other investments to improve the efficiency of the facility, reducing the reliability of power provision. In addition to discouraging investment, borrowing costs increase, since the capacity payment schedules serve as a signal for where capital will yield attractive returns.

These financial impacts are tied in part to the climate of uncertainty created by the operational issues of the PJM capacity market. Elements of this market have been the subject of successful challenges through the Federal Energy Regulatory Commission (FERC). In June 2018, FERC held that state-supported generation resources artificially depress capacity market prices and that "the effectiveness of the capacity market administered by PJM…have become untenably threatened."[11]

In addition to depressed pricing, recent PJM changes have increased the penalties for plants that fail to operate and meet their capacity commitments. Accordingly, plants have seen increases in risk at the same time they have seen reductions in the reward for participating in the market.

As noted below, the depressed wholesale energy prices realized through significant portions of the year since mid-2015 have led to plant idlings and to closures, even at prior capacity payment levels. The significant drop in revenues commencing as of June 1, 2019 is an additional blow to the economic viability of industry plants, and further highlights the unsustainable nature their current cost and revenue structure absent a strengthening of their partnership with the Commonwealth or the federal government.

Regulatory Challenges

In addition to changes in market conditions, coal refuse plants face challenges from new federal and state regulations that increase capital and operating costs for plants.

Since the removal and remediation of coal refuse is considered "mining" under federal and state statutes, new and updated mining regulations have contributed additional operating burdens to the plants. Bonding rates, availability of certified bonding sources, Mine Safety and Health Administration (MSHA) regulations, the regulation of water discharge trusts and water quality standards, Total Maximum Daily Load (TMDL) permits under the U.S. Clean Water Act, encompassing a plan for restoring impaired waters, and the waters of the United States (WOTUS) rulemaking, have all been subject to change and an unsettled regulatory climate. This uncertainty contributes additional operating costs for these facilities and imposed without an effective market mechanism from which to recover the additional cost burdens.

An additional example are Title V emission fees for plants that are by definition "major sources" with air pollution permits under the Clean Air Act. The PA DEP has proposed maintaining the emissions fees, which disproportionally affect coal refuse reclamation to energy plants under the existing and proposed structure.[12]

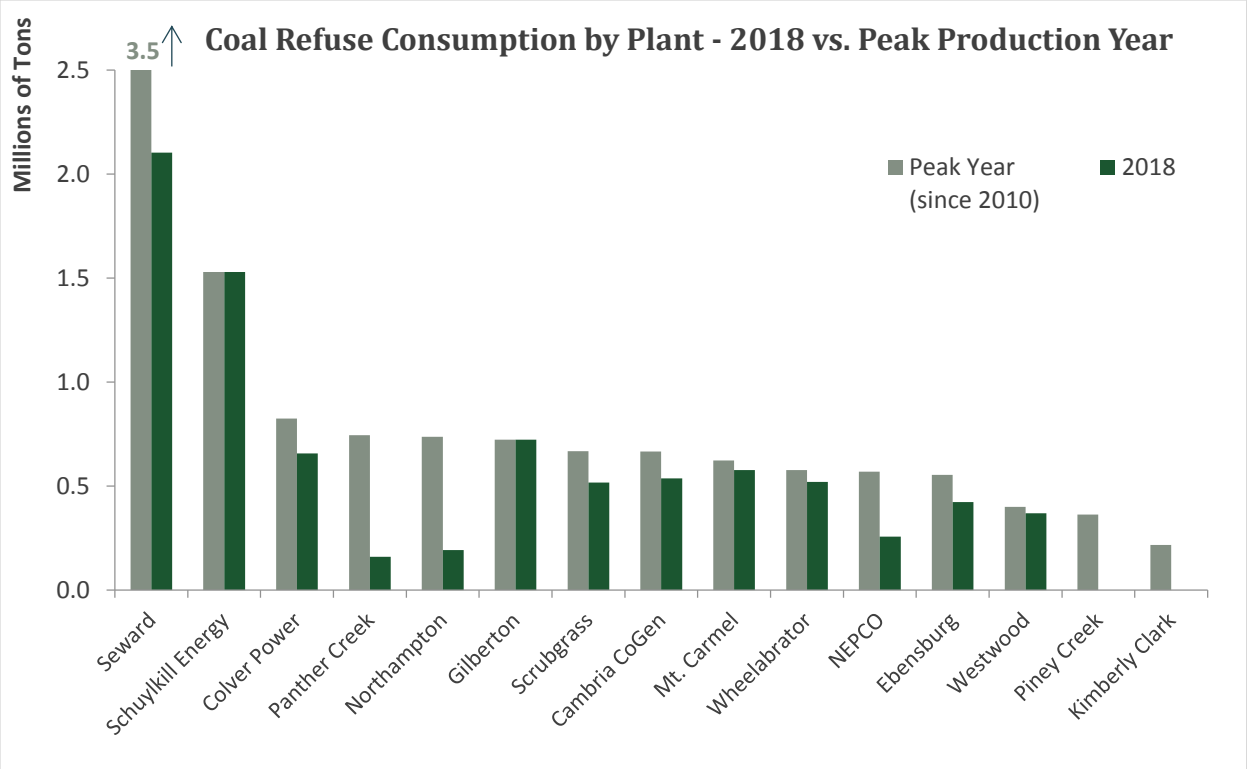
Central to all of these challenges is an asymmetry between the environmental contributions of the industry and a regulatory framework that often accounts only for negative environmental externalities in its regulation of coal refuse reclamation to energy plants. For instance, during the MATS rule-making process, the federal EPA acknowledged the "multimedia environmental benefits of units that burn coal refuse," but did not develop an approach that accounts for any offsetting benefits that coal refuse reclamation to energy provide within the MATS emissions standards.[13]

Plant Idlings and Closures

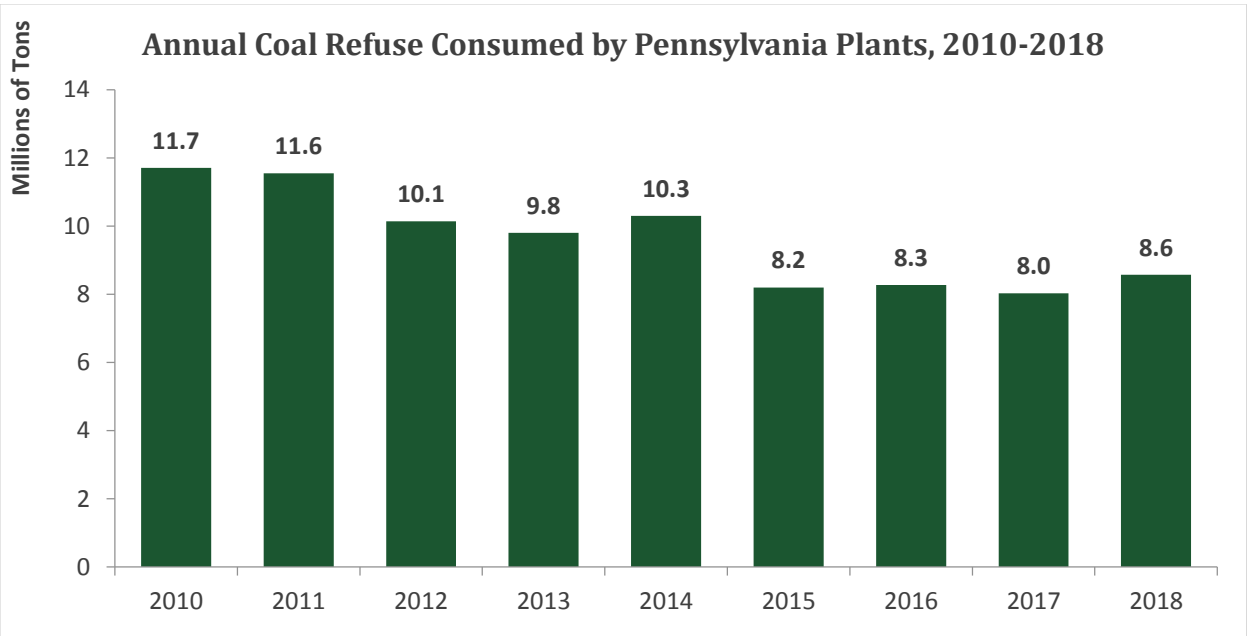
The reductions in revenues from wholesale and capacity payments and increases in regulatory costs have created a fundamental mismatch between revenues and costs for the industry.

