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Economic Performance in US Fossil Fuel Communities

By **Dr. Noah Kaufman**, **Ariane Desrosiers**, and **Sarah Doctor**

December 2024

REPORT

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Noah received his BS in economics from Duke University, and his PhD and MS in economics from the University of Texas at Austin, where his dissertation examined optimal policy responses to climate change.

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Sarah Doctor is an MS Applied Analytics student at Columbia University. She has been working at the Center on Global Energy Policy with Noah Kaufman, analyzing the performance of fossil-fuel-dependent communities and federal spending in the United States. Prior to this, she spent two years working in research-based consulting at Edelman DXI. She holds a bachelor's degree in Economics from Mumbai University and a post-graduate diploma in Econometrics from the Meghnad Desai Academy for Economics, where her dissertation focused on the determinants of foreign aid for least-developed nations.

Executive Summary

Rapidly reducing greenhouse gas emissions from fossil fuels to address the severe threats of climate change requires economic transformations that pose challenges for regions heavily dependent on coal, oil, natural gas, or other carbon-intensive industries. The United States is the world's largest producer of oil and natural gas and the fourth-largest producer of coal, and communities across the country depend heavily on fossil fuel industries for jobs, investments, and public revenues that fund schools and other critical services. These communities will need considerable support to successfully navigate a global transition away from fossil fuels, and a better understanding of their local economies will help policymakers design and implement pragmatic support. However, scant evidence exists for such use today.

This report, part of the Resilient Energy Economies initiative co-led by the Center on Global Energy Policy at Columbia University SIPA, uses a novel dataset and case studies to establish a baseline of local economic performance in fossil fuel–dependent communities between 2004 and 2019. This period captures the peak and first decade of decline of the US coal industry as well as the shale revolution that boosted US oil and gas production.

The report finds:

- **Weak economic performance in coal communities.** In US counties with coal mines or coal power plants, gross domestic product (GDP) per capita and wages per capita grew slower than the national average and at a similar rate to small counties (populations less than 100,000) without fossil fuel infrastructure. Counties with coal mines also experienced relatively high levels of poverty and unemployment.

- **Signs of economic distress in communities with substantial declines in coal production, but not with large coal power plant closures.** Four of the five counties with the largest recent decline in coal production experienced sizable contractions of their economies. In some cases, this has led to restrictions of basic amenities for residents, such as school closings in Boone County, West Virginia. In contrast, the effects on economic outcomes of large coal power plant closures were unclear.

- **Strong economic performance in oil and natural gas communities.** Across US counties with wells or refineries associated with oil or natural gas production (but no coal infrastructure), GDP per capita and wages per capita grew faster than the national average.

- **The most carbon-intensive communities are booming.** GDP per capita in US counties in the top 10th percentile of most carbon-intensive jobs (using a metric that estimates the carbon dioxide emissions attributable to the supply chain of each industry) grew at more than twice the rate of the national average, while wages per capita grew nearly twice as fast.
- **More diversified economies have been less vulnerable to fossil fuel declines.** The data show a strong positive correlation between economic diversity and the ability of local economies to better weather the decline of fossil fuel industries. For communities with the largest reductions in coal production, wages and GDP outcomes were worse in counties with less economic diversity.

While economic outcomes vary widely across regions, the analysis in this report indicates that, absent policy support, fossil fuel–dependent communities that fail to diversify their local economies face acute risks from the clean energy transition. The results of this report can contribute to forthcoming research assessing the effectiveness of government support for fossil fuel–dependent communities, which should enable improved policymaking going forward.

Introduction

All major countries have agreed to transition away from fossil fuels to address the severe threats of climate change. This transition raises concerns about economic struggles for communities dependent on fossil fuel industries. If the departure of major employers has caused prolonged economic strife to local economies in the past, will a transition to a clean energy economy lead to economic distress in communities that heavily depend on fossil fuels or carbon-intensive industries? Can policymakers take actions to mitigate those risks? Answering these questions requires a better understanding of these local economies and how they respond to changes in the demand for fossil fuels.

This report analyzes the local economic performance of fossil fuel–dependent communities across the United States in recent decades. Case studies are used to examine the economic performance in US counties with the largest declines of coal production and large retirements of coal-fired power plants. They show signs of economic distress in the coal mine communities, but the effects on economic outcomes of the large coal power plant closures were unclear.

Then, a novel dataset is developed to analyze economic performance across different categories of fossil fuel–dependent counties around the country. The domestic coal industry declined during our analysis period, while the oil and gas industry grew, and the economic performance of communities that depend on these industries generally followed suit. More diverse local economies appear better able to weather the decline of fossil fuel industries.

Background and Literature Review

Concerns about communities experiencing persistent economic distress are not unique to the effects of the energy transition. About one-third of US counties with unemployment rates above 8 percent in 2019 also had unemployment rates in the worst quartile of US counties in 1980, 1990, 2000, and 2010. Europe has experienced similar challenges with persistently struggling labor markets (Council of Economic Advisors 2022; Kline and Moretti 2013).

A long literature in economics analyzes regions that have experienced booms and busts in natural resource extraction. Local economic effects are complex and multifaceted, but in general, resource booms provide local economic benefits while the subsequent busts cause economic harms (Black et al. 2005; Allcott and Keniston 2015; Autor et al. 2021). A lack of economic diversity may make local economies that specialize in the extraction of particular resources more vulnerable to economic shocks (Michaels 2011).

While there have been efforts to support economically distressed regions of the United States—perhaps most notably with the creation of the Appalachian Regional Commission in the 1960s—US policymakers have mostly shied away from large-scale commitments to local-level economic development. Until recently, the conventional wisdom among economists was to avoid targeting struggling places, instead preferring policies that target struggling people wherever they live (Busso et al. 2013; Bailey et al. 2015). Traditional spatial economic models suggested that regional disparities may naturally decline as people relocate to more productive regions and as firms invest where input costs are low (Glaeser 2007).[1]

In contrast to these model results, the empirical evidence suggests that the loss of dominant industries has led to prolonged periods of economic distress for communities across the United States. In the early 2000s, economic competition from China led to economic struggles in manufacturing-dependent US communities that have lasted for decades (Autor et al. 2021). Persistently distressed local economies experience more unemployment, poverty, addiction, disease, and crime (Case and Deaton 2020).

The importance of "just, orderly, and equitable" transitions for fossil fuel communities has long been recognized in the climate policy community and was codified at last year's Conference of the Parties in Dubai (United Nations Framework Convention on Climate Change 2023). Absent credible economic strategies, fossil fuel–dependent regions may continue to oppose policies that encourage the transition away from fossil fuels, thus making ambitious climate change goals more difficult to achieve.

Conventional wisdom on the need for place-based policies is changing among economists and policymakers alike. Instead of focusing on the limitations of place-based policies, the recent economics literature highlights justifications for such policies, including the pursuit of distributional goals (Fajgelbaum and Gaubert 2020), insurance against location-specific economic shocks (Neumark and Simpson 2014), differences in the provision of public goods across localities (Bartik 2020), and the desire to collocate similar firms in geographic regions (referred to as "agglomeration effects") (Kline 2010).

