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ORIGINAL ARTICLE

The economic, fiscal, and workforce impacts of coal-fired power plant closures in Appalachian Ohio

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Abstract

This study examines the economic, fiscal, and workforce impacts of two Dayton Power & Light (DP&L) coal-fired power plant closures in Adams County, Ohio. The decommissioning of these facilities, and the closure of an associated training centre, will result in over 1,100 total lost jobs in the Appalachian region. A skillshed analysis revealed that displaced workers transitioning to emerging occupations with similar skill requirements will experience wage decreases. Decommissioned power plants in Ohio no longer pay tangible personal property (TPP) taxes, which will result in $8.5 million in lost tax revenue for local governments. These findings suggest that a multi-pronged recovery effort will be required to assist this region, which has implications for similar communities in Appalachian Ohio dealing with coal plant closures.

KEYWORDS

Appalachia, coal-fired power plants, IMPLAN, skillshed

JEL CLASSIFICATION

R58; Q32; R11; R15; Q40

1 | INTRODUCTION

The decline of the coal economy has been a salient issue on federal and state economic development agendas in the United States since the Great Recession. For instance, the federal government has expended considerable resources to assist communities impacted by the decline in the coal economy through the POWER (Partnerships for Opportunity and Workforce and Economic Revitalization) Initiative and the Assistance to Coal Communities programmes. This is an important issue since, from 2008 to 2016, coal mining and fossil fuel power plant employment has declined nationally by 35,064 jobs (40.4%) and 43,608 jobs (31.7%), respectively.[1] Ohio has experienced similar declines of 1,283 jobs (46.7%) and 1,469 jobs (28.6%), respectively, as shown in Figure 1.

The coal economy decline has disproportionally impacted the US's Appalachian region. In fact, Betz, Partridge, Farren, and Lobao (2015, p. 107) noted that the Appalachian coal economy has actually been facing decline as far back as 1998, as it has "different coal production technologies, a longer history of coal mining, and [a] historical economic deprivation" relative to other US coal regions. Appalachian metallurgical coal is also relatively expensive, hurting its competitiveness with coal from other US regions (Kearney, 2016). Other factors, such as increased environmental regulations (Dechezleprêtre & Sata, 2017) and declining costs of alternative energy generation resources (Barbose, Darghouth, & Lawrence Berkeley National Laboratory, 2016), have also hindered the coal industry. Consequently, Appalachia, and Ohio in particular, has been transitioning to cheaper natural gas for electricity generation, which now represents over one-third of the state's generation portfolio and has grown in market share by nearly 30% per year since 2000, while coal has declined by −9.5% over that same timeframe (U.S. Energy Information Administration, 2016). Taken as a whole, these factors have resulted in a decreased reliance on coal and stimulated the decommissioning of coal-fired power plants throughout the region.

As such, this study contributes to the literature on the Appalachian coal economy via an analysis of the economic, fiscal, and workforce impacts of two Dayton Power & Light (DP&L) coal-fired power plant closures in Adams County, Ohio. The study has three distinct purposes: (i) Economic Impact: The study reports the economic impact of these coal-fired power plant closures in terms of direct, indirect, and induced employment in the study region using (Impact Analysis for Planning) IMPLAN input–output modelling; (ii) fiscal impact: the study documents the considerable and unique fiscal impacts to Adams County and its local governments due to the tangible personal property (TPP) tax losses, which, as explained in the paper, are unique to public utilities. This is done most accurately through estimates provided by the county auditor as IMPLAN does not capture local tax losses with this accuracy or granularity; and (iii) workforce impacts: the study documents workforce impacts in terms of viability of retraining employees in comparable wage jobs.

Adams County is a rural county with a population of 27,726 located in Southern Ohio in the Appalachian region (U.S. Census Bureau, 2018). The Appalachian Regional Commission (ARC) (2018, para 6) designates Adams County as a distressed county under their classification system, noting that: "distressed counties are those that rank in the worst 10 percent of the nation's counties."

On 21 March 2018, AES Ohio Generation, LLC (DP&L's parent company) filed a Worker Adjustment and Retraining Notification Act (WARN) letter with the Ohio Department of Job and Family Services (2018). This WARN letter reported that 370 direct jobs would be lost due to the closure of the Killen Station (Manchester, Ohio) and J.M. Stuart Station (Aberdeen, Ohio) power plants, as well as the associated training centre in Manchester, Ohio, which are all located in Adams County (Ohio Department of Job and Family Services, 2018). Killen Station has been operational since 1982, whereas J.M. Stuart has been operational since 1969. Combined, they have capacity for 2,908 megawatts (MW) of coal-fired power generation.

Using detailed occupational data from the Utility Workers Union of America, Figure 2 presents the breakdown of employment in the Killen and Stuart power plants, by county. Adams County (Ohio), Mason County (Kentucky) and Brown County (Ohio) are the counties of residence for the majority of workers in the Killen and Stuart power plants, with 32.2%, 29.2%, and 15% of the workers, respectively. The remaining workers reside in neighbouring counties (Highland and Scioto in Ohio, as well as Backen, Fleming, and Lewis in Kentucky).

[1]The fossil fuel electric power generation industry includes establishments primarily operating electric power generation facilities powered with fossil fuels i.e. coal, oil, or gas (North American Industry Classification System, 2017).

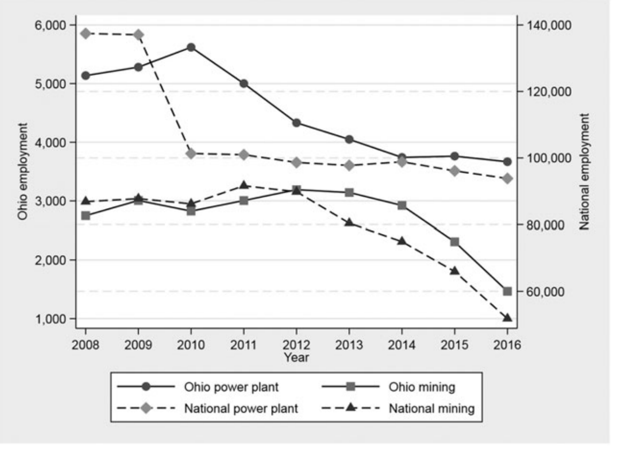

FIGURE 1 Coal Mining and Power Plant Employment, 2008–2016
Notes: Figure created by authors using data from the U.S. Energy Information Administration (EIA) (2017) and the Quarterly Census of Employment and Wages (Bureau of Labor Statistics, 2018). Mining employment refers to employment in coal mines and is available through EIA. Power plant employment refers to employment in the fossil fuel electric power generation industry (NAICS = 221112) and is available through Quarterly Census of Employment and Wages (QCEW).