This dynamic has led a number of coal refuse reclamation to energy operators to idle their plants for significant portions of the year. At least two plants in Pennsylvania operated on a seasonal basis in 2018, resulting in energy production levels well below their peak production levels achieved in recent years (in addition to the retirement of a plant at the end of 2018).

Collectively, the industry consumed between 8 and 9 million tons of coal refuse each year from 2015 to 2018, well below the levels achieved in prior years when higher energy prices enabled more continuous operations (see Figure on following page). This reduction in energy generation translates into a reduction in the environmental benefits realized by the Commonwealth.



Many ARIPPA plants are forced to idle operations for portions of the year due to lower energy prices. This results in significant reductions in coal refuse consumption relative to recently achieved levels (defined for each plant as the maximum annual production observed in any year since 2010). (Data source: ARIPPA Plants, PA DEP)



Plant closures and idlings have led to an overall reduction in the volume of coal refuse consumed each year by plants across the Commonwealth. In recent years, plants have consumed 8-9 million tons of coal refuse annually, down from more than 10 million a year prior to the changes in market conditions. This reduction in activity results in attendant reductions in economic and environmental benefits.(Data source: ARIPPA Plants, PA DEP)

While idling plants may be economically preferable to operating them in the short-term, over the long-term the gap between revenues and costs creates an unsustainable situation for Pennsylvania's coal refuse reclamation to energy plants and their operators. Multiple plants have been forced to shutter operations in recent years or convert to other uses, a trend that is accelerating as industry economics remain problematic. Importantly, plants that have been closed are typically dissembled, meaning that their potential environmental and economic benefits are lost to Pennsylvania permanently.

- *Piney Creek Power Plant* in Clarion County ceased operations in 2013, and was demolished in January 2019.
- *Northeastern Power Company (NEPCO)* in Schuylkill County was closed in late 2018 due to what its parent company Vistra Energy termed "uneconomic operations and negative financial outlook."[14]
- *Kimberly Clark Chester Plant*, a facility supplying "inside-the-fence" power to the Kimberly Clark Company, is investing millions to replace its plant with a gas-fired facility, and therefore will no longer contribute to addressing the state's coal refuse liability.

In April 2019, the Cambria Cogeneration Plant announced that it will go into "standby" status in summer 2019 through at least 2021, and its prospects to return to active production at that time are uncertain (see case study).

Reductions in activity from plant idling and plant closures reduce or negate the economic and environmental benefits that coal refuse reclamation to energy plants deliver to Pennsylvania, especially to the communities where they are located. The current economics threaten the long-term viability of the industry, putting the public benefits it delivers at risk.

Plants that have been closed are typically demolished and sold for scrap, or disassembled and reassembled in another region or country. As a result, once plants are shuttered, they are unable to return in the future even if the economics of the industry were to change. Pictured above is the demolition of the Piney Creek Power Plant in January 2019 (Image source: Explore Clarion).

CASE STUDY

Cambria Cogeneration Plant

In 2019, Cambria Cogeneration Plant announced that due to poor economic conditions the plant would cease operations for at least two years, though unpredictable market forces could make the closure permanent. Low energy prices and competition from Marcellus Shale gas led the plant to move from active production to standby, operating only as needed. The idling of the plant has impacts on the local community and economy, and ultimately means less coal refuse converted to energy and fewer sites remediated.

The plant, which has operated since 1991, has a long history of successful projects and community involvement. Cambria was responsible for removing, remediating and reclaiming two large scale coal refuse piles, Ernest and Lucerne, in neighboring Indiana County. Combined, the two sites contained 20 million tons of coal refuse, and over 15 million tons of coal refuse fuel have been removed to date. Reclamation of both sites, which includes 5 million tons of non-fuel coal refuse on nearly 200 acres, is underway using CFB beneficial ash. Over the past decade, the plant has consumed more than 500,000 tons of coal refuse per year.

Cambria Cogen has also made significant investments bettering the surrounding community of Revloc, which include a community park, a playground, ballfields and pavilions. , and has historically provided funding to the Cambria-Somerset Authority to help maintain and manage the Wilmore Dam which is also used for public recreation. The permanent closure of the plant would result in the loss of a significant community anchor.

3. Environmental and Public Benefits under Threat

CHAPTER SUMMARY:

- **Industry activity generates positive externalities, meaning that plants can deliver a net positive societal value even if their activity is not profitable in a private market context.**
- **The removal of coal refuse piles and the reclamation of mining-affected lands has demonstrated benefits including water quality, public health and safety, and land value. The environmental and public benefits produced by the industry are estimated at an annual value of $37 million over a twenty-year horizon.**
- **Alternately, industry activity can be valued as an avoided cost to the Commonwealth. The avoided costs to the state of undertaking remediation itself are estimated at $93 to $267 million per year.**

Positive Externalities from Industry Activity

The remediation activities of the industry deliver documented benefits to the environment, the Commonwealth and the public at large relative to leaving coal refuse piles unaddressed. These benefits include water quality impacts, public health and safety impacts, and value increases for restored and nearby land.

While environmental benefits are by nature difficult to fully capture in purely financial terms, ESI's 2016 study of industry impacts developed a rigorous framework for estimating the economic value of projected environmental benefits over a 20 year time horizon using a mix of avoided cost, societal benefit, and direct value frameworks.[15] This analysis reviews those calculations using updated data as available. Most notably, this analysis assumes an annual volume of coal refuse removal of 8 million tons (based on recent activity levels as shown in Section 2).

"Positive externalities" are benefits from an activity that accrue to the general public, and are not captured within the business model of the activity.

While these envrionmenal benefits are substantial in economic terms, they are not captured within the industry's business model. Rather, they are "positive externalities" that accrue publicly. This distinction has two important implications:

1) Industry activity can be economically beneficial on net even if it is not profitable in private sector financial terms.
2) Absent continued industry activity, the Commonwealth and its citizens will lose out on these public benefits and bear additional environmental liability, creating a net loss in value.

Water Quality

Coal refuse piles degrade water quality through Acid Mine Drainage (AMD), where precipitation picks up pollutants that then leach into ground and surface waters. The iron-sulfide minerals found in coal refuse piles are oxidized and discharge iron, manganese, aluminum, and other metals and minerals into water flows. These discharges increase the acid level and silt content of local waterways, causing streams to turn orange in color and harming their ability to sustain marine and plant life.

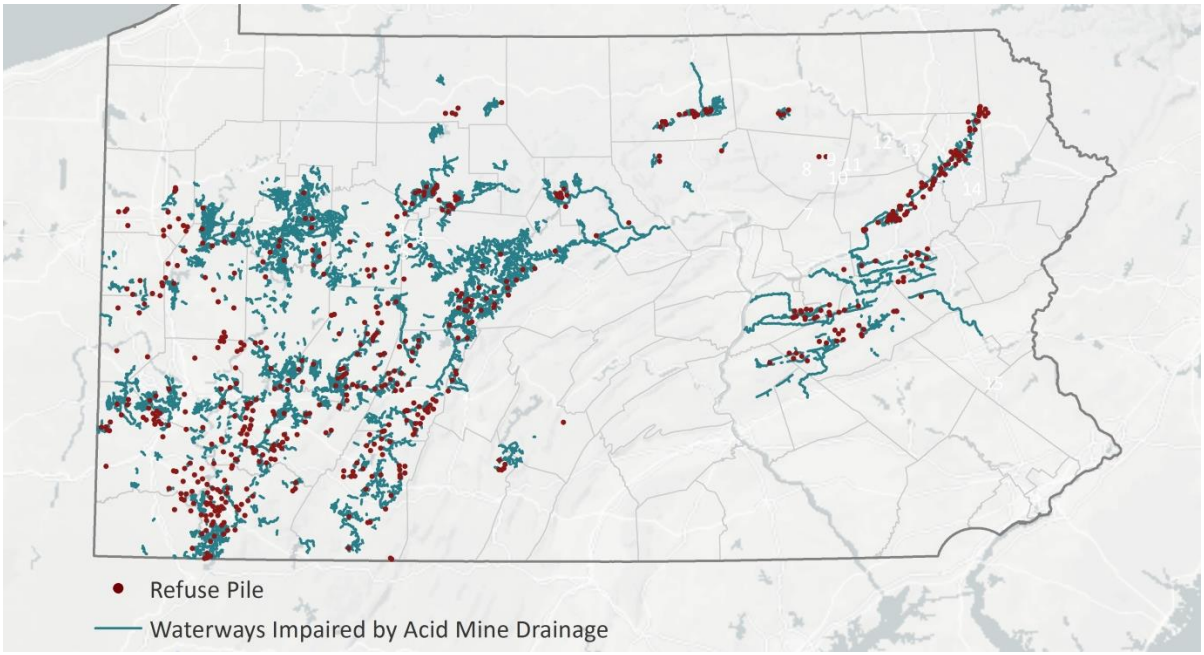
Together, abandoned mine issues, including coal refuse piles, impact nearly 5,000 miles of Pennsylvania streams.[16] Importantly, the local streams impacted by AMD are located within, or extend to, all four of Pennsylvania's major river basins, and are ultimately carried from local waterways into the Chesapeake Bay and Delaware River Watersheds to the east, and the Ohio, Mississippi, and Gulf of Mexico Watersheds to the west – creating environmental impacts that are national in scope.