In recent years, President Biden's administration and the US Congress have put place-based investments in struggling communities at the center of their economic agenda. Congress has passed numerous large spending bills, each with place-based policy elements, including funding targeted at fossil fuel–dependent communities (see the concluding section for further details). Some state governments have also taken steps to help build economic resilience in fossil fuel–dependent communities, including Colorado, Illinois, New Mexico, and California (Clarke et al. 2024).

These measures may be insufficient for various reasons. They focus disproportionately on struggling coal-dependent communities, rather than on communities dependent on oil, natural gas, or carbon-intensive products. They also focus disproportionately on deploying clean energy, rather than on promoting more holistic economic development strategies.[2] The existence of funding also does not mean that communities will have the capacity or desire to take advantage of the opportunities provided by the programs (Clarke et al. 2024).

Another important concern with existing measures to support fossil fuel communities is that they typically have not been designed based on a rigorous examination of which strategies work well, and which do not. The age of large-scale support for fossil fuel–dependent communities is in its infancy, and the challenges associated with a global transformation to clean energy are unprecedented, so policymakers can rarely look to history to provide clear analogues for guidance.

An enormous opportunity exists for scholars to study the effectiveness of programs currently being implemented to support fossil fuel–dependent communities. Rigorous policy evaluations should enable policymakers to improve place-based policies targeted at these communities over time. Such policy assessments may proceed in three broad steps:

- Step 1: develop a baseline that provides information about the economic performance across fossil fuel–dependent communities in the absence of the recent policy measures being assessed.
- Step 2: gather information to characterize the policies being implemented to support fossil fuel–dependent communities, such as program structures and funding levels.

- Step 3: analyze how the policy measures are affecting the economic performance in fossil fuel–dependent communities.

At the time of this writing, federal and subnational governments are in the early stages of implementing recent policy measures. It is therefore premature to attempt to characterize this support or to assess its effectiveness (steps 2 and 3). Even when better data is available, isolating the effects of policy measures from myriad other factors affecting local economic outcomes will be a considerable challenge.

This paper, therefore, focuses on step 1: assessing the economic performance across US fossil fuel–dependent communities before recent measures were employed.

Methodology

This paper's analysis is conducted at the US county level. The challenges to fossil fuel–dependent communities often manifest as fiscal problems to local governments, including county-level governments that provide funding for schools and other public services. The downside of using county-level data—as opposed to geographic regions that characterize local labor markets, like commuting zones—is that the boundaries of local economies and counties differ.

We use five metrics to capture county-level economic performance, with data from the US Bureau of Labor Statistics, the Bureau of Economic Analysis, and the US Census Bureau. Gross domestic product (GDP) per capita, personal income, and wages per capita provide indications of overall economic activity and income within the county, including for workers specifically; unemployment rates and poverty rates provide indications of economic distress for populations.

The Hachman Index is a commonly used metric of economic diversity within a region. It measures the mix of industries in a particular region compared to a reference region, with a higher index value indicating greater diversity (an index value of one indicates the region has the same employment structure as the reference region, while a value of zero indicates a fully concentrated economy). A dataset from Noor and Erickson (2023) provides Hachman Index values for all US counties, with the United States as the reference region, using average data from 2003 to 2017, which should provide a useful (albeit imperfect) indication of economic diversity across counties during our analysis period.

We focus on data for the years between 2004 and 2019 because this 15-year period captures the peak and first decade of the decline of the US coal industry, as well as the shale revolution that boosted US oil and gas production starting in the late 2000s. The data currently available beyond 2019 (only to 2021 from some county-level sources) are affected by the COVID-19 pandemic and recovery, so are not included.

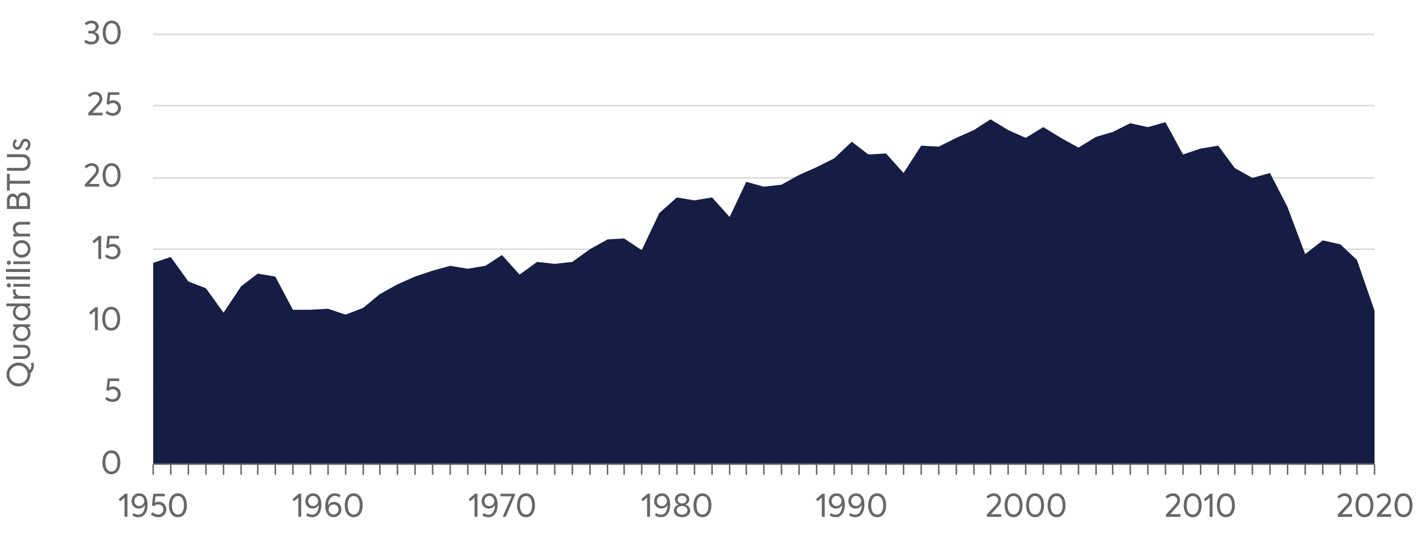
Case Studies of US Counties during a Period of Coal Decline

US coal production is geographically concentrated, with 25 counties accounting for over three-quarters of total production (Energy Information Administration 2022a). In many of these communities, the coal industry is an important contributor to jobs and public revenues.

Employment in the US coal-mining industry has been declining since the middle of the 20th century due largely to productivity improvements that meant fewer jobs were needed to produce each ton of coal. In the late 20th century, regulatory changes caused a shift toward coal production in the western part of the country, exacerbating economic challenges in coal-producing communities in the East (Kolstad 2000).

Still, coal production continued to increase in the United States until 2009 (see Figure 1). In the decade following 2009, US coal production and use declined by nearly 50 percent (Energy Information Administration 2022b) due to cheap and abundant natural gas, along with a host of additional factors such as environmental regulations and advocacy efforts (Jackson et al. 2018; Coglianese et al. 2020). The large declines in US coal production provide an opportunity to better understand how coal-dependent local economies were affected by declines in the coal industry.

Figure 1: Annual US coal production



Source: EIA (2021).