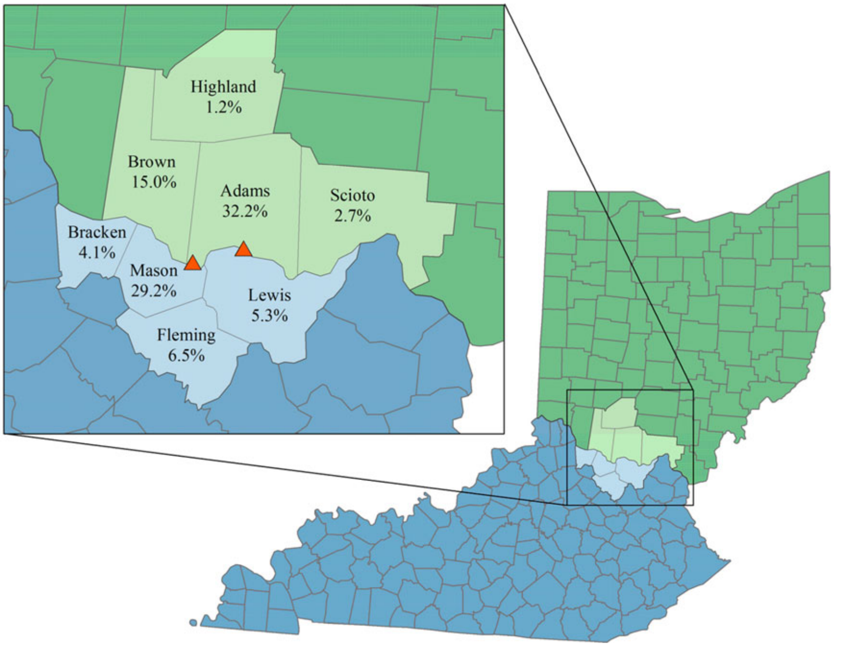

FIGURE 2 Killen & Stuart Employment by County of Residence
Notes: Figure created by authors using data from the Utility Workers Union of America. Counties of residence with less than 1% of total Union employment in Killen & Stuart power plants not included on map. The total number of union workers in Killen & Stuart power plants is 339. The WARN notice reported 370 jobs lost due to the closure of the Killen Station (Manchester, Ohio) and J.M. Stuart Station (Aberdeen, Ohio) power plants, as well as the associated training centre in Manchester, Ohio. The difference between the WARN numbers and the union numbers may be due to the number of employees working in the training centre or the numbers of non-union employees.

2 | ECONOMIC IMPACT

2.1 | Literature of economic impact of the coal economy

The economic and community impacts of coal mining have been thoroughly studied in the regional science and economic development literature (e.g., Betz et al., 2015; Black, McKinnish, & Sanders, 2005; Ivanova & Rolfe, 2011; Lobao, Zhou, Partridge, & Betz, 2016). Moreover, the academic literature on resource extraction on rural economies is also plentiful (e.g., Deaton & Niman, 2012; Deller, 2014; Deller & Schreiber, 2012; Douglas & Walker, 2017; Partridge, Betz, & Lobao, 2013), often showing job gains and environmental damages. Taken as a whole, most of these economic impact type studies related to coal mining have suggested positive energy generation metrics, as well as job benefits, often with multipliers in the 2.0–3.0 range. Nevertheless, the academic literature on the economic impacts of coal-fired power plants remains relatively less developed.

This underdeveloped suite of literature on coal-fired power plants and their relationship with economic development metrics, such as employment, remains mixed. For instance, most studies have indicated that coal-fired power plant impacts vary widely based on technology, size, and geographic location (Tegen, 2006; Tola & Pettinau, 2014). One study of interest found a positive relationship between mining, the existence of coal plants, and employment/income growth in Ohio and other rural counties in the eastern US (Deller, 2014). Another found that coal employment may have short-term employment benefits for Appalachian communities but appears to have negative long-term effects on comprehensive employment figures (Betz et al., 2015). While most research on this matter has shown positive impacts such as net job gains (Thompson, 2014), several other academic articles have noted how coal-based electricity generation may be unsustainable in the long run and, peripherally, contribute to emissions and pollutions damages (Guttikunda & Jawahar, 2014).

Measuring economic impacts using IMPLAN, and, more generally, input–output models, has been a common approach in the regional science and related literature. Input–output models refer to a set of quantitative designs or procedures that allow researchers to use direct effect inputs (e.g., projected job gains) and determine other, multiplier effects (e.g., indirect and induced jobs) via the output. These models can be useful tools in predicting how an economy will respond to an external or exogenous shock, such as a power plant closure (Deller, Sumathi, & Marcouiller, 1993). IMPLAN has been used in a wide variety of contexts, such as measuring the impact of recreational fishing (Steinback, 1999), tourism events (Brown, Var, & Lee, 2002; Chhabra, Sills, & Cubbage, 2003; Johnson, Obermiller, & Radtke, 1989; Strauss & Lord, 2001), industry closures (Burrows, Cheney, & Rahn, 2002), Supplemental Nutrition Assistance Program (SNAP) spending (Paynter, Jolley, & Nousaine, 2014), and pension benefits (Furdek & Lucas, 2017), among many others. IMPLAN utilization has been extended to measuring the effects or contribution of sectors and subsectors of the economy, such as health (Doeksen, Johnson, Biard-Holmes, & Schott, 1998), agriculture (Tanjuakio, Hastings, & Tytus, 1996), and forestry products (Aruna, Cubbage, Abt, & Redmond, 1997; Brandeis & Hodges, 2015; Michaud & Jolley, 2019).

Resource extraction and energy generation impacts are commonly studied using IMPLAN or another input–output model. For instance, Lester, Little, and Jolley (2015) utilized IMPLAN to examine the economic impact of alternative biomass uses by comparing biofuels, wood pellets, and electricity generation. Further, Bae and Dall'erba (2016) assessed the economic impact of a new solar energy plant comparing estimates generated by IMPLAN versus JEDI (Jobs and Economic Development Impact), a software developed by the U.S. National Renewable Energy Laboratory. They compared four models and found similar total job and output numbers with some deviations in labour income (Bae & Dall'erba, 2016). Jackson, Neto, and Erfanian (2018) used the social account matrices from IMPLAN to construct a regional input–output table to assess the economic impact of a woody biomass processing facility in Central Appalachia.

It is apparent that IMPLAN is broadly used in the academic literature to measure economic impacts. Of course, caution must be taken in applying IMPLAN as an economic assessment tool, as it has been frequently misused and misapplied leading to an overstatement of impact (Schlosser, Leatherman, & Peterson, 2008; Swenson, 2006).

2.2 | Economic impact results

This study estimated the direct, indirect, and induced employment, as well as labour income impact, of the Killen Station, Stuart Station, and training centre closures on the regional economy using IMPLAN version 3.1. A regional study area comprised of Adams, Brown, and Scioto Counties in Ohio, and Mason County in Kentucky was used, as these counties encompass the large majority of the employment laboürshed. Data on the number of employees subject to layoff were acquired from the letter AES Ohio Generation issued in accordance with the WARN notice, which reported that 370 direct, full-time jobs would be lost at these facilities. Using the 370 direct jobs as the input figure, the researchers ran an input–output model with these geographic bounds and without any modifications to the underlying structures of the data, such as through commodity value or local use ratio edits. An inherent limitation to this method is in how the built-in multiplier values represent industry linkages in a certain year/geography, but do not account for changes in behaviour that might result based on the exogenous shock specifically under investigation. Despite this, IMPLAN still provided the best tool for analysis given its highly specific geographic bounds and multi-region modelling capabilities, as well as the capacity for fiscal/tax impact analyses, an attribute not permitted by other modelling software such as RIMS II.