Unlike water treatment systems, the elimination of coal refuse piles and reclamation of sites removes the source of AMD and its associated environmental consequences. After coal refuse is removed from a site for use as an energy source, the alkaline ash byproduct is typically used to stabilize the site, neutralizing the acidity of any remaining unusable coal refuse. The reclamation process also diverts water runoff from reclaimed areas reducing the concentration of metals in local waterways.

The permitting requirements for obtaining a surface mining permit (a precondition to removing coal refuse piles) require companies to develop an abatement plan for discharges of surface and ground waters, including the remediation of AMD. Before and after measurements of loadings of acid, iron, aluminum, manganese and sulfate have verified the successful long-term restoration of impaired streams and waterways (see Blacklick Creek case study). This process represents an obligation and liability taken on by industry plants in order to produce an external benefit.

Water quality issues related to AMD are national in scope, since impacted streams flow in all four of Pennsylvania's major river basins, where they are ultimately carried to the Chesapeake Bay, Delaware River, Ohio, Mississippi and Gulf of Mexico Watersheds.

Seeps and discharges from coal refuse piles significantly impair nearby streams. At left is a stream adjacent to the Lucerne Mine coal pile, which cannot support aquatic life and has a pH level of three. At right is Solomon's Creek, outside Wilkes-Barre, where iron in the water turns the surroundings a bright orange. (Image Source: Stephen Lee, Bloomberg BNA)



Acid Mine Drainage issues have impaired around 5,000 miles of waterways across the Commonwealth. The location of these impaired waterways corresponds closely with the location of coal refuse piles across the state. (Data source: Pennsylvania Integrated Water Quality Monitoring and Assessment Report – 2018, PA DEP).

Industry activities have improved or restored more than 1,200 miles of polluted streams. The removal of millions of tons of coal refuse annually can be expressed in monetary terms by comparing its effects to water treatment costs to remove the same volume of pollutants.

An analysis by Dr. Paul Ziemkiewicz, Director of the West Virginia Water Research Institute, established the potential acidity reduction from coal refuse removal and beneficial ash replacement for the coal refuse plant in Grant Town, West Virginia.[17] Scaling these benefit levels to the activity of plants throughout Pennsylvania indicates that the annual removal of 8 million tons of coal refuse produces a reduction of more than 3,100 metric tons of acid loadings annually (based on a 100 year drainage lifespan).[18] Further, the deployment of 6 million tons of beneficial use ash annually produces a reduction of nearly 2,500 metric tons of acid loadings each year.

To combine these values, an "overlap adjustment" of 50% is conservatively applied to account for situations where beneficial ash is returned to the original site where coal refuse was remined, thus combining to remediate the same waterway. The unique annualized savings in acid loadings from coal refuse removal and beneficial use ash totals more than 4,350 metric tons in year one. Importantly, this amount accumulates in future years, because remediation that takes place in year one continuously delivers benefits in subsequent years.

Earlier work by Ziemkiewicz, Skousen and Simmons found that the industry standard treatment cost for a metric ton of acid loadings with caustic soda (NaOH) was $500/ton/year.[19] Applying this figure to the annualized volume of acid loading reduction from industry activity yields an avoided cost of $2.18 million in year one. This figure accelerates over time, since avoided costs benefits from prior years remain in place.

Notably, this figure monetizes only the benefits from a reduction in acid loadings and the associated treatment savings. The removal of coal refuse also reduces loadings of iron, aluminum, manganese and sulfate.

Environmental benefits such as water quality accumulate over time, because once an area is remediated, it continues to deliver benefits in future years. These benefits are additive to the value attributable to further remediation activity undertaken in those years.

CASE STUDY

Blacklick Creek

The reclamation and remediation of the 4 million ton coal refuse pile in Revloc successfully restored local water quality and brought aquatic life back to the South Branch of Blacklick Creek. The southern fork of the creek, which ran through the pile, has been stocked with trout by a private sportsman group and can now be enjoyed for fishing and recreation.

The south branch of the Black Lick Crick running through Nanty Glo, after it was stocked with Trout by the South Branch Fishing Club in June 2017. (Image Source:6WJAC, Johnstown)

The cleanup of the Revloc coal refuse piles was accomplished by the nearby coal refuse reclamation to energy plant, Ebensburg Power Company, which removed 3 million tons of coal refuse to use as fuel, and returned approximately the same amount of beneficial use ash to remediate and reclaim the land. The process reclaimed 56 acres of land and restored aquatic life to 6 miles of the South Branch of Blacklick Creek. Through reclamation, water runoff at the site saw reductions of 96 percent acidity, 99 percent iron, 94 percent aluminum, 87 percent manganese and 82 percent sulfate.

The success at the South Branch demonstrates the effectiveness of coal refuse reclamation to improve local watersheds for long-term stability and environmental quality. In addition to permanently removing the refuse pile and restoring the health of the South Branch of the Blacklick Creek, these efforts returned the land to the community for economic and recreational uses.

"We've got fish in the water now. People weren't fishing here before. This is a good news story."

Cambria County Commissioner Tom Cherinsky

Public Health and Safety

Coal refuse piles pose a number of threats to public health and safety, including air quality impacts, the potential for damaging collapse, and injury from unsafe recreational uses.

Coal dust from piles is swept up in the wind and deposited across nearby communities, creating adverse effects. Coal refuse piles can ignite spontaneously or through human intervention (like garbage burning).[20] PA DEP's database tracks 45 current coal refuse fires across the state in addition to 47 burning pile sites where interventions have been completed.

Once ignited, fires may continue to burn for decades, since the coal refuse provides a continuous fuel source. Further, "methods to extinguish or control AML fires…are generally expensive and have a low probability of success" according to a report from the U.S. Bureau of Mines, which terms these fires "a serious health, safety and environmental hazard."[21]

Coal refuse pile fires are also never in the budget of municipal or county emergency response entities nor are they budgeted at PA DEP, making fire response both an environmental and a financial challenge.

Burning piles create a range of uncontrolled negative atmospheric impacts, including smoke, minute dust particles, and the release of poisonous and noxious gases, including carbon monoxide, carbon dioxide, hydrogen sulfide, sulfur dioxide, ammonia, sulfur trioxide, sulfuric acid, and oxides of nitrogen. These pollutants can be fatal to vegetative life and negatively impact human health. A study by the EPA established that concentrations of sulfur dioxide can increase illness rates and hospital admissions for older persons with respiratory disease, increase absenteeism from work, accentuate the symptoms of patients with chronic lung disease, and increase daily death rates.[22]

There are currently 45 identified burning coal refuse fires in Pennsylvania, which burn for decades if left unaddressed. These fires give rise to substantial air pollution, as seen in the image at left from the Loomis Culm Bank in Nanticoke. Fires that can spread must be contained at considerable cost, such as the 2014 fire at Simpson Park (at right), which required 1.6 million gallons of water daily to contain and was extinguished at a cost to the state of nearly $2.2 million. (Image source: Stephen Lee, Bloomberg BNA (left) and Associated Press)

These uncontrolled emissions stand in contrast to the removal and use of coal refuse as a fuel source under highly controlled and regulated conditions. Coal refuse reclamation to energy plants use limestone injection to control acid gas and fabric filter systems to reduce filterable particulate matter (FPM) emissions. In addition, these plants have made considerable investments to meet federal and state emissions standards. All coal refuse reclamation to energy electric generating units in Pennsylvania qualify as mercury low-emitting generating units, and all but one qualify as particulate matter low-emitting electric generating units as specified by the MATS rule requirements.