We begin by identifying the counties with the largest declines in coal production in the decade following coal's peak in 2009. The top five counties are listed in Table 1, along with other metrics characterizing these counties and their economies in 2019. For comparison, the same metrics are provided at the national level and for "small" US counties without fossil fuel infrastructure, where "small" is defined as counties with populations less than 100,000.

Figure 2 shows how the four metrics of economic performance changed between 2004 and 2019 for each of the counties. Economic performance was poor over the decade of declining coal production: GDP per capita and wages per capita declined while the national economy grew. Except for Campbell County, Wyoming, unemployment and poverty rates were relatively high in 2019.

In Campbell County, coal production declined by over 100 million tons per year, far more than any other county. However, Campbell County is by far the nation's largest coal-producing county—responsible for about one-third of total production—so even the large decline in coal production over this decade accounted for less than one-third of total county production. The percentage declines in the other four counties in Table 1 are over two times larger.

The second-, third-, and fourth-largest county declines were in one region: southern West Virginia and eastern Kentucky. In this coal-producing region, after over a century of coal mining, the remaining coal tends to be deeper in the ground and the coal seams tend to be thinner, making coal production more expensive compared to production in other parts of the country (Jackson et al. 2018). Coal production is also more labor intensive here than in the western United States, so the industry's coal decline in the east will affect more workers.

For decades, poverty has plagued the central Appalachian region (Hall Blanco 2021). Nevertheless, in the early 2000s, wages per capita in the coal-dependent counties listed in Figure 2 exceeded averages for the country as a whole and for small counties, many of which do not have an engine of economic activity that coal provided.

The degree of dependence on coal in Boone County, West Virginia, makes it an extreme case and cautionary tale. Historical economic development in Boone can largely be attributed to the coal industry, which dates to the 19th century and expanded with railroads in the early 20th century (Department of the Interior 2017). Over the period from 1969 to 2009, over half of all jobs in Boone were in mining industries, which does not account for the jobs indirectly reliant on mining (O'Leary and Boettner 2011). Boone is the least economically diverse county in West Virginia and in the bottom first percentile of economic diversity for all US counties (Noor and Erickson 2023).

Table 1: Top 5 US counties by coal production decline, 2009–2019

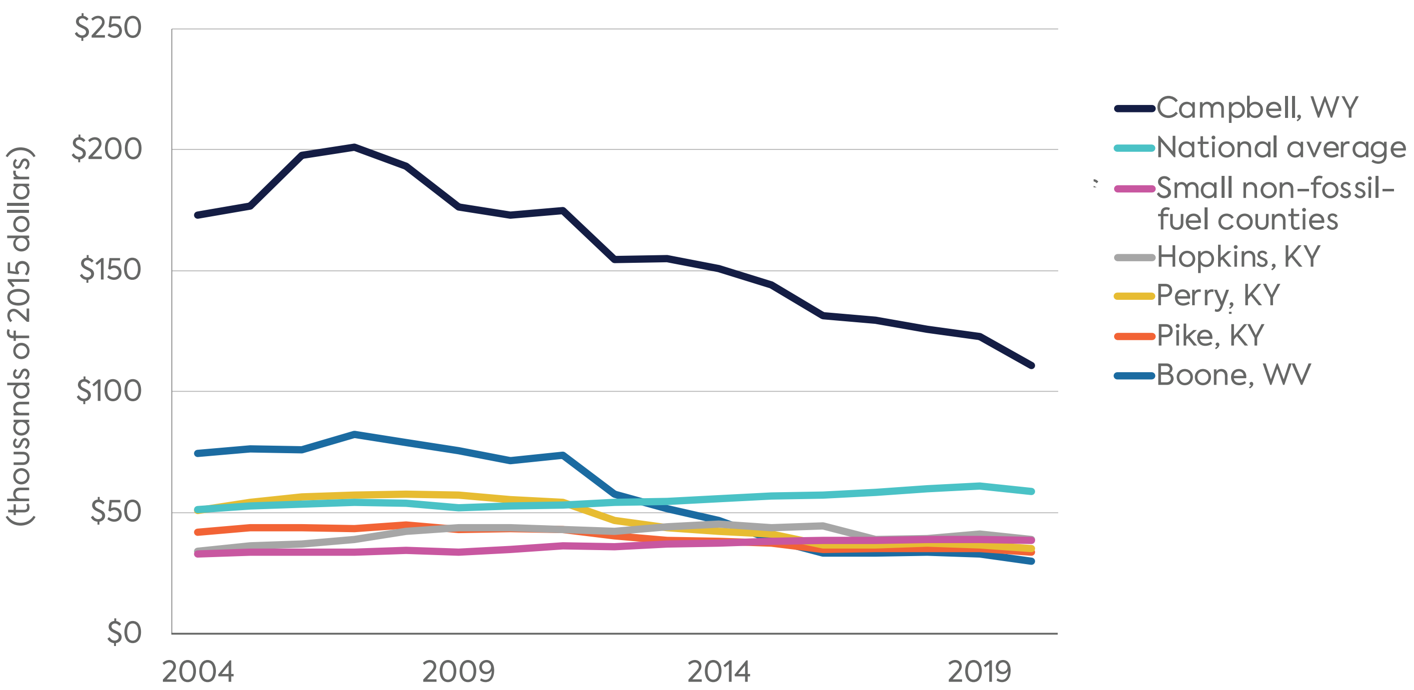
County	Population (2019)	Decline in annual coal production (2009 to 2019)	Relative decline in coal production (2009 to 2019)	GDP per capita ($) (2019)	Wages per capita ($) (2019)	Unemployment rate (2019)	Poverty rate (2019)	Economic diversification (Hachman Index)
Campbell, WY	46,420	139,386,260	36.4%	122.8	30,173	3.8	7.7	0.10
Boone, WV	21,352	21,611,429	83.5%	32.8	9,086	5.5	18.9	0.06
Pike, KY	57,919	12,926,069	82.5%	35.0	14,557	5.5	24	0.27
Perry, KY	25,801	12,544,085	81.2%	36.5	16,319	5.7	24.2	0.22
Hopkins, KY	44,660	11,168,828	75.3%	41.1	15,075	4.4	18.1	0.74
National average	105,147	-	-	60.9	15,126	3.7	12.3	-
Small non-fossil-fuel counties	25,677	-	-	38.8	12,368	3.9	14.7	-

Note: All dollar values are in real 2015 dollars. The economic diversity metrics are Hachman Index values averaged between 2003 and 2017, per Noor and Erickson (2023).