As shown in Table 1, the Killen and Stuart power plant closures, and the closure of the associated training facility in Manchester, Ohio, will lead to the direct loss of 370 jobs. These 370 jobs generated an estimated $56 million in employee compensation. An additional 760 full-time equivalent jobs will be lost in a variety of industries as an indirect consequence of the power plant closures. Exemplary ancillary industries affected in this regard include full and limited-service restaurants, hospitals, real estate, transportation services, and marketing and other employment services. In total, our models found that the closure of these facilities will result in 1,131 lost jobs, over $82 million in lost labour income, and a reduction in economic output of nearly 700 million dollars. A multiplier of 3.06 indicates that, for every job lost at the facilities, an additional 2.06 jobs are lost in the regional economy (in the indirect and induced effect categories).

3 | FISCAL IMPACTS

Much of the literature on closures focuses heavily on jobs lost, as outlined in subsection 2.2 of this study. However, scholars have also noted the need to focus on the downstream tax losses and wage reduction costs associated with lower wage reemployment (Cole, 1987). This section, and the following section on workforce impacts, address those impacts associated with the DP&L closures. The tax losses to Adams County and its local governments and schools are large in magnitude and percentage of tax base due to the State of Ohio's TPP tax laws.

In contrast to real property (e.g., real estate, land, buildings), tangible personal property is generally defined as property that can be physically relocated or moved, such as machinery, equipment, furniture, computers, etc., other than real estate. Taxing of personal property has been a historic source of local government tax revenue, but, as Mughan and Propheter (2017, p. 299) note, “its significance has waned over the past 60 years.” The TPP, in particular, has been targeted for elimination in an effort to make states move globally competitive (Mughan & Propheter, 2017).

TABLE 1 Summary of impact results based on WARN Report

Impact type	Employment	Labour income	Value added	Output
Direct effect	−370	-$56,008,657	-$269,519,825	-$608,363,072
Indirect effect	−423	-$15,326,387	-$23,918,932	-$52,335,275
Induced effect	−337	-$10,876,287	-$20,941,699	-$37,446,881
Total effect	−1,131	-$82,211,331	-$314,380,456	-$698,145,227
Multiplier	3.06	1.47	1.17	1.15

Starting in 2005, Ohio began gradual elimination of the TPP tax with the goal of enhancing employment and economic growth (Jolley, 2017; Mughan & Propheter, 2017). While this paper is not focused on the merits of TPP elimination at the state level, it is worth noting that models suggest the state has fewer manufacturing jobs, on average, as a result of eliminating the tax due to capital substitution for labour (Mughan & Propheter, 2017).

Electric utilities were unaffected by the changes to Ohio's TPP laws. This is important to Adams County and its local governments, as we note here, because these entities rely heavily on the "tangible" public utility personal property taxes levied on the DP&L facilities. As outlined by the Ohio Department of Taxation (2017, p. 120), "public utility personal property is the only personal property remaining subject to taxation in Ohio because of changes enacted by the Ohio General Assembly in 2005." As such, when the DP&L facilities close and cease producing power, they will no longer be subject to the TPP tax. The Adams County Auditor (2017) provided estimates on tax loss by source (Table 2), township/district (Table 3), and by decrease in tax revenue and total revenue (Table 4).

These tables note that Adams County and its local governments and school districts will lose a collective $8.5 million in tax revenue due to the closures. This represents a 32% decrease in the county's general fund and tax decreases ranging from 29 to 40% across other county service areas. Total revenue for the county general fund will decrease by 10%, and some service areas will see total revenue decline by larger percentages. The Manchester local school district is projected to lose $5.6 million in annual tax revenue, which accounts for about 50% of the district's revenue stream.

Our fiscal impact focuses on the TPP revenue loss given the unique structure and relevance of this tax source to electricity generation and the inability of the local governments (due to the state tax laws) to replenish this revenue in the absence of another electricity generation facility. There are additional, but less substantial, local income, sales, and real property tax losses associated with the job losses. IMPLAN does generate tax impacts, but these impact estimates are limited in that local and state impacts are aggregated. As Charney and Vest (2003, p. 29) document in their study of tax impact models, "Tax Impact Reports generated from IMPLAN have little or no use in conducting tax impacts." IMPLAN cannot calculate or capture the TPP loss impacts with the same accuracy or granularity as those provided by the Adams County Auditor.

4 | WORKFORCE IMPACTS

4.1 | What is a skillshed analysis?

Skillshed analysis was a concept first introduced by the Institute for Decision Making at the University of Northern Iowa in 1998 (Scott & Kotlyar, 2014). The goal of this type of analysis was to provide economic development groups with a better understanding of an area's labour force characteristics. Generally, the first step in this type of analysis is to geographically define a skillshed. Studies vary in how they establish skillshed boundaries. However, some common factors include population density, physical geography (e.g., rivers), and transportation infrastructure (e.g., roads and highways). Once a skillshed is defined, data are needed on a region's labour supply and demand.

TABLE 2 Source of tax loss in Adams County (2017)

Source	Amount in tax Loss (US$)
AEP Generation Resources	$2,017,104
Dayton Power & Light Company	5,198,383
Duke Energy	829,385
Dynegy	461,848
Total	8,506,720

TABLE 3 Tax loss by township or district in Adams County (2017)

Township/district	Amount in tax loss (US$)
County General Fund	$768,952
Adams Co developmental disabilities	308,950
Children services	388,761
Ambulance/EMS	394,329
Senior citizens	138,012
Library	197,164
Health department	98,580
Hope van	30,860
Monroe township	246,794
Sprigg township	159,743
Manchester local school district	5,661,482
Adams Co/Ohio Valley school district	108,165
Brush Creek township	215
Jefferson township	45
Liberty township	385
Meigs township	383
Scott township	1,044
Tiffin township	1,840
Wayne township	983
West Union village	33
Total	8,506,720

TABLE 4 Tax loss by public service in Adams County (2017)

Source	Amount in tax loss (US$)	Decrease in tax revenue (%)	Decrease in total estimate revenue (%)
County general fund	$768,952	32%	10%
Adams Co developmental disabilities	308,950	35	17
Children services	388,761	37	14.6
Ambulances	394,329	34	24
Senior citizens	138,012	33	31
Health district	98,580	29	18.5
Hope van	30,860	40	33

Reports aiming to examine the skills gap can be classified into two categories depending on their data source: survey-based data or publicly available data. The majority of skillshed analyses use data from a workforce survey and an employer survey. While survey data provides access to information at the skillshed level, which is otherwise not available in publicly available data, information collected from surveys are based on individual perception of the labour market. Sometimes in employer surveys, the individual filling out the survey may not have direct knowledge of the skillset needed on the job. The advantage of using publicly available data is in avoiding the significant costs of large-scale survey data collection and administration (Scott & Kotlyar, 2014). Regardless of data source, the goal of a skillshed analysis is to identify the top occupations that will drive regional economic growth and to determine into which of these emerging occupations the workforce can transition into with ease.

A typical skillshed analysis: (i) identifies occupations in which a region has a comparative advantage; (ii) determines if these occupations are exhibiting increasing or declining employment projections; and (iii) contrasts the current skillset of declining occupations with the skillset needed for emerging occupations. A shortage of skills can create challenges for local governments in the form of structural unemployment and slower regional growth. Economic development officials can benefit from skillshed analyses to develop initiatives and policies that ensure the workforce is prepared to fill emerging occupations.