The removal of coal refuse piles eliminates any possibility that they will catch fire in the future, producing a quantifiable avoided fire response cost for Pennsylvania. In recent years, BAMR commissioned the extinguishing of coal refuse fires at Simpson Northeast (completed May 2014) and Staback Park (completed May 2015), both in Lackawanna County, at an average cost of approximately $120,000 per acre.[23]

Based on this benchmark and the average pile size of more than 11 acres, extinguishing a new fire will cost of the Commonwealth an average of more than $1.3 million. Assuming one new ignition per year statewide, the removal of 8 million tons of refuse annually by the industry (out of a total tonnage of around 220 million) reduces the Commonwealth's expected fire response costs by nearly $50,000 in year one. These benefits accumulate over time, because the fire risk is permanently removed when a site is remediated.

In addition to fire risks, piles are structurally unstable and can collapse, leading to landslides and mud slides that have affected public and private lands, including highways, homes, crops, and forests. Public safety issues are compounded by the many coal refuse piles located in populated areas. Unfortunately, unsupervised piles are frequently used for recreational purposes, particularly all-terrain vehicle (ATV) and bike riding. Due to the instability of the piles and dangerous debris on the sites, this activity can lead to serious injury and even loss of life, with four documented deaths from ATV accidents on coal refuse piles in Pennsylvania between 2005 and 2014, and additional casualties since that time.[24]

Benefits from avoided fatalities and injuries can be quantified based on government guidance on the statistical value of a life and varying degrees of injury commonly used in cost-benefit analyses.[25] Based on the historic rate of annual fatalities and the established relationship between ATV deaths and injuries,[26] the removal of 8 million tons of coal refuse annually by the industry yields an avoided fatality and injury value of nearly $700,000 in year one. This amount grows over time as sites remediated in future years.

Land Value

The remediation of coal refuse piles also returns substantial areas to productive land use. Reclaimed land has become recreational parks and soccer fields, pastures, industrial parks, shopping centers, and housing developments, adding considerable value to private land holders and to the general public. Further, coal refuse piles are frequently located in populated areas where they represent a disamenity for nearby homes, reducing quality of life and property values for residents.

Both the reclamation of previously unusable land and the value impacts to nearby residents represent quantifiable economic benefits resulting from the industry's remediation of coal piles. These benefits accrue largely to private residents and local governments (which benefit from increased land value and the potential for commercial uses) throughout Pennsylvania, rather than directly to the Commonwealth. Land value benefits from the remediation of a site are one-time rather than cumulative.

Coal refuse piles are not confined to uninhabited areas, but often loom directly over residential properties and communities, reducing property values. At left is a pile in Ehrenfield (which is being removed and remediated using state funding) and at right a pile in Fredericktown sitting directly above residential back yards. (Image source: The Tribune-Democrat (left), The Allegheny Front (right)).

Industry activity has reclaimed more than 7,200 acres of land, restoring it to productive use. Applying the historic relationship between beneficial ash utilization and reclamation to the recent annualized volume of ash reclamation, it is estimated that 240 acres will be restored annually.[27] Using an assumed land value of $5,600 (based on agricultural land values in Pennsylvania published by the U.S. Department of Agriculture) the annual benefit of this rehabilitation activity is estimated at $1.34 million.[28]

Incremental benefits to properties within one-quarter mile are conservatively estimated at 5 percent, at the lower end of the range of statistical results for similar blighting influences, such as landfills.[29] This increment is applied to an estimated land value of $25,000 per acre, based on a review of market prices for a mix of property used.[30] Spatial analysis based on refuse pile sizes indicates that for each acre of coal refuse, there are around 16 acres of nearby property, yielding an estimated increase in nearby property values of $4.9 million per year from industry activity.

Aggregate Benefits

Benefits from each of the categories above are estimated for years 1 through 20, and can be aggregated to estimate the total value of environmental benefits attributable to the industry at current operating levels. Benefits grow over time due to the cumulative nature of water and public health and safety benefits, in which areas that are remediated in earlier years continue to deliver benefits in future years.

The nominal value of these benefits over a twenty year time horizon totals $738 million, growing from $9.2 million in year 1 to $64.7 million in year 20, and averaging $36.9 million per year.

This sum is indicative of the fact that simply "doing nothing" in the absence of industry efforts does not eliminate the costs or liabilities of Pennsylvania's legacy coal refuse problems.

$37 Million in Annual Benefits		Year 1	Year 10	Year 20	Total	20 Year Avg
Water Quality	Cumulative	$2.2	$21.8	$43.6	$457.9	$22.9
Public Health and Safety	Cumulative	$0.7	$7.4	$14.9	$156.0	$8.0
Land Value	One-Time	$6.2	$6.2	$6.2	$124.9	$6.2
Total ($M)		**$9.1**	**$35.4**	**$64.7**	**$738.7**	**$36.9**

Avoided Costs to Pennsylvania

To achieve the benefits described above without the industry, the state could alternatively commission the removal of piles, disposal of refuse, and rehabilitation of sites. The cost of this effort to the state represents the "avoided cost" from activity that is instead undertaken by the industry.

From an economic standpoint, the reclamation and energy generation cycle has key structural advantages as a cost-effective means of addressing coal refuse sites:

- Landfill costs for the permanent storage of refuse material are not required, since it is instead utilized as a fuel source. Permanent storage often represents the largest cost driver for remediation activity undertaken by the Commonwealth.
- Energy generation produces revenue that offsets costs, while the refuse removal, transportation, disposal and site remediation are purely a cost to the Commonwealth.
- The industry adheres to extensive bonding, permitting and testing requirements that ensure that water quality impacts are addressed at their source, rather than through long-term treatment at facilities that carry both upfront and operating costs.

Recent project bids provide a basis to estimate the avoided cost from activity undertaken by the industry that would otherwise be borne by the state.

PA DEP recently sought bids and awarded a contract for the removal, disposal and rehabilitation of a 62 acre coal refuse pile in Ehrenfeld, using federal AML pilot funds. The contract was awarded in 2016 to Rosebud Mining Company, at a bid of $13.5 million for removal and rehabilitation. Including an additional $12.7 million for disposal of the material, project costs totaled $26.2 million.[31]

Importantly, Rosebud controlled disposal costs for this project by relocating the refuse (mixed with an alkali) to nearby strip mining pits that it owned, limiting transportation and storage costs. PA DEP's announcement of the award notes that previous bids (originally solicited in July 2013) were cost-prohibitive, until the identification of the nearby disposal location "resulted in a cost reduction to allow the contract to proceed."[32] This unique circumstance created a favorable outcome for the Commonwealth and the community, but is not replicable on a large scale across the state.

Rosebud's bid reflected a cost of around $11 per ton (split roughly evenly between removal and disposal) as well as a rehabilitation cost of around $20,000 per acre. Pricing from three bidders in 2016 for removal and rehabilitation were 15 to 20 higher than Rosebud, at about $7.50 per ton for removal and $23,000 per acre for rehabilitation.[33]

Cost differentials for disposal are far higher, with two competitive bids for disposal costs in 2013 averaging more than $25 per ton, more than four times the cost to Rosebud.[34] This cost is likely to be more reflective of the typical cost profile that the state would incur for disposal absent the unique circumstances of the Rosebud bid.

Combined, estimated disposal and removal costs therefore range from around $11 per ton (in the unique Roesebud case) to around $33 per ton (under more typical conditions). Rehabilitation costs represent an additional $20,000 - $23,000 per acre.