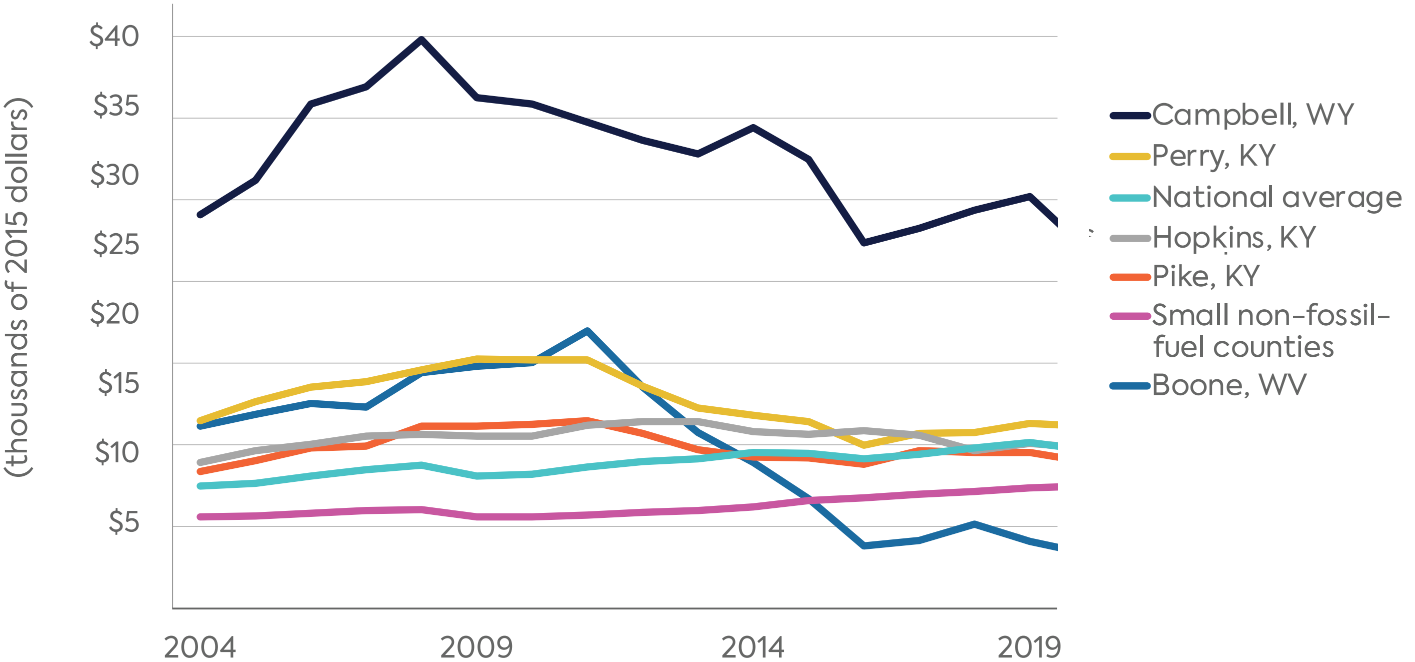
Source: See Table A1: Energy Information Administration (2022), St. Louis Federal Reserve (2023), Bureau of Economic Analysis (2023a, 2023b), Bureau of Labor Statistics (2023a, 2023b), United States Census Bureau (2024), Noor and Erickson (2023).

Figure 2: Trends in economic performance in US counties with the largest coal production declines