For this paper, the researchers mapped occupations into skills to determine which skills overlap between struggling and emerging occupations, and which skills are lacking or need improving. The capacities and knowledge required to perform a job as well as work activities and job zones were derived from the Occupational Information Network (O*NET).[2] O*NET is a joint effort between the U.S. Department of Labor and the North Carolina Employment Security Commission. It provides a database of standardized and occupation-specific descriptions based on the Standard Occupational Classification (SOC) codes that help determine which factors are critical in the performance of an occupation.

O*NET classifies occupation in one of five job zones. A job zone is a group of occupations that are similar in terms of the education, experience and on-the-job training that people need to do the job. Job Zone 1 includes occupations that require little preparation. Job Zone 2 occupations usually require at a minimum a high school diploma, plus some vocational training or job-related coursework. The level of preparation required to perform a job increases by zone, up to Job Zone 5, where occupations require the most specialized knowledge. All O*NET job zones are included in this analysis. Previous skillshed analyses focus on job zones 3, 4, and 5 (Iowa Innovation Gateway, 2010; Nolan, Morrison, Kumar, Galloway, & Cordes, 2011). These occupations require more education and are higher paying so they can drive innovation. However, focusing only on these jobs excludes a significant portion of the available occupations in the Appalachian Ohio region.

Job zone was one of the variables used to calculate the dissimilarity index. In addition, we used 109 variables divided across three categories. A knowledge category was used, which includes any skill obtained through formal education, such as chemistry and biology. Each variable takes a value ranging from 0 to 7, indicating the level of proficiency required in that skill that is needed for a given occupation. A knowledge variable with a value equal to 5 implies that, for a given occupation, the individual needs a bachelor's degree level of knowledge of that skill. The second category is work activities which includes skills obtained while working on the job. The "controlling machines and processes," of the work activities variable includes a value that is equal to 5 for the "power plant operator" occupation, implying the need for a minimum of 2–4 years of training or experience on that skill for the job. The last category is the capacities category which includes basic and cross-functional skills like social perceptiveness or critical thinking.

In this skillshed analysis, O*NET data were used to calculate a dissimilarity measure. The dissimilarity measure used in this study is the squared Euclidean distance, or $\ell 2$ squared. The Euclidean squared distance measures the distance between an occupation X and an occupation Y in n-dimensional space with each dimension representing one of the 110 variables (i.e., proxies for skills). The distance between two occupations increase when the level of proficiency on skills or variables diverges for the two occupations.

Using 110 variables describing occupations' work activities, required capacities, knowledge levels, and job zone, the authors compared emerging occupations to struggling occupations by calculating the Euclidean squared distance between occupations. This effectively calculates the distance from different multidimensional points of emerging occupations to multidimensional points of struggling occupations.

[2]O*NET classifies occupational information in categories. This analysis uses information classified under three categories: work activities, knowledge, and skills. In the text, O*NET skills category is referred to as capacities to avoid confusion with our broader definition of skills used throughout the report.

Once a dissimilarity measure was calculated, Ward's agglomerative method (Ward, 1963) was used to cluster emerging and coal-dependent occupations into homogeneous groupings.[3] The goal of this analysis is to provide displaced coal-dependent workers with relatively easy transitions into emerging occupations. Therefore, we used Ward's clustering which is an agglomerative clustering algorithm that first merges very similar observations or occupations, similar defined in terms of short distance using the Euclidean squared distance, and then incrementally builds larger clusters out of smaller clusters. Two clusters are merged when the increase in their variance is the lowest compared to merging with any other cluster.

Emerging occupations were chosen by examining industry location quotients and employment projections. Industry location quotients are calculated as the concentration of employment in an industry in a region compared to the concentration of employment in that industry statewide for 2016, using data on employment from QCEW. Employment projections are 10-year employment estimates of future employment from the Ohio Department of Job and Family Services, Bureau of Labor Market Information. Classifying an occupation as emerging depends on it being nested in an industry with a regional location quotient higher than 1.1 or an industry classified as a regional economic driver by the region's Development Commission, as well as having positive labour employment projections.

Coal-dependent occupations were chosen by examining the occupations described in the Utility Workers Union of America data (specific to the DP&L power plants) and the industry-occupation matrices for coal mining and fossil fuel electric power generation industries.[4]

Clustering is a tool that detects patterns in data and groups observations with similar characteristics. Occupations were grouped into five clusters. In this paper, two illustrative examples of clusters are presented. The first cluster includes occupations requiring a high level of proficiency on the “computers and electronics” skill (4.4 on average) and the “administration and management” skill (4.1 on average). Occupations within this cluster are occupations that require an associate degree and 1–2 years of on the job training on average (job zone 3.7 on average). The second cluster includes occupations requiring a high level of proficiency on the ‘mechanical’ skill (4.6 on average). Occupations within this cluster are occupations that require a high school degree and months of on the job training on average (job zone 2.5 on average).[5]

4.2 | Skillshed analysis results

The focus of this skillshed analysis was the displaced coal-fired power plant workers in Adams County and the associated region following the closure of two coal-fired power plants. The coal-fired power plant occupations adversely affected in the region were identified and those occupations were translated into skills. Displaced coal-fired power plant occupations identified through the Utility Workers Union of America data are: bookkeeping, accounting, and auditing clerks; computer system analysts; control and valve installers and repairers, except mechanical door; industrial machinery mechanics; inspectors, testers, sorters, samplers, and weighers; Labourers and freight, stock, and material movers, hand; Machinist; maintenance and repair workers, general; mechanical drafters; power plant operators; purchasing agents, except wholesale, retails, and farm products. Additional fossil fuel electric power

[3]This work is a byproduct of a larger project (Appalachian Ohio Skillshed Analysis) that maps coal-dependent occupations into emerging occupations in the 32 Appalachian Ohio counties.

[4]The focus of this paper is the impacts of the power plant closures. Therefore, although in the larger project, 126 emerging occupations and 53 coal-dependent occupations were clustered into homogeneous groupings, only results pertinent to power plant workers are presented here.

[5]The other three clusters not presented in this paper are: (i) a cluster that includes occupations requiring a high level of proficiency on the “psychology” skill (5.1 on average), the “education and training” skill (4.6 on average), and the “medicine and dentistry” skill (3.5 on average). Occupations within this cluster are occupations that require a bachelor's degree on average (job zone 4.3 on average); (ii) a cluster that includes occupations requiring a high level of proficiency on the “clerical” skill (3.8 on average). Occupations within this cluster are occupations that require a high school degree and months of on the job training on average (job zone 2.8 on average); and (iii) a cluster that includes occupations requiring a high level of proficiency on the “customer and personal service” skill (3.2 on average). Occupations within this cluster are occupations that may require a high school degree and days of on the job training on average (job zone 1.7 on average).

generation occupations exhibiting below average employment growth were identified through the Bureau of Labor Statistics (BLS) industry-occupation matrix. Those occupations are: bill and account collectors; first-line supervisors of production and operating workers; chief executives; gas plant operators; computer programmers; helpers–production workers; electrical and electronics engineering technicians; hoist and winch operators; electrical and electronics repairers, powerhouse, substation, and relay; human resources assistants except payroll and timekeeping; electrical engineers; Industrial production managers; electrical power-line installers and repairers; meter readers, utilities; electro-mechanical technicians; petroleum engineers; electronics engineers, except computer; plant and system operators, all other; environmental engineering technicians; power distributors and dispatchers; excavating and loading machine and dragline operators; procurement clerks; executive secretaries and executive administrative assistants; stationary engineers and boiler operators; financial specialists, all other; and surveying and mapping technicians.