At these costs, replicating the annual removal of 8 million tons of refuse and remediation of 240 acres generated by the industry would cost Pennsylvania $93 to $267 million annually.[35] Addressing all identified piles across the state would cost $2.6 to $7.4 billion.[36]

	Rosebud	Average Bidders	Modeled Annual Industry Activity	Avoided Cost Range
Removal (per ton)	$5.40	$7.40	8 million tons	$43 - $59 M
Disposal (per ton)	$5.60	$25.30	8 million tons	$45 - $202 M
Rehabilitation (per acre)	$20,000	$23,000	240 acres	$5 - $6 M
				Annual avoided costs to the Commonwealth: $93 - $267 M

4. Economic Benefits under Threat

CHAPTER SUMMARY:

- **Plant operations are a driver of economic opportunity and employment in rural communities throughout the state.**
- **Direct expenditures by the industry are estimated at $363 million annually, and industry employees earn an average salary of greater than $75,000.**
- **Including spillover effects, the annual economic impact of the industry is $615 million within Pennsylvania, supporting nearly 3,000 jobs and generating $18 million in state taxes and fees.**
- **This activity is concentrated in coal country, creating family-sustaining jobs and purchasing power in areas that have lost population and struggled to create economic opportunities.**

Statewide Economic Impact

The industry is also a major economic generator and a major employer for Pennsylvania. The activities of the industry extend well beyond the footprint of the plants themselves, encompassing the full fuel cycle of mining, transportation, energy generation, and environmental remediation. Each of these expenditures, which represent the direct footprint of the industry, in turn create indirect and induced "spillover" effects within the Pennsylvania economy.

Annual expenditures associated with the industry totaled an estimated $363 million for calendar year 2018.[37]

Annual Industry Direct Economic Activity

$363 million total expenditures

1,550 direct FTE jobs supported

Average Salary: >$75,000

Source: ESI Analysis of Plant Data

Labor costs make up a significant share of operating expenses for industry plants. While plants take a variety of approaches to which mining and mining-related functions are performed in house and which are contracted, employment across the fuel cycle is directly attributable to their existence.

Inclusive of contracted activity, direct employment in the industry totaled more than 1,500 full-time equivalent (FTE) jobs in 2018, of which a bit less than half were direct positions with the plants. Direct jobs carry an average salary of more than $75,000 on an annualized basis, allowing workers to earn a family-sustaining living.

In addition to labor costs, plants also have a number of fixed costs (including utilities, administration, insurance, regulatory and compliance fees, equipment and supplies) that occur regardless of the production level of the plant and variable costs (reviewed in Section 2) that are directly responsive to production levels.

Industry expenditures on employees, contractors, goods and services have "spillover" effects as they circulate through the state's economy, stimulating further activity and supporting employment across a variety of sectors. Spillover effects include indirect impacts from increased supply chain activity and induced effects from the recirculation of labor income as household spending across the state economy.[38] When plants are idled or closed, the lost economic activity includes not just the direct expenditures and employees of the plants, but these downstream impacts as well.

Building on ESI's 2016 analysis using the industry-standard IMPLAN modeling framework, it is estimated that the industry generates $615 million in annual economic impact in Pennsylvania, supporting 2,960 total FTE jobs with $194 million in earnings. [39]

The economic activity and earnings associated with industry operations also yield significant tax revenues for the Commonwealth. These impacts are generated in numerous ways:[40]

- *Environmental taxes and fees* paid directly by plants, including emittance fees, permit fees and reclamation bonding;
- *Direct activity* revenues, including income tax on earnings, sales tax on purchasing, and applicable business taxes; and
- *Spillover activity* revenues, from additional private sector activity throughout the supply chain and from the recirculation of earnings as household spending.

Collectively, annual tax revenues to the Commonwealth of Pennsylvania from industry activity total $18 million.[41]

$615 Million in Annual Economic Impact

$363M
Direct Expenditures

2,960
FTE Jobs

$252M
Indirect/ Induced Impact

$194M
Earnings Supported

$615M
Total Economic Impact

$18M
State Taxes/Fees

Annual direct and spillover impacts within Pennsylvania

Impact in Rural Communities

The coal refuse reclamation to energy industry plays a prominent role in rural and disadvantaged communities across Pennsylvania's two legacy coal regions, revitalizing both economic and environmental conditions. Plants are economic anchors for their host jurisdictions, serving as employment hubs and large components of the local tax base.

Due to the interconnected nature of economic activity, plants not only support direct employment of local residents, but generate demand for a range of support industries. The earnings within the industry are also a crucial component of household spending power that supports small businesses (maintenance shops, restaurants, retailers, etc.) in these communities.

This activity is particularly important given the economic insecurity and hardship faced by most coal communities in Pennsylvania. Each of the seven counties in which plants are located had a higher unemployment rate and lower average wage than the state average in 2018, and six of the seven have seen a decline in population since 2010, with a combined loss of more than 23,000 residents.[42] Further erosion of the job and income base in these communities would only accelerate these trends given the existing challenges in generating economic opportunities in these areas.

In addition to the industry's crucial role in the environmental and economic health of their host localities, member plants embrace their roles as community anchors and have made numerous civically minded investments and contributions. Plants engage in community service, sponsor community events and associations, and serve local schools through educational tours and scholarships.

Further, plants have invested in infrastructure and community spaces that serve the general public. Many plants assist communities with the maintenance of their reservoirs while allowing recreational access. Plants have built, maintained, or donated land for community parks. Others have constructed or reconstructed nearby road infrastructure.[43]

Industry trade group ARIPPA also partners with environmental groups, community organizations and conservation districts to improve the landscape and environmental health of Pennsylvania coal regions. Each year, ARIPPA partners with the Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR) and the Western Pennsylvania Coalition for Abandoned Mine Reclamation (WPCAMR) to award grants to watershed organizations working on Abandoned Mine Land (AML) and Acid Mine Drainage (AMD) remediation projects. Since 2010, more than $70,000 has been awarded to help support a variety of worthy efforts across the state.

CASE STUDY

Colver Power Project

The Colver Power Project in Cambria County notified PJM Interconnection in December 2017 of its intent to close in 2020, after its long running power supply contract with local energy company Penelec ends. Accordingly, the plant declined to participate in the PJM capacity auction for 2021-22. A decision has not yet been made on the permanent status of the plant.

Colver Power has been an economic engine and a mainstay in the community since it was built at a cost of $200 million in the early 1990s. Colver is the third-largest coal refuse reclamation to energy plant in Pennsylvania, with a capacity of 110 MW, enough power for approximately 130,000 homes. Over more than two decades, Colver has nearly eliminated an adjacent 3.5 million ton coal refuse pile left behind by the Eastern Associates Coal Mining Company, restoring Elk Creek and downstream waterways like the North Branch Blacklick Creek and the Stoney Creek-Conemaugh River Basin.

Colver Power has also been dedicated to local employment and training. When 16 coal miners were displaced in Cambria County, the Colver Power Project enrolled them in “power plant school” through the PA Customized Job program and, upon completion of the program, hired all 16 as full-time employees.

The plant has also made significant capital investments benefitting the Colver community (a small town with fewer than 1,000 residents) and the Ebensburg area. The plant invested $7 million in new construction and reconstruction of 3.5 miles of state road from the power station to U.S. Route 422, eliminating community impacts from trucking. Colver Power also invested $20 million dollars through the Cambria Township Water Authority in order to reconstruct the Colver Reservoir and the public water supply system.

Walleye in the Colver Reservoir (Image Source: Pennsylvania Fish and Boat Commission)

5. Saving the Industry: Options to Sustain the Public Benefits under Threat

CHAPTER SUMMARY:

- **Industry activity is not viable under current market conditions, but nonetheless remains a valuable public resource as a means of environmental remediation. To sustain these public benefits, the economic and regulatory framework must recognize the positive externalities that the industry delivers.**
- **Options include raising the statutory cap on the existing state tax credit to $45 million so that funding is sufficient to achieve its purpose, and leveraging the state credit with a long-term federal tax credit program.**
- **Alternative regulatory approaches could also be used to financially recognize the positive externalities detailed throughout this report.**

Public Benefits under Threat

As described throughout this report, Pennsylvania's coal refuse reclamation to energy industry has served for nearly three decades as a valuable environmental remediation tool for the Commonwealth. The industry has made significant progress on the issue of Pennsylvania's legacy coal refuse and the attendant environmental problems, consuming more than 225 million tons of refuse, restoring more than 7,200 acres of land and more than 1,200 miles of polluted streams under careful regulation of the Commonwealth. It also serves as a hub of employment and economic activity.

Recent changes in the market and regulatory conditions faced by the industry have created an existential crisis for the industry, in which its commodity (energy) frequently sells for lower than the cost of production.

While converting coal refuse to energy is not currently viable as a market-based means of energy production, it remains a valuable and cost-effective means of environmental remediation.

Nonetheless, the industry still delivers a strong *public* return on investment. A public investment to maintain the viability of the industry would be far smaller relative to the costs borne by Pennsylvania to address coal refuse piles through state cleanup efforts or the public costs of inaction in the form of water quality, public health and safety and land value losses.