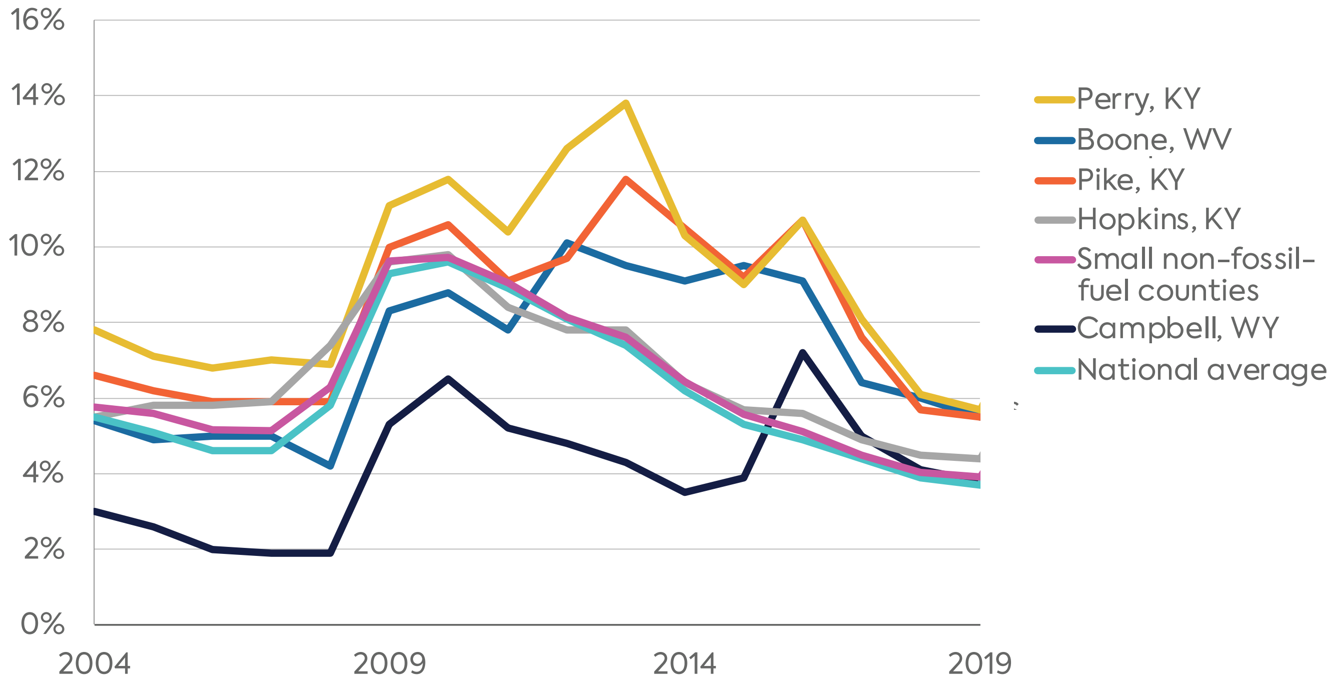
GDP per capita



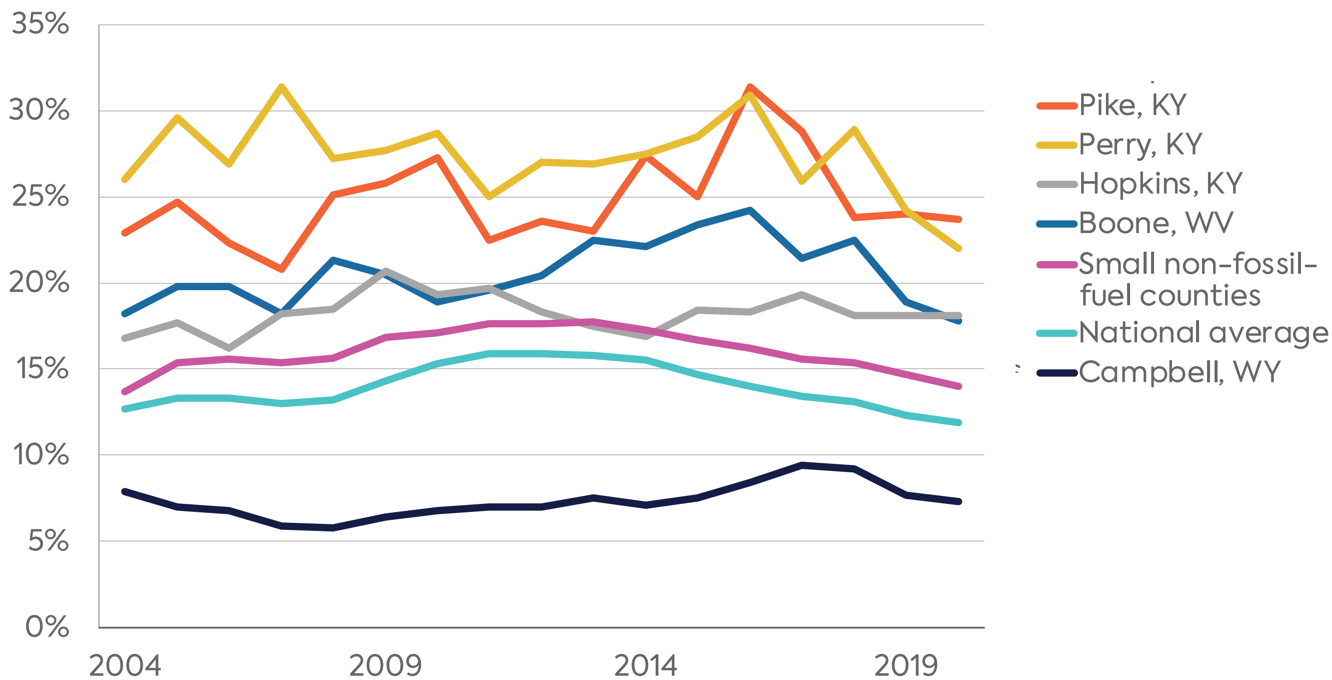
Wages per capita



Unemployment rate



Poverty rate



Note: Each legend is ordered to match the highest to lowest number in 2019.
Source: See Table A1: St. Louis Federal Reserve (2023), Bureau of Economic Analysis (2023a, 2023b), Bureau of Labor Statistics (2023a, 2023b), United States Census Bureau (2024).

Boone's coal production declined by over 80 percent between 2009 and 2019 (Energy Information Administration 2024). Coal-mining jobs in the county declined from 4,000 in 2009 to 600 in 2017. As shown in Figure 2, GDP and wages per capita fell sharply in Boone over this period, while unemployment and poverty rates rose. Local governments in Boone cut back on critical public services like trash collection and schools: three of the county's 10 elementary schools closed due to budget cuts and declining enrollment (Maher and Frosch 2015).

A political realignment also occurred in Boone while coal production declined. Boone had voted for the Democratic Party candidate for US president in every election since 1972. But President Barack Obama's vote share in Boone fell from 54 percent in 2008 to 33 percent in 2012, and Hillary Clinton received just 21 percent of the vote in the 2016 presidential election (West Virginia Secretary of State 2008; West Virginia Secretary of State 2012; Politico 2016). The decline in coal production therefore corresponded with a large shift in support away from the political party that is more supportive of policies to accelerate the transition to clean energy.

Perry County, Kentucky, also experienced a dramatic decline in coal production: over 80% between 2009 and 2019. Perry has long struggled with relatively high poverty rates and poor health outcomes (Adkins 2016). In 2013, Perry ranked third to last in life expectancy of all US counties (Institute for Health Metrics and Evaluation 2015).

The decline in coal is evident in Perry's countywide economic metrics, with GDP and wages per capita declining over the period. The county's poverty rate also increased in the mid-2010s, while it declined on average throughout the country. Perry is categorized as a county in economic distress by the Kentucky government (Appalachian Regional Commission 2022).

The data show clear and large economic declines in nearby Pike County as well. Economic diversity in Perry and Pike Counties is low, albeit considerably higher than in Boone (recall that a Hachman Index value of zero indicates a fully concentrated economy, while a score of one indicates economic diversity levels equivalent to the country as a whole). Perry includes the town of Hazard, Kentucky, and its regional medical center and related health care industry employment.

Of the counties with the largest coal production declines, Hopkins County in Kentucky appeared to weather the decline best. Unlike Perry and Pike, Hopkins is in the western part of Kentucky, outside of the Appalachian Basin. Economic diversity in Hopkins is much larger than in the other four counties, with health care industries and various manufacturing facilities contributing substantial economic activity to the local economy (JobsEQ 2022). Still, GDP and wages per capita declined over the decade, and poverty rates were far higher than a typical small US county, which underscores the challenges faced by any coal-dependent county when a source of considerable local economic activity declines.

What About Counties with Coal-Fired Power Plant Retirements?

Next, we turn to the question of how local economies have fared following the retirement of large coal-fired power plants. Like coal mines, coal power plants directly and indirectly contribute to local economic activity.

During the decade following the US coal industry's peak in 2009, 473 coal-fired electricity generators retired, accounting for 80 gigawatts of capacity and representing nearly one-third of the US coal fleet (Davis et al. 2022). Table 2 highlights US counties with the five largest coal plant retirements during the decade, using the same metrics as in Table 1 and Figure 2.[3]

Figure 3 shows the economic performance in these counties from 2004 to 2019, noting for each the year in which the coal plant retired. Perhaps with the exception of GDP per capita, it is difficult to discern an effect of coal plant retirements on countywide economic outcomes. Poverty and unemployment rates were relatively high in these counties, but the trend lines resemble small counties nationwide. In Greene and Putnam Counties, retirements of power plants may have been one symptom of broader economic struggles. Greene is also a coal-mining county (none of the other counties in Table 2 have coal mines), and between 2009 and 2019, coal production in the county declined by nearly 20 percent.

Retirements of large coal plants may influence local economic outcomes less than coal mine closures for various reasons. First, large power plants are often located where there is considerable economic activity nearby, which means more employment opportunities. Indeed, economic diversity in the coal plant counties shown in Table 2 is markedly higher than in the coal mine counties shown in Table 1. The one exception, with very low economic diversity, is Greene County, Pennsylvania, which is a coal-mining county as well.

In addition, power plant employees are often transferred to other facilities owned by the same utility when plants shut down. For example, when the Harllee Branch Generating Plant in Putnam County, Georgia, retired, the plant's 480 workers were either relocated or given early retirement. Putnam County officials worried about the lost economic activity and tax revenue, given that the power plant accounted for about 14 percent of county property tax revenue (Israel 2013), but the trends in economic performance in Putnam (or neighboring Baldwin County) do not display notable changes following the retirements.