The skills of coal-fired power plant workers were compared to the skills required in occupations within regionally concentrated industries that are exhibiting above average openings. When select emerging occupations for which the required skillset is examined, occupations nested in growing industries with a regional location quotient above 1.1 are included. A location quotient above 1.1 implies regional specialization. Again, the location quotients measure the concentration of industry in the region compared to the concentration of the industry statewide. These are calculated by dividing the regional industry share of employment over the industry statewide share of employment. Industries that enjoy greater than average concentration within an area (i.e., location quotient above 1) benefit from a set of environmental and or economic characteristics making firms within these industries more competitive than similar firms located elsewhere (Baer & Brown, 2006).

The goal of this analysis is to provide displaced workers with possible occupations into which they can transition. However, given the desire to ensure that the occupations presented to the displaced workers were occupations with high demand for labour, the occupations into which declining occupations were mapped where restricted to those with above average openings. Searching for jobs within occupations with above average openings would increase the probability of the displaced worker finding a job. Alternatively, not making this restriction might mislead displaced workers into investing in skills that are not in high demand in the labour market.

In the skillshed to which Adams County belongs, defined as all counties under the purview of the Ohio Valley Regional Development Commission (OVRDC), emerging occupations included are the ones nested within the following industries: health care and social assistance, and construction. These two industries are growing regionally as concentrated industries with 1.2 and 1.1 location quotients, respectively, and 19% and 12% as projected employment growth rates, respectively.[6] Also included are occupations in traditional and emerging industry clusters that were designated by OVRDC as regional economic drivers due to their employment concentration factor, economic prosperity factor, and being export-oriented industries. The development commission designated target industries as the following: agriculture, forestry, fishing and hunting, health care and social assistance, manufacturing, and transportation and warehousing. Mapping the declining occupations into occupations within both growing regionally concentrated industries and industries designated regional economic drivers by OVRDC was executed conditional on the occupations exhibiting above average projected openings.[7]

Comparing the knowledge, capacities, work activities, and job zone of the coal-fired power plant workforce to those needed by growing regionally concentrated industries, we calculated an occupation dissimilarity measure. Employees impacted by coal-fired power plant closures, and the economic development practitioners helping them, can use the measure as a guide into which new career to transition, thus effectively decreasing their search costs. In this paper, colour-coded indicators (based on the dissimilarity measure) were provided to local economic

[6]Location quotient is the concentration of occupation in the region compared to the concentration of occupation statewide for 2016 and it is calculated using data on employment from the QCEW. The Ohio industry employment forecast is from the Ohio Department of Job and Family Services, Bureau of Labor Market Information.

[7]Projected openings are imputed using QCEW and the industry-occupation matrix.

		Helpers--production workers	Inspectors, testers, sorters, samplers, and weighers	Laborers and freight, stock, and material movers, hand	Meter readers, utilities	Control and valve installers and repairers, except mechanical door	Electrical and electronics engineering technicians	Electrical and electronics repairers, powerhouse, substation, and relay	Electrical power-line installers and repairers	Electro-mechanical technicians	Excavating and loading machine and dragline operators	Gas plant operators	Hoist and winch operators	Industrial machinery mechanics	Machinists	Maintenance and repair workers, general	Plant and system operators, all other	Power plant operators	Stationary engineers and boiler operators
		$13	$17	$12	$20	$31	$29	$34	$32	$26	$19	$33	$18	$23	$19	$18	$23	$33	$25
Automotive service technicians and mechanics	$17	$4	$0	$5	-$3	-$14	-$12	-$17	-$15	-$9	-$2	-$16	-$1	-$6	-$2	-$1	-$6	-$16	-$9
Bus and truck mechanics and diesel engine specialists	$21	$9	$4	$9	$1	-$10	-$8	-$13	-$11	-$5	$2	-$12	$3	-$1	$2	$3	-$2	-$12	-$4
Carpenters	$21	$8	$4	$9	$1	-$10	-$8	-$13	-$11	-$5	$2	-$12	$3	-$2	$2	$3	-$2	-$12	-$4
Computer-controlled machine tool operators, metal and plastic	$18	$5	$0	$6	-$2	-$14	-$11	-$16	-$15	-$8	-$2	-$15	-$1	-$5	-$1	$0	-$5	-$16	-$8
Construction laborers	$18	$5	$0	$6	-$3	-$14	-$11	-$16	-$15	-$9	-$2	-$15	-$1	-$5	-$1	$0	-$6	-$16	-$8
Electricians	$24	$11	$6	$12	$4	-$7	-$5	-$10	-$8	-$2	$4	-$9	$6	$1	$5	$6	$1	-$10	-$2
Heavy and tractor-trailer truck drivers	$20	$7	$2	$8	-$1	-$12	-$9	-$14	-$13	-$7	$0	-$13	$1	-$3	$1	$2	-$4	-$14	-$6
Operating engineers and other construction equipment operators	$23	$11	$6	$12	$3	-$8	-$5	-$10	-$9	-$3	$4	-$9	$5	$1	$4	$5	$0	-$10	-$2
Painters, construction and maintenance	$18	$5	$1	$6	-$2	-$13	-$11	-$16	-$14	-$8	-$2	-$15	$0	-$5	-$1	$0	-$5	-$16	-$8
Plumbers, pipefitters, and steamfitters	$25	$12	$8	$13	$5	-$6	-$4	-$9	-$7	-$1	$5	-$8	$7	$2	$6	$7	$2	-$9	-$1