Government can assist the industry either through enhanced tax credit support, or through a restructuring of the regulatory framework. Either approach would recognize and assign a financial value to the public benefits that are not currently realized within the industry economics.

Tax Credit Programs

Recognizing of the importance of the industry and the external benefits that it delivers to Pennsylvania, the Pennsylvania legislature and Governor Wolf enacted the Coal Refuse Energy and Reclamation Tax Credit in 2016. Under the program, eligible facilities may receive a credit of $4 per ton of coal refuse used to generate electricity in the Commonwealth in the previous calendar year (as verified by PA DEP). This credit level was advocated by the industry to help to address the gap between production costs and realized revenues.

However, the total amount of credits is capped statutorily at $10 million per year until the expiration of the program in 2026. Based on industry production levels of more than 8 million tons annually, potential credits at $4 per ton are in excess of $30 million. With the $10 million annual cap, all awards are scaled down proportionally, and the realized yield per plant is around $1.20 per ton. As documented in this analysis, this subsidy level is insufficient to cover the basic mismatch between the cost of production for plants and the wholesale price of energy for large portions of the calendar year.

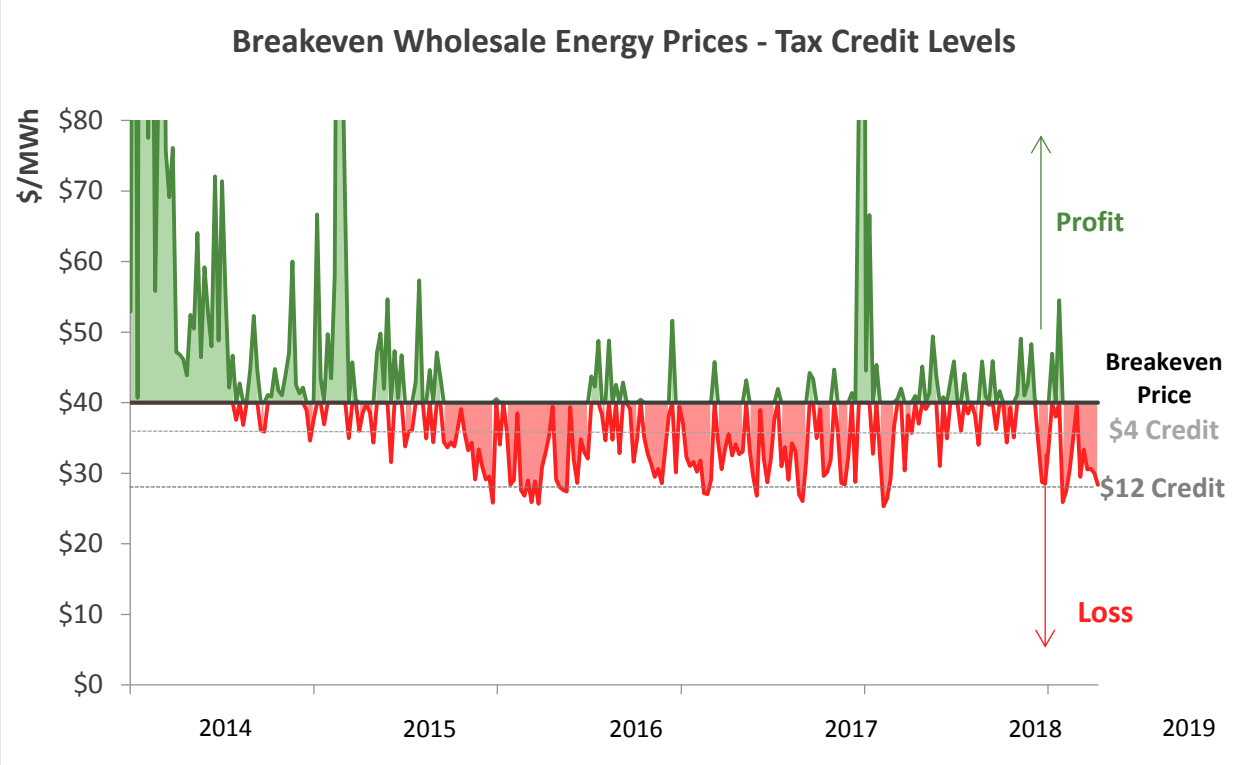
In this respect, the credit suffers from a similar weakness to other tax credit programs recently reviewed by the Pennsylvania Independent Fiscal Office (IFO). In its January 2019 tax credit review, IFO found that the New Jobs Tax Credit level "is insufficient to incentivize job creation," the Film Tax Credit is "too small to attract large feature films and long-term investment" and within the Historic Preservation Tax Credit "the current dollar caps make the program ineffective for most projects."[44] structured and well in line with the IFO's general criteria, but given the current statutory cap, is insufficient in size to achieve its intended goal of supporting the continued viability of the industry as a means to promote environmental remediation and economic activity.

Awards under the Pennsylvania Coal Refuse Energy and Reclamation Tax Credit have been far below eligible levels due to the total program cap of $10 million. Like other tax credit programs, the current funding level is insufficient to achieve the program goal of closing the gap between industry production costs and revenues.

Recognizing these realities, Senators David Argall (R-29) and John T. Yudichak (D-14) introduced in April 2019 a bipartisan bill to increase the total statewide allocation of the tax credit to $45 million, as originally envisioned. At a statewide allocation of $45 million as originally envisioned, plants would be able to realize the allowable $4 per ton credit. This would have the effect of lowering the "breakeven price" needed to cover the cost of generation, increasing the duration of periods in which plants could operate economically. This mechanism could serve as a bridge to a federal tax credit as a long-term solution.

Another option under consideration is a federal tax credit that builds off the structure of the Pennsylvania state credit. Former Representative Lou Barletta introduced the "Coal Refuse Reclamation Act" in the 115th Congress in February 2018, proposing a federal credit of $12 per ton of coal refuse for qualifying facilities. This approach would bring federal resources to bear while leveraging the demonstrated state investment and commitment to supporting the industry, and build on the state's initial success in creating and administering the program. A similar effort is currently underway in the 116th Congress.

A federal credit of $12 per ton would reduce the "breakeven price" to a point where plants could operate continuously, maximizing the environmental benefits that the industry delivers at far less cost than the monetized benefits provided.



Amore substantial tax credit program would have the effect of lowering the "breakeven price" of generating each unit of energy for coal refuse to energy plants. Based on recent pricing trends, a $4 per ton credit would increase the duration of periods in which plants could operate economically, while a $12 credit would allow plants to operate continuously, maximizing the environmental benefits the industry provides.

Alternative Solutions

Alternative regulatory approaches could also be used to recognize the environmental benefits of the industry documented throughout this report. Pennsylvania has an Alternative Energy Portfolio Standards (AEPS) program to promote the mix of alternative electricity generation within the state. These standards require that 18 percent of the electricity supplied by Pennsylvania's electric distribution companies and electric generation suppliers come from alternative energy resources by 2021, and allows suppliers to comply by procuring Alternative Energy Credits from generators.

AEPS establishes two tiers of eligible energy sources, requiring 8 percent to be supplied through Tier I (which includes sources like solar PV, wind and geothermal) and 10 percent to be supplied through Tier II, which includes coal refuse (as well as distributed generation, demand-side management, large-scale pump hydro and others). While Tier I credits generate significant revenue for generators (with a weighted average price of more than $12 in 2017), the glut of supply in Tier II led to a weighted average price of only $0.16.[45]

Like the state tax credit at current levels, this yield is insufficient to provide a meaningful incentive to achieve the program's purpose. While moving coal refuse energy to Tier I within the AEPS standards may not be an appropriate remedy, this framework illustrates the way in which regulatory mechanisms can be used to incentivize the production of energy sources with positive externalities. Credits could potentially be adjusted between tiers, or a distinct tier could be created that provides value through the program (or another mechanism) commensurate with the industry's contribution to the Commonwealth.

Regulatory mechanisms like the Alternative Energy Portfolio Standards (AEPS) program demonstrate that the government has effective tools to incentivize forms of energy production that produce public benefits.

Alternatively, power purchase agreements with local utilities, state or federal agencies could provide a reliable revenue stream to enable continued production and the associated environmental, economic and public benefits.