Table 2: Top 5 US counties with the largest coal power plant retirements, 2009–2019

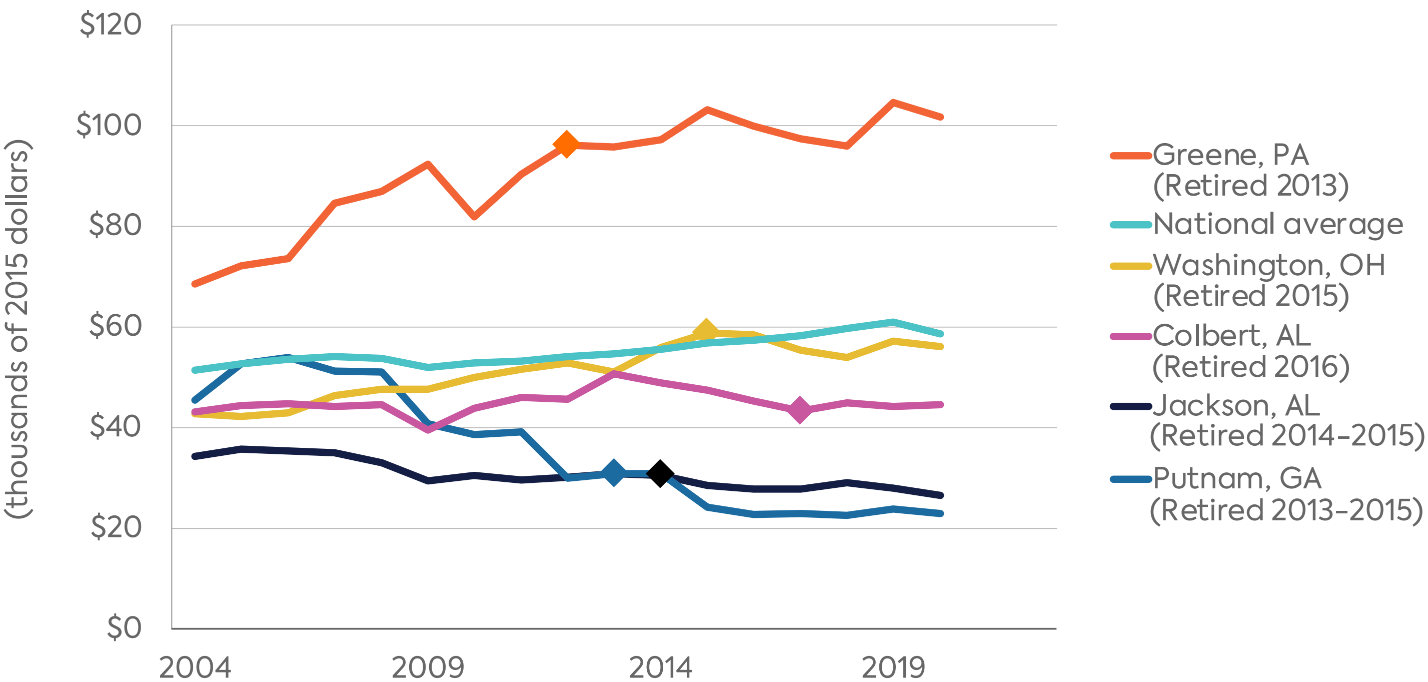
County	Population (2019)	Coal plant name	Retire-ment year(s)	Plant capacity (mega-watts)	GDP per capita ($) (2019)	Wages per capita ($) (2019)	Poverty rate (2019)	Unem-ployment rate (2019)	Economic diversification (Hachman Index)
Jackson, AL	51,672	Widows Creek Fossil Plant	2014-2015	1,968.6	27.9	10,469	14.7	3.5	0.58
Putnam, GA	22,083	Harllee Branch Generating Plant	2013-2015	1,746.2	23.7	8,364	15.1	4.5	0.74
Greene, PA	36,062	Hatfields Ferry power station	2013	1,728.0	104.5	19,215	14.2	5.1	0.16
Washington, OH	60,018	Muskingum River Plant	2015	1,529.4	57.2	19,102	11.0	5.4	0.75
Colbert, AL	55,241	Colbert Fossil Plant	2016	1,350.0	44.3	18,507	14.6	4.0	0.80
National average	105,147	-	-	-	60.9	15,126	12.3	3.7	-

Note: Two plants (Widows Creek and Muskingum) were shut down after the parent company lost a lawsuit regarding the plant's carbon emissions. Another two plants (Harllee and Hatfields) closed following the EPA's Mercury and Air Toxics Standards (MATS) regulations in 2013, which would have required expensive upgrades to the plants that the parent companies deemed 'uneconomical.' All dollar values are in real 2015 dollars. The economic diversity metric are Hachman Index values averaged between 2003 and 2017, per Noor and Erickson (2023).

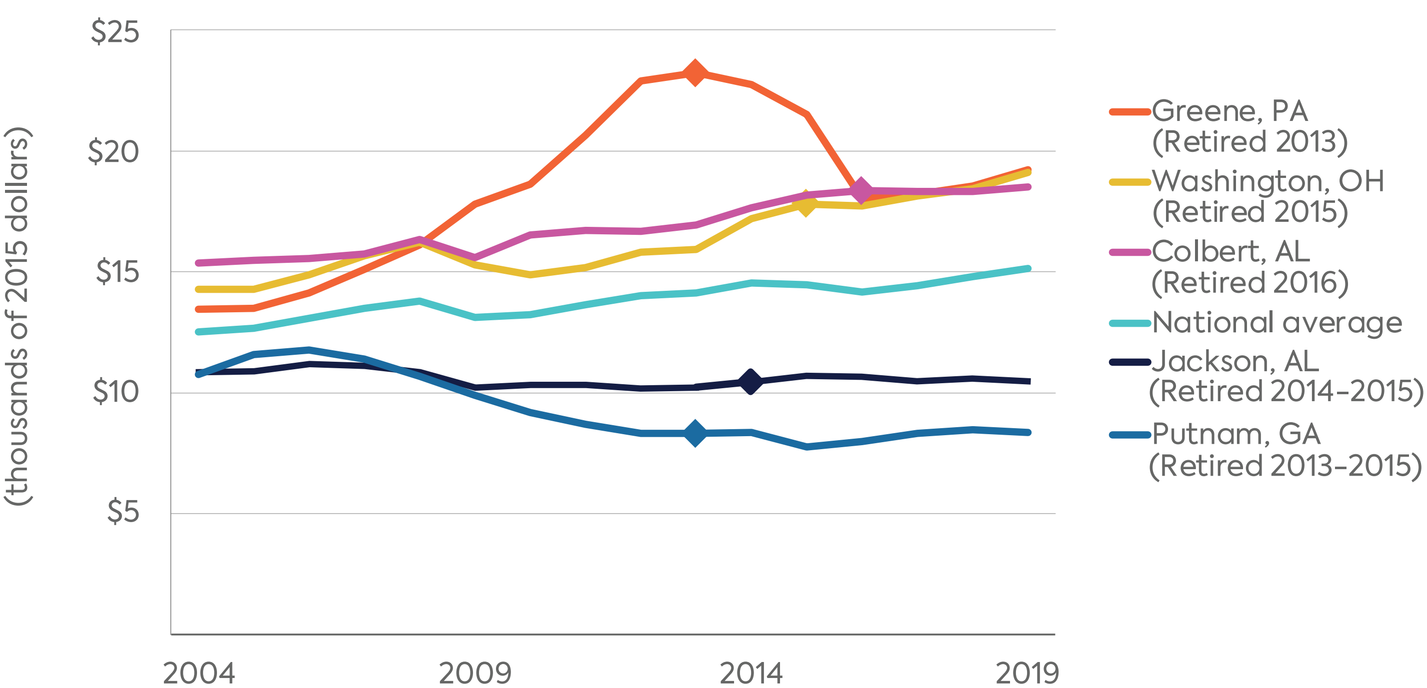
Source: See Table A1: Bureau of Economic Analysis (2023c), Bureau of Labor Statistics (2023a, 2023b), Noor and Erickson (2023); Global Energy Monitor (2024).