FIGURE 3 Blue collar occupations into occupations requiring mechanical mkill

		Chief executives	Computer programmers	Computer systems analysts	Electrical engineers	Electronics engineers, except computer	Environmental engineering technicians	Financial specialists, all other	First-line supervisors of production and operating workers	Industrial production managers	Petroleum engineers	Power distributors and dispatchers	Purchasing agents, except wholesale, retail, and farm products	Surveying and mapping technicians	Mechanical drafters	Bill and account collectors	Bookkeeping, accounting, and auditing clerks	Executive secretaries and executive administrative assistants	Human resources assistants, except payroll and timekeeping	Procurement clerks
		$84	$33	$40	$37	$43	$28	$34	$27	$41	$53	$36	$29	$20	$24	$15	$17	$24	$18	$18
Accountants and auditors	$30	-$54	-$2	-$9	-$7	-$12	$3	-$3	$4	-$11	-$22	-$6	$1	$11	$7	$15	$13	$7	$13	$12
Computer and information systems managers	$57	-$27	$24	$17	$20	$14	$29	$23	$30	$16	$4	$21	$28	$37	$33	$41	$40	$33	$39	$38
Computer user support specialists	$21	-$64	-$12	-$19	-$16	-$22	-$7	-$13	-$6	-$20	-$32	-$15	-$9	$1	-$3	$5	$3	-$3	$3	$2
Cost estimators	$27	-$57	-$6	-$12	-$10	-$16	$0	-$7	$1	-$14	-$25	-$9	-$2	$7	$4	$12	$10	$4	$9	$9
Financial managers	$51	-$33	$18	$11	$14	$8	$24	$17	$24	$10	-$2	$15	$22	$31	$27	$36	$34	$28	$33	$33
First-line supervisors of construction trades and extraction workers	$29	-$55	-$4	-$11	-$8	-$14	$1	-$5	$2	-$12	-$24	-$7	-$1	$9	$5	$13	$12	$5	$11	$10
First-line supervisors of food preparation and serving workers	$14	-$70	-$19	-$26	-$23	-$29	-$14	-$20	-$13	-$27	-$39	-$22	-$15	-$6	-$10	-$1	-$3	-$10	-$4	-$5
First-line supervisors of mechanics, installers, and repairers	$29	-$55	-$4	-$11	-$8	-$14	$1	-$5	$2	-$12	-$24	-$7	$0	$9	$5	$14	$12	$5	$11	$10
First-line supervisors of office and administrative support workers	$24	-$60	-$9	-$16	-$13	-$19	-$4	-$10	-$3	-$17	-$29	-$12	-$6	$4	$0	$8	$7	$0	$6	$5
General and operations managers	$43	-$41	$10	$4	$6	$0	$16	$10	$17	$2	-$9	$7	$14	$23	$20	$28	$26	$20	$25	$25
Management analysts	$36	-$48	$3	-$4	-$1	-$7	$8	$2	$9	-$5	-$17	$0	$6	$16	$12	$20	$19	$12	$18	$17
Managers, all other	$45	-$39	$12	$5	$8	$2	$17	$11	$18	$4	-$8	$9	$16	$25	$21	$29	$28	$21	$27	$26
Market research analysts and marketing specialists	$29	-$56	-$4	-$11	-$9	-$14	$1	-$5	$2	-$12	-$24	-$7	-$1	$9	$5	$13	$11	$5	$11	$10
Medical and health services managers	$42	-$42	$9	$2	$5	-$1	$14	$8	$15	$1	-$11	$6	$13	$22	$18	$27	$25	$18	$24	$24
Sales representatives, services, all other	$24	-$61	-$9	-$16	-$14	-$19	-$4	-$10	-$3	-$17	-$29	-$13	-$6	$4	$0	$8	$6	$0	$6	$5
Software developers, applications	$41	-$43	$8	$1	$4	-$2	$13	$7	$14	$0	-$12	$5	$11	$21	$17	$25	$24	$17	$23	$22

FIGURE 4 White collar occupations into occupations requiring computer and electronics/administration and management skills

development and workforce development officials, illustrating the level of difficulty associated with a transition as well as wage differentials to better inform displaced worker's decision. In the figures, coal-fired power plant occupations are broken into two groups: blue-collar occupations and white-collar occupations.[8] Both Figures 3 and 4 have a column of power plant occupations (either blue-collar or white-collar), as well as a row of emerging occupations. Each figure presents a different cluster of emerging occupations.

In this paper, we use two illustrative examples of figures: (i) blue-collar occupations into occupations requiring mechanical skill; and (ii) white-collar occupations into occupations requiring computer and electronics/administration and management skills. The two figures were chosen because they illustrate the least

[8]White collar occupations encompass occupations within clusters requiring the following skills: computers and electronics or psychology/education and training/medicine and dentistry or clerical. Blue collar occupations encompass occupations within clusters requiring the following skills: customer and personal service or mechanical.

challenging transitions for these two types of power plant workers (blue-collar and white-collar). Least challenging transitions for the blue-collar workers are within the mechanical cluster, to which 14 out of 18 blue-collar occupations belong. Belonging to the same cluster implies a small multidimensional distance between occupations or the need for similar proficiency levels on the variables used to calculate the dissimilarity measure. The least challenging transitions for the white-collar workers are within the computer and electronics/administration and management cluster, to which 14 out of 19 white-collar occupations belong.

A red line around a grouping of declining occupations is used to denote that those occupations belong to the same cluster as the emerging occupations shown in the figure, that is, the transition would be less challenging because the occupations require the same skills. The median hourly wage rate for the coal-fired power plant occupation is noted for each occupation along with the median hourly wage rate for the transitioning occupation. The matrix contains the difference in hourly wage between each occupation, while the colour denotes the ease of transition. A green to light green colour indicates an easier transition, while an orange to red colour indicates that substantial retraining is required.

Figures 3 and 4 display the comparison for workers transitioning to occupations requiring mechanical skills and to those requiring computer, electronics, administration, and managerial skills. By providing a colour-coded indicator for

TABLE 5 Average change in pay and average distance to new occupation for blue-collar workers transitioning into occupations within the mechanical cluster

Occupations	Average wage change	Average distance
Helpers—production workers	$8	118
Inspectors, testers, sorters, samplers, and weighers	$3	120
Labourers and freight, stock, and material movers, hand	$9	154
Meter readers, utilities	$0	90
Control and valve installers and repairers, except mechanical door	-$11	72
Electrical and electronics engineering technicians	-$8	96
Electrical and electronics repairers, powerhouse, substation, and relay	-$13	102
Electrical power-line installers and repairers	-$12	126
Electro-mechanical technicians	-$6	108
Excavating and loading machine and dragline operators	$1	72
Gas plant operators	-$12	71
Hoist and winch operators	$2	102
Industrial machinery mechanics	-$2	91
Machinists	$2	70
Maintenance and repair workers, general	$3	78
Plant and system operators, all other	-$3	64
Power plant operators	-$13	84
Stationary engineers and boiler operators	-$5	84
Total average	-$3	95

Note: To benchmark the distance values, we provide the minimum, maximum, and average distance from our larger project (Appalachian Ohio Skillshed Analysis) mapping the skills of 53 coal-dependent occupations into 126 emerging occupations in the 32 Appalachian Ohio counties. The easiest observed transition is associated with a distance equal to 28 (Industrial machinery mechanics into Maintenance workers, machinery), the hardest transition is associated with a distance equal to 788 (Mine shuttle car operators into Management analysts), and the average transition is associated with a distance equal to 242.

the level of difficulty associated with an occupational transition and wage differentials, the occupational mapping guides the coal-fired power plant workforce into emerging occupations. On average, displaced workers can either transition into occupations that require no skill improvements or new skills but endure a pay cut. The alternative is to spend significant resources on improving skills and obtaining new ones to guarantee similar compensation to the coal-fired power plant occupations.

White-collar occupational transitions are the least challenging in the "computer and electronics/administration and management" cluster on average. Figure 4 makes it evident that these transitions will require acquisition and improvements of skills. Blue-collar power plant occupations are able to transition easier than white-collar occupations, that is, they do not have to acquire new skills. However, the easier transitions have associated pay cuts. On average, it appears that transitioning is easier for the blue-collar occupations in the mechanical cluster. However, only 19% of transitions are associated with a pay increase, and only by a couple dollars per hour, whereas transitioning is much more difficult for the white-collar occupations in the computer and electronics cluster, but 46% of transitions are associated with a pay increase. Tables 5 and 6 provide an aggregate snapshot of the challenges displaced workers face.