Another approach is to reform the manner in which Title V fees are assessed. For example, Olympus Power has proposed to the Pennsylvania Environmental Quality Board that these fees should be assessed based on the number of net MWh generated rather than based on the emissions of regulated pollutants, which would equalize the assessment among energy generation types.[46]

The Commonwealth could also consider whether other options exist to provide relief to the industry from regulatory costs and fees. For instance, the Commonwealth could potential cover costs for bonding obligations, or waive taxes and fees on a defined set of activities to facilitate environmental activity by the industry that produces a significant avoided cost to the Commonwealth.

Each of these approaches fundamentally would recognize the positive externalities and public benefits provided by coal refuse plants, and seek to incentivize their continued activity.

Endnotes

[1] Historical summary data is provided by Commonwealth of Pennsylvania Department of Conservation and Natural Resources, which tracks annual production going back to 1870. Production totals more than 11.9 billion tons in the bituminous region and more than 5.4 million in the anthracite region. Production in 1944 at the height of World War II was more than 200 million tons.

[2] The data inventory was provided by PA DEP on April 15, 2019. Out of 772 piles, the inventory lists an estimated acreage 739 and an estimated volume for 608. Where one of these two measures is available, the remaining measure is extrapolated based on the average tonnage per acre for piles where both measures are available. No extrapolation is applied to the 33 piles with no size information.

[3] DEP's documentation acknowledges that the inventory is "by no means complete as many AML problems and features exist that have never been added to the inventory ("History of Pennsylvania's Abandoned Mine Land Inventory," PA DEP). For example, in addition to pre-existing sites that may not have been identified, coal refuse sites that were abandoned or went into forfeiture after 1977 have not been added to the inventory. Accordingly, the inventory should be understood as a baseline but incomplete count of coal refuse piles across Pennsylvania.

Further, alternative studies of specific counties or regions have yielded larger estimates than those represented in the BAMR inventory for the same geographic area. For example, when the Western Pennsylvania Coalition for Abandoned Mine Reclamation (WPCAMR) carried out a survey of the refuse piles in Westmoreland County, it identified 103 piles, 36% greater than the 76 listed for the county in the original BAMR report. In addition, surveys of the anthracite region conducted prior to the development of the inventory identified approximately 800 banks and 1 billion tons of coal refuse in the anthracite region alone.

[4] Pennsylvania has received more than $1.3 billion in total AML funding since the initiation of the program in 1980. However, since funding for the program is based on a fee on active coal mining, declines in industry production in recent years have led to declines in this funding source, and concerns about its sustainability.

[5] ESI's 2016 study, "Economic and Environmental Analysis of Pennsylvania's Coal Refuse Industry," established historical environmental remediation levels through a comprehensive survey of member plants and government and industry records. This analysis extends those historic calculations to cover activity in the years 2016-2018.

[6] The permitting requirements for obtaining a surface mining permit (a precondition to removing coal refuse piles) require companies to develop abatement plans for discharges of surface and ground waters, including the remediation of AMD. Companies are required to take baseline measurements of water conditions and are liable for worsening conditions, which creates an economic incentive for the improvement of local water quality and allows improvements to be scientifically quantified.

[7] Cost components are drawn from detailed survey data provided by member plants in 2016 as part of ESI's Economic and Environmental Analysis.

[8] Pricing data is drawn from the U.S. Energy Information Administration "Wholesale Electricity and Natural Gas Market Data." Pricing is shown as the weekly average of daily weighted average prices on the PJM Real Time Peak market. Prices for individual plants will vary due to their location within specific nodes and other factors.

[9] "Breakeven" pricing varies by plant and period of time due to a variety of factors influencing the cost of production, and should be understood as approximate on an industry-wide basis. ESI's 2016 study estimated the combination of fixed, labor and variable cost at around $39 per MWh, a cost which increases over time with

inflation and any reductions in efficiency from plant idling and restarting. While plants receive capacity payments (estimated at roughly $5.50 per MWh at current pricing in endnote 8 above) in addition to wholesale payments, the realized price per MWh can be several dollars lower than the listed wholesale price due to various factors including congestion, line losses, plant locations and PJM's price nodes. These losses are understood to roughly offset capacity payments at current levels, yielding an industry "breakeven" wholesale price of around $40 MWh.

[10] Pricing shown reflects "Base Residual Auction" for the "Rest of RTO" region covered by PJM, which encompasses the majority of Pennsylvania and of member plants. Due to subsequent incremental auctions, these prices may not reflect the exact capacity payment received by a given plant, but annual differentials are reflective of realized differences in revenues. Data is available through PJM at: <https://pjm.com/markets-and-operations/rpm.aspx>

[11] FERC's June 2018 order in Calpine Corp, et al v. PJM Interconnection L.L.C. held that "out-of-market payments provided or required by certain states for the purpose of supporting the entry or continued operation of preferred generation resources—such as those associated with renewable portfolio standard ("RPS") programs—depress capacity market prices in the PJM market." (Federal Energy Regulatory Commission: "FERC Finds that State-Supported Generation Resources Suppress PJM Capacity Market Prices, Establishes Proceeding to Design and Implement Broad Market Reforms." June 29, 2018). Structurally, the federal and state support for certain energy generation technologies allows those projects to bid their energy pricing into the PJM market at rates below the true cost to produce such electricity, dampening pricing for other producers, impacting the wholesale market in addition to the capacity market. This problem is likely to be compounded by recent large scale subsidies approved by several states for the nuclear power industry.

[12] Title V fees impose a charge corresponding to the amount of regulated criteria pollutants emitted annually, along with additional fees such as plan reviews, to fund the Commonwealth's Clean Air Fund. Coal refuse plants paid $1.8 million of the $14.9 million in total emissions fees in 2017, far exceeding the proportion of energy that the plants generate, meaning that costs are far higher on a per output basis. DEP is currently proposing to increase existing fees and impose new fees due to the declining balance of the Clean Air Fund (see: Proposed Rulemaking Environmental Quality Board (25 PA Code Chs. 121 and 127): "Air Quality Fee Schedules"). However, to the extent that fees contribute to the closure of additional plants, this effort would be self-defeating as a revenue generation mechanism.

[13] During regulatory development of the MATS rule, the U.S. EPA stated that, "Units that burn coal refuse provide multimedia environmental benefits by combining the production of energy with the removal of coal refuse piles and by reclaiming land for productive use…" (Environmental Protection Agency, "Solid Waste Rule-Identification of Non-Hazardous Secondary Materials That Are Solid Waste," Federal Register 76: 54. March 21, 2011).

[14] See: Vista Energy Press Release, "Luminant to Close 51-Megawatt Power Facility in PJM Electric Market." August 24, 2018. Plant closure was undertaken prior to the end of calendar year 2018, and steps are being taken to decommission the facility.

[15] For further detail on this framework and calculations, see Section 3.3 of ESI's 2016 "Economic and Environmental Analysis of Pennsylvania's Coal Refuse Industry" report.

[16] A comprehensive accounting of conditions throughout the Commonwealth is contained in Pennsylvania's integrated water quality monitoring and assessment report, satisfying requirements under the Clean Water Act. Data from the most recent report is available for public review through a mapping application at: <https://www.depgis.state.pa.us/integrated_report_viewer/index.html>

[17] Ziemkiewicz, Paul, "Acid Load Reduction Resulting from Operation of the American Bituminous Power Partners, L.P. Grant Town Power Plant." April 28, 2016.

[18] Accounting for the lifespan during which acid loadings drain from a coal refuse pile is necessary to express the total savings in annualized terms. This lifespan is also applied to reductions derived from beneficial use ash. The straightforward use of an annualized average over a 100 year lifespan is likely conservative in expressing annualized benefits over a shorter duration, because acid drainage is typically higher in the earlier years of the total lifespan.

[19] Ziemkiewicz, P.F., Skousen, J.G. & Simmons, J., "Long Term Performance of Passive Mine Drainage Systems," 2003. Available at: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.492.7225&rep=rep1&type=pdf>. Notably, this figure was developed more than a decade ago, and is likely conservative relative to current costs.

[20] United States Department of the Interior, "Coal Refuse Fires, an Environmental Hazard," 1971. This analysis explains that the flow of air through untreated piles oxidizes combustible coal refuse materials. The oxidation process generates heat which ultimately ignites the combustible components of piles.

[21] Kim, A. and Chaiken, F., U.S. Department of Interior Bureau of Mines, "Information Circular 9352: Fires in Abandoned Coal Mines and Waste Banks," 1993.