Figure 3: Trends in economic performance in US counties with the largest coal power plant retirements, 2004–2019

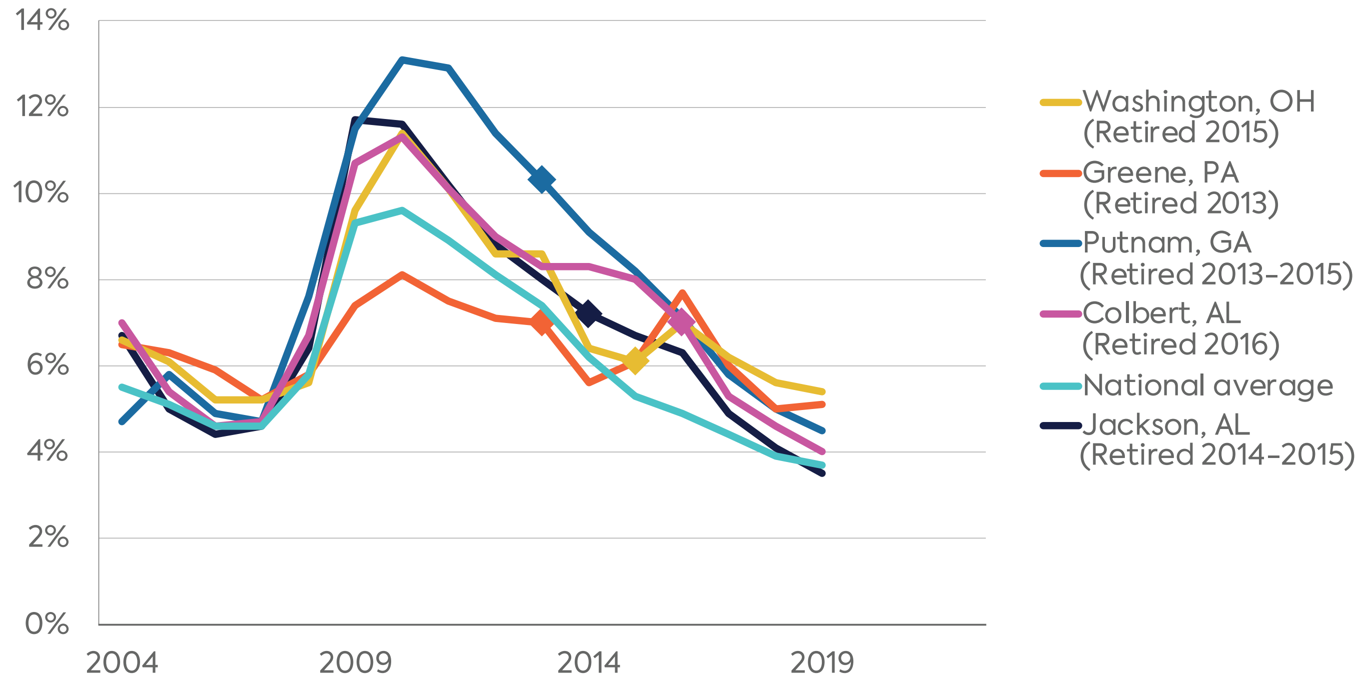
GDP per capita



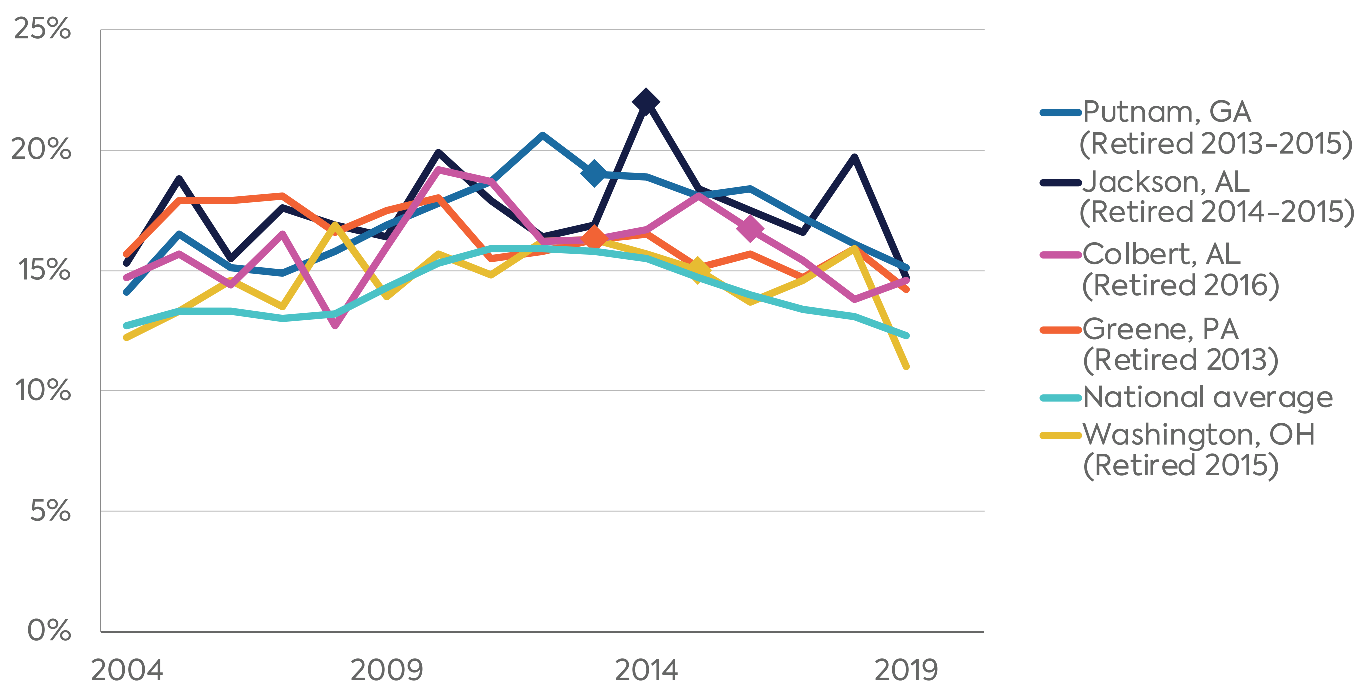
Wages per capita



Unemployment rate



Poverty rate



Note: Diamond indicates date of coal power plant closure. Each legend is ordered to match the highest to lowest number in 2019.
Source: See Table A1: St. Louis Federal Reserve (2023), Bureau of Economic Analysis (2023a, 2023b), Bureau of Labor Statistics (2023a, 2023b), United States Census Bureau (2024).

Economic Performance across US Fossil Fuel–Dependent Communities

While the previous section highlighted economic performance in individual counties, this section explores aggregated economic performance across various categories of US fossil fuel–dependent counties during the period from 2004 to 2019. The results show considerable heterogeneity in economic performance across different categories of US fossil fuel communities in recent decades, though perhaps not as much variation as one might expect given the diverging trends of the domestic coal industry compared to the oil and gas industry.

The United States and the world have committed to a transition away from fossil fuels, and the previous section showed how certain fossil fuel–dependent communities are struggling as US coal production is declining. However, while clean energy technologies are growing rapidly, the global transition away from fossil fuels is in its early stages. The annual production of oil, natural gas, and coal continues to increase globally, and US production of oil and gas has reached record highs in recent years.