TABLE 6 Average change in pay and average distance to new occupation for white-collar workers transitioning into occupations within the computer and electronics/administration and management cluster

Occupations	Average wage change	Average distance
Chief executives	-$50	155
Computer programmers	$1	211
Computer systems analysts	-$6	122
Electrical engineers	-$3	170
Electronics engineers, except computer	-$9	188
Environmental engineering technicians	$6	209
Financial specialists, all other	$0	112
First-line supervisors of production and operating workers	$7	177
Industrial production managers	-$7	161
Petroleum engineers	-$19	170
Power distributors and dispatchers	-$2	167
Purchasing agents, except wholesale, retail, and farm products	$4	118
Surveying and mapping technicians	$14	192
Mechanical drafters	$10	238
Bill and account collectors	$18	234
Bookkeeping, accounting, and auditing clerks	$17	214
Executive secretaries and executive administrative assistants	$10	168
Human resources assistants, except payroll and timekeeping	$16	161
Procurement clerks	$15	167
Total average	$1	176

Note: To benchmark the distance values, we provide the minimum, maximum, and average distance from our larger project (Appalachian Ohio Skillshed Analysis) mapping the skills of 53 coal-dependent occupations into 126 emerging occupations in the 32 Appalachian Ohio counties. The easiest observed transition is associated with a distance equal to 28 (Industrial machinery mechanics into Maintenance workers, machinery), the hardest transition is associated with a distance equal to 788 (Mine shuttle car operators into Management analysts), and the average transition is associated with a distance equal to 242.

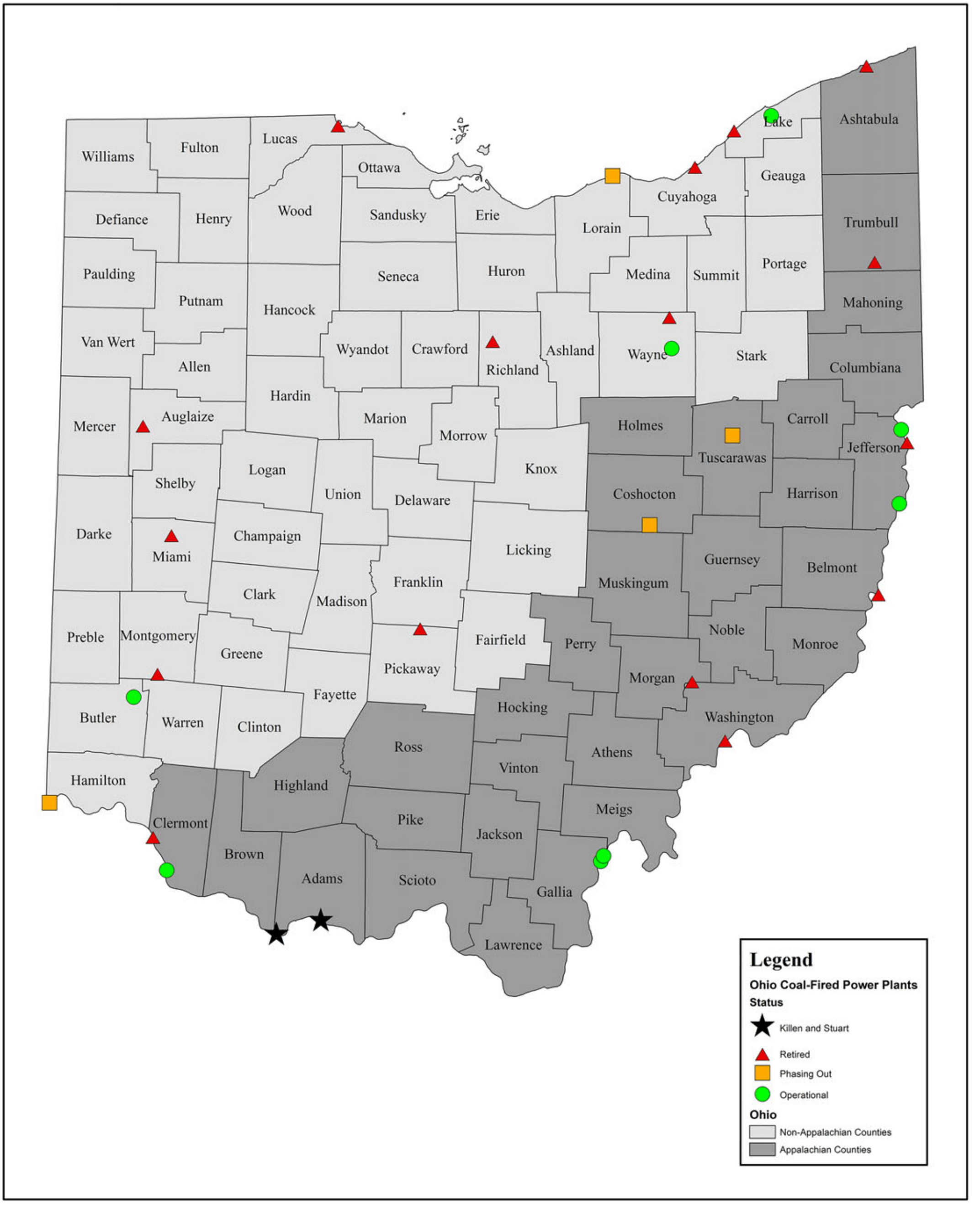

FIGURE 5 Ohio coal-fired power plants

Notes: Figure created by authors using data from the U.S. Energy Information Administration (2017). The focus of this map is power plants using conventional steam coal technology to produce electricity. The map does not include information on generators that retired prior to 2002 since EIA did not comprehensively gather data on closures prior to that year. A power plant is defined as retired if all generators are retired. A power plant is defined as operational if all generators are operational. A power plant is defined as phasing out if some of its generators are retired.

5 | CONCLUSIONS AND POLICY IMPLICATIONS

Prior studies have suggested that rural communities facing the loss of traditional industries, outmigration/depopulation, and sluggish regional economies have limited short-term options for economic renewal (Jolley, Nousaine, & Huang, 2012). While the concept of rural resilience is often ill-defined, subject to a dominate paradigm of resistance, or rebound from external shocks (Skerratt, 2013), studies of the Appalachian Ohio region have found that the area is often less fiscally resilient to shocks due to the limited economic base and inability to recoup lost tax revenue (Jolley, O'Donovan, & Sandler, 2018). This study supports the limited fiscal resilience of Appalachian communities to exogenous shocks, such as a major industry closure, especially when fiscal policies limit the ability to recoup lost taxes. The structural changes to Ohio's tax code and elimination of the TPP tax leave few, if any, options for the local governments to recoup the $8.5 million annual loss in tax revenue as a result of the closure.

In the case of the DP&L closures, workforce training for individuals who have been displaced may be a necessary strategy to re-introduce these workers into the labour market in other fields. Technical assistance and leadership from key regional partners and relevant economic development organizations is vital to help mitigate the impact of this negative economic shock on the region. Further, access to information emerges as one of the main challenges that Appalachian displaced workers face. Outside of workers within the "computer and electronics/administration and management" cluster, the coal reliant workforce has low digital literacy which would complicate both occupational transitions, as well as the search for job openings. Access to information in this study, or resources by the Department of Labor aiming to help in career transitions, is contingent on access to online sources and the ability to navigate the digital world.