[22] Industrial Research Laboratory, United States Environmental Protection Agency, "Source Assessment: Coal Refuse Piles, Abandoned Mines and Outcrops, State of the Art," 1978.

[23] Total contracted costs for Simpson and Staback, as reported by BAMR, was $2.46 million ($2.18 million for Simpson and $280,000 for Staback) to extinguish a total of 20.9 acres (17.6 for Simpson and 3.3 for Staback). From an economic cost-benefit standpoint, there may be instances in which the financial value of environmental benefits does not exceed the cost of addressing the fire, in which case the Commonwealth may bear the environmental costs rather than address the fire. Conversely, however, this approach does not consider the environmental costs prior to a fire being extinguished, which results in an understatement of "all-in" societal costs for addressing a new fire.

[24] United States Department of Labor: Mine Safety and Health Administration, "Stay Out – Stay Alive Fatal Accident Summaries, 1999-2014."

[25] U.S. Department of Transportation, "Guidance on Treatment of the Economic Value of a Statistical Life (VSL) in U.S. Department of Transportation Analyses – 2016 Adjustment," August 8, 2016.

[26] U.S. Consumer Product Safety Commission, "2017 Annual Report of ATV-Related Deaths and Injuries," February 2017. This report identifies 588 ATV related deaths in 2014 (the most recent year for which complete data is available) and estimates 93,800 ATV-related, emergency-department-treated injuries annually, a ratio of 160 injuries to each fatality. This ratio is applied to extrapolate from fatalities to injuries, with injury severity assigned based on the distribution calculated by the U.S. Department of Transportation for traffic accidents and provided in DOT cost-benefit guidance.

[27] Recent industry data reported by PA DEP indicates that the tonnage of beneficial ash utilized by the industry for remediation is around 75% of the tonnage of coal refuse consumed in a given year. The annualized level of 8 million tons of coal refuse consumed utilized in this analysis therefore translates to 6 million tons of ash. Historical ratios for industry activity indicate a ratio of approximately 25,000 tons of ash per acre remediated. Therefore, the 6 million tons of ash annually are projected to translate to 240 acres of remediated land per year, similar to historical levels that have produced more than 7,000 acres of remediated land.

[28] U.S Department of Agriculture, "Land Values: 2017 Summary," August 2017. This estimate is likely conservative relative to the market value of remediated land, because many sites are located near residential or commercial areas where more profitable land uses may be possible. Land value per acre for areas remediated by the industry

and under Government-Financed Construction Contracts (GFCCs) between Fiscal Years 2012-2015 was estimated by PA DEP at more than $10,000 per acre.

[29] See for example: Richard C. Ready, "Do Landfills Always Depress nearby Property Values?" Journal of Real Estate Research 32: 3 (2010), 321-339. This analysis of three Pennsylvania landfills found that their presence decreased adjacent property values by an average of 2.7 to 13.7%.

[30] An analysis of public asking prices for a mix of 25 residential, commercial and industrial vacant properties in mining-affected areas found an average price per acre of more than $32,100. A discounted figure of $25,000 is used to reflected differentials in asking and sales prices and to account for variation among sites.

[31] Bids for removal and rehabilitation of the site were submitted publicly to PA DEP in November 2015 under contract number OSM 11(3041)102.1. Rosebud's winning bid included removal costs of $12.22 million and rehabilitation costs of $1.24 million for a total of $13.46 million. In addition, disposal costs of $5.14 per cubic yard for 2.478 million cubic yards of refuse totaled $12.74 million, for an aggregate cost of $26.2 million.

[32] Former DEP Secretary John Quigley, quoted in: PR Newswire. "Pennsylvania DEP Awards Contract to Reclaim Long-Abandonded Ehrenfeld Mine Site in Cambia County. March 8, 2016.

[33] Per unit costs for Rosebud are derived by dividing the volume of refuse and acreage of the site by the quoted cost. Costs submitted by three other bidders for removal and rehabilitation were uniformly higher.

[34] Bids for removal, disposal and rehabilitation of the site were submitted publicly to PA DEP in August 2013 under contract number OSM 11(3041)101.1. The two submitted bids totaled $59.8 million and $98.2 million, respectively, driven by disposal costs of $53.4 million and $91.3 million, respectively, and the project was not awarded.

[35] This range is defined by applying the per ton removal, disposal and remediation costs of Rosebud to the annual activity level of the industry to estimate the low end cost, and applying the average per unit costs of the three remaining bidders (2016) for removal and rehabilitation, along with average disposal costs for the two 2013 bidders, to define the higher estimate. Depending on the specifics of the piles addressed in a given year and available locations for disposal, state costs could be considerably higher.

[36] This range is similarly defined using low end costs from Rosebud and average costs from the remaining bids. Notably, this estimate includes only those piles identified in the current PADEP inventory, and does not make any adjustment for a variety of circumstances that could increase per unit costs relative to the Ehrenfeld pile, including piles that are on fire, difficult to access, far from appropriate disposal sites, etc.

[37] ESI's 2016 study included detailed submissions from ARIPPA member plants describing the level and composition of their operating expenditures for calendar year 2015, which was utilized to determine the aggregate industry impact, inclusive of spillover effects. That analysis remains the most comprehensive source of expenditure detail available on industry activities. Accordingly, the composition of plant expenditures by type was retained from that study, while the overall level of expenditures was scaled to the known difference in industry production between 2015 (when the industry consumed 8.20 million tons of refuse) and 2018 (8.57 million tons). This approach conservatively excludes any adjustment for inflation, though this may be appropriate since expenditures in the industry are subject to energy-market specific changes that do not necessarily track with overall inflation.

[38] For a detailed explanation of ESI's economic modeling approach, see Appendix A of ESI's 2016 "Economic and Environmental Analysis of Pennsylvania's Coal Refuse Industry" report.

[39] The IMPLAN system, licensed by the Minnesota IMPLAN Group, is one of the leading choices for input-output modeling within a region of state. The role of input-output models is to determine the linkages across industries within a given geography in order to estimate the magnitude and composition of spillover activity of direct activity

in a given set of industries. The economic impact (including employment and earnings impacts) is expressed as the sum of direct, indirect and induced impacts.

[40] Tax revenue impacts from direct and spillover activity are modeled based on a combination of directly reported data on taxes and fees paid by plants, and the modeled relationship between activity types and tax collections (i.e. effective rates). ESI has developed a custom fiscal model of the Pennsylvania economy to translate economic activity estimates derived from IMPLAN into resulting tax revenue impacts. For further explanation, see Appendix A of ESI's 2016 "Economic and Environmental Analysis of Pennsylvania's Coal Refuse Industry" report.

[41] Pennsylvania revenue estimates are comprised as follows: $5.8 million in income tax from increased labor income associated with the industry, $6.0 million from increased sales tax and $1.5 million in corporation tax from increased business activity associated with the industry, and $4.9 million in direct industry fees, for a total of $18.2 million. These increases are inclusive of both direct and spillover economic effects.

[42] Plants are located in Cambria, Carbon, Indiana, Northampton, Northumberland, Schuylkill and Venango counties, which declined collectively from 893,000 residents in 2010 to 870,000 residents in 2018 according to the U.S. Census Bureau, with only Northampton gaining population. Unemployment and earnings comparisons are drawn from Bureau of Labor Statistics data.

[43] For more detail on specific community investments, see Section 5.2 of ESI's 2016 "Economic and Environmental Analysis of Pennsylvania's Coal Refuse Industry" report.

[44] Pennsylvania Independent Office: "Tax Credit Reviews," January 2019.

"Pennsylvania New Jobs Tax Credit: An Evaluation of Program Performance" (page 19).

"Pennsylvania Film Production Tax Credit: An Evaluation of Program Performance" (page 25).

"Pennsylvania Historic Preservation Tax Credit: An Evaluation of Program Performance" (page 28).

[45] Comments of ARIPPA Executive Director Jaret Gibbons to the Pennsylvania Joint Legislative Air and Water Pollution Control and Conservation Committee on the Coal Refuse to Energy Industry, October 4, 2018.

[46] Olympus Power LLC, "Proposed Amendments to 25 Pa. Code, Chapters 121 (relating to general provisions) and 127, Subchapters F and I (relating to operating permit requirements; and plan approval and operating permit fees) as set forth in Annex A. June 17, 2019.

ESI ECONSULT SOLUTIONS INC.

1435 Walnut Street, 4th Floor
Philadelphia, PA 19102

EconsultSolutions.com