Moreover, transportation to technical centres or community colleges where displaced workers can bridge their skills gaps has also been a challenge that complicates occupational transitions. Even if reemployment occurs, low-skilled workers will find difficulty in finding job opportunities with the same wage premium for their existing skillset. These findings suggest a multi-pronged recovery effort will be required to assist Adams County and the surrounding region with the economic, fiscal, and workforce impacts of the DP&L closures.

Policy implications also exist for other communities in Ohio and similar states where coal-fired power plants have been recently decommissioned or are scheduled to be decommissioned. While the energy transition to cleaner generation sources has many societal benefits, scholars have noted the negative impact on and vulnerabilities of "the political, economic and societal fabric of communities disproportionately reliant on incumbent energy sources" (Carley, Evans, Graff, & Konisky, 2018, p. 621). Appalachian Ohio, in particular, has been disproportionally impacted by the decommissioning and closure of aging coal-fired power plants. Since 2010, eight plants have closed representing 6.67 gigawatts of generation capacity, roughly one-third of the state's coal-based generation (see Figure 5). The average initial year of operation for these plants was 1965. To compare, the remaining operating coal-fired plants in Appalachian Ohio are aging with an average initial operating year of 1967. Two of the plants are schedule to be decommissioned or partially decommissioned by 2020 (U.S. Energy Information Administration, 2017). As the coal-fired power plants in Appalachian Ohio continue to age, there remians pressure to replace them with more profitable natural gas generation facilities and renewable energy generation sources, which will likely not be located in the same Appalachian Ohio communities. Thus, these Appalachian Ohio communities will face similar economic, fiscal, and workforce impacts as Adams County and the lessons identified here are generalizable to those communities.

6 | EPILOGUE

In response to the coal economy declines faced by Adams and surrounding counties in the 12-county OVRDC region, the U.S. Economic Development Administration (EDA) awarded $4.3 million in Assistance to Coal Communities funds to the OVRDC region in October of 2018. Shawnee State University, located in adjacent Scioto County, was awarded $2.7 million to complete the Kricker Innovation Hub to provide business incubation, entrepreneurship, and other support services. The authors of this study were awarded $1.6 million in funding for a two-year project to create and launch the Building Opportunities Beyond Coal Accelerating Transition (BOBCAT) Network. The BOBCAT Network focuses on accelerating the region's transition out of the coal economy via entrepreneurial growth, workforce development, cluster expansion, opportunity zone enhancement, and the identification of infrastructure investment needs. In Adams County, the BOBCAT Network will identify area nonprofits and spur the creation of new social ventures to address the service gaps created by the loss of the TPP revenue. An industrial/commercial park feasibility and financing plan will be developed for a publicly-owned parcel of land. Additionally, prospectus and entrepreneurial support plans will be created to assist the OVRDC region, including Adams County, in prioritizing and marketing the region's opportunity zones. The concerted federal effort to support these regional partnerships between local governments, regional councils, and universities demonstrates the collaborative efforts required to assist communities facing significant economic and fiscal loss in rural areas.

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APPENDIX

TABLE A1 Variables by category

Knowledge variables	Work activities variables	Capacities variables
Administration and management	Analysing data or information	Active learning
Biology	Assisting and caring for others	Active listening
Building and construction	Coaching and developing others	Complex problem solving
Chemistry	Communicating with persons outside organization	Coordination
Clerical	Communicating with supervisors, peers, or subordinates	Critical thinking
Communications and media	Controlling machines and processes	Equipment maintenance
Computers and electronics	Coordinating the work and activities of others	Equipment selection
Customer and personal service	Developing and building teams	Installation
Design	Developing objectives and strategies	Instructing
Economics and accounting	Documenting/recording information	Judgment and decision making
Education and training	Drafting, laying out, and specifying technical devices, parts, and equipment	Learning strategies
Engineering and technology	Establishing and maintaining interpersonal relationships	Management of financial resources
English language	Estimating the quantifiable characteristics of products, events, or information	Management of material resources
Fine arts	Evaluating information to determine compliance with standards	Management of personnel resources
Food production	Getting information	Mathematics (on the job)[a]
Foreign language	Guiding, girecting, and motivating subordinates	Monitoring
Geography	Handling and moving objects	Negotiation
History and archeology	Identifying objects, actions, and events	Operation and control
Law and government	Inspecting equipment, structures, or material	Operation monitoring
Mathematics	Interacting with computers	Operations analysis
Mechanical	Interpreting the meaning of information for others	Persuasion
Medicine and dentistry	Judging the qualities of things, services, or people	Programming
Personnel and human resources	Making decisions and solving problems	Quality control analysis
Philosophy and theology	Monitor processes, materials, or surroundings	Reading comprehension
Physics	Monitoring and controlling resources	Repairing
Production and processing	Operating vehicles, mechanized devices, or equipment	Science
Psychology	Organizing, planning, and prioritizing work	Service orientation

(Continues)

TABLE A1 (Continued)

Knowledge variables	Work activities variables	Capacities variables
Public safety and security	Performing administrative activities	Social perceptiveness
Sales and marketing	Performing for or working directly with the public	Speaking
Sociology and anthropology	Performing general physical activities	Systems analysis
Telecommunications	Processing information	Systems evaluation
Therapy and counselling	Provide consultation and advice to others	Technology design
Transportation	Repairing and maintaining electronic equipment	Time management
	Repairing and maintaining mechanical equipment	Troubleshooting
	Resolving conflicts and negotiating with others	Writing
	Scheduling work and activities	
	Selling or influencing others	
	Staffing organizational units	
	Thinking creatively	
	Training and teaching others	
	Updating and using relevant mnowledge	

[a]*Note*: Mathematics (on the job) is a different variable than mathematics included in the knowledge variables. This capacity variable is an indicator of mathematics knowledge not in a formal education setting but more in practical work setting, e.g. count the amount of change to be given to a customer or calculate the square footage of a new home under construction.

TABLE A2 Variables categories and their corresponding scale

	Variables type	Scale	Example
Knowledge variables	Continuous	0–7	● A value of 1 on the biology variable is equivalent to an individual having the ability to feed domestic animals. ● A value of 7 on the biology variable is equivalent to an individual having the ability to isolate and identify a new virus.
Work activities variables	Continuous	0–7	● A value of 2 on the "assisting and caring for others" variable is equivalent to an individual having the ability to help a coworker complete an assignment. ● A value of 6 on the "assisting and caring for others" variable is equivalent to an individual having the ability to care for seriously injured persons in an emergency room.
Capacities variables	Continuous	0–7	● A value of 2 on the "active listening" variable is equivalent to an individual having the ability to take a customer's order. ● A value of 6 on the "active listening" variable is equivalent to an individual having the ability to preside as judge in a complex legal disagreement.
Job zone	Categorical	1–5	

Note: Additional detailed information on the interpretation of scale value by variables can be found at https://www.onetcenter.org/dictionary/20.1/excel/level_scale_anchors.html.