Categories of Fossil Fuel–Dependent Communities

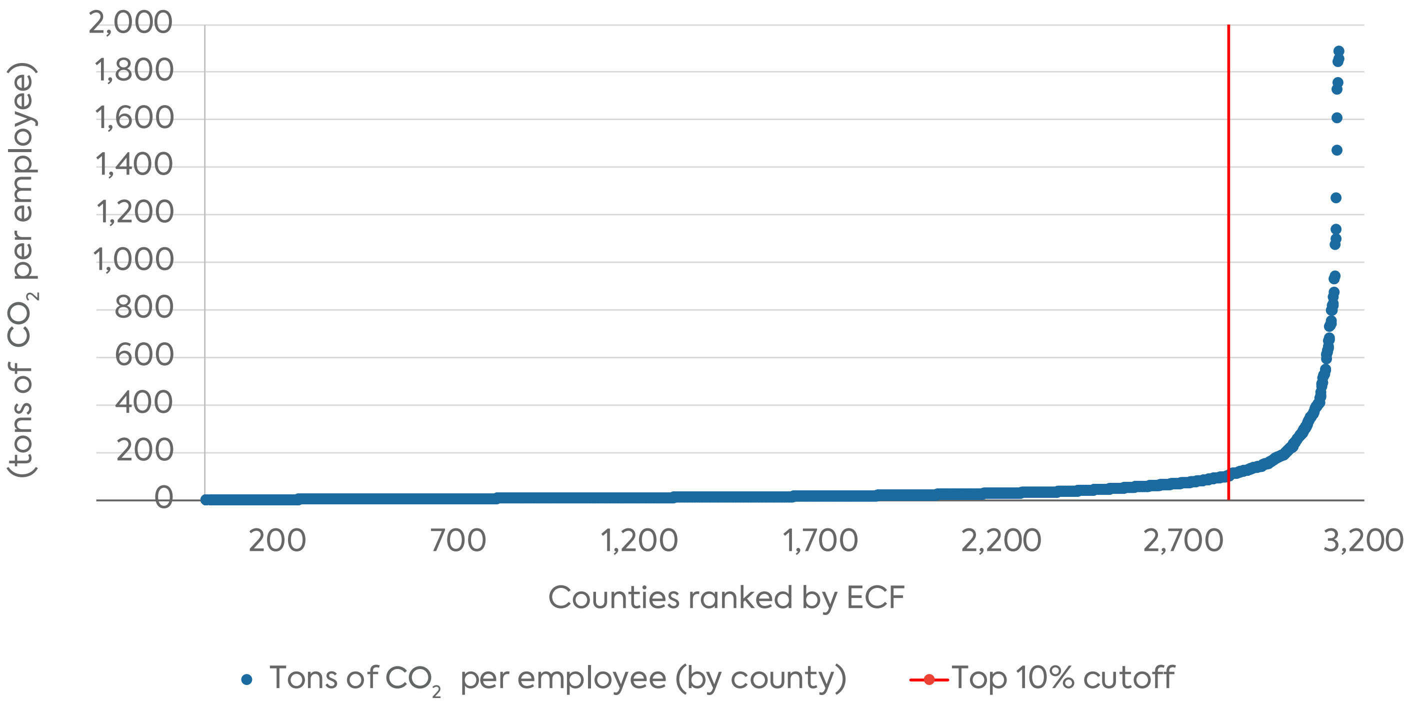
We divide US fossil fuel counties into categories largely leveraging county-level data from Raimi and Pesek (2022) on various types of fossil fuel infrastructure.

A “Coal Plant” category includes counties with at least one coal-fired power plant (operating or retired in recent decades). A separate “Coal Mine” category includes counties that have coal production but not coal power plants, because these are largely rural counties that, given the findings of the previous section, may be especially susceptible to the downturn of the coal industry.

An “Oil and Gas” category includes counties with wells or refineries associated with oil and natural gas production but no coal mines or coal plants, to keep these three categories mutually exclusive. Note that counties with other types of infrastructure directly or indirectly associated with the fossil fuel industry—such as a natural gas processing plant or a steel mill—may be excluded from these categories because they were excluded from the underlying dataset. While natural gas power plants were included in this dataset, we chose to exclude them from the analysis because power plants are often found in large metropolitan areas that are not fossil fuel dependent.

A concern with using binary indicators is that the categories described above will not differentiate between degrees of dependence on fossil fuel–related industries. We therefore also use a continuous metric of the carbon intensity of jobs within each US county from Graham and Knittel (2024), called employment carbon footprints (ECFs). The ECF metric estimates carbon intensity by calculating the carbon dioxide (CO_2) emissions attributable to the supply chains of eight sectors: agriculture, manufacturing, commercial sectors, construction, coal mining, oil and gas extraction, other mining, and fossil fuel power generation. We create a category of counties with the top 10th percentile of ECF scores, which are the most carbon intensive in the country using this metric (see Figure 4).

Figure 4: Distribution of Employment Carbon Footprint (ECF) across US counties



Source: Graham and Knittle (2024) and author calculations.

The same metrics of economic performance introduced in the previous section are displayed in Table 3 for the year 2019. For comparison, national data and a category of "small" US counties (under 100,000 in population) without fossil fuel infrastructure are again included.

(Two options for aggregating county-level data are: first, weighting each county equally, or second, weighting counties by population. Population weighting will emphasize performance in relatively large counties, while equal weighting will emphasize the performance in relatively small counties. Without a clear reason to choose one approach over the other, we include population-weighted results in Table 3 and equal-weighted results in the appendix.)

Table 3: Economic performance of US fossil-fuel-dependent counties by category, 2019

	Coal Mine	Coal Plant	Oil & Gas	ECF Top 10%	Small non-fossil-fuel counties	National average
Number of counties	93	390	779	313	1,487	3,144
Average county population	49,720	193,177	103,286	22,746	25,630	76,336
GDP per capita ($)	44,081	59,055	64,523	82,140	36,805	60,930
Wages per capita ($)	16,584	24,309	24,198	17,186	13,169	19,089
Personal income per capita ($)	41,548	50,832	52,352	43,833	40,766	51,966
Poverty rate	15.5	12.5	13.5	14.2	13.9	12.3
Unemployment rate	4.8	3.7	4.0	4.2	3.9	3.7

Note: In this table, all data is from 2019. The economic indicators (GDP per capita, wages per capita, personal income per capita, poverty, and unemployment) are all population-weighted, meaning that larger counties represent a larger share of the corresponding value. GDP per capita, wages per capita, and personal income per capita are represented in real 2015 dollars.

Source: See Table A1: Bureau of Labor Statistics (2023a), Bureau of Economic Analysis (2023b, 2023c), United States Census Bureau (2024).

Counties in the Coal Mine category are generally small, with about half the population of the average US county. Across each metric, the economic performance of Coal Mine counties is weaker than the national average. Still, GDP and wages per capita in Coal Mine counties remained higher than in Small Non-Fossil-Fuel counties in 2019 (though they are almost equal when counties are not population weighted). Poverty rates are high in Coal Mine counties, and even higher when the counties are not population weighted, indicating that smaller coal mine counties have higher poverty rates.

In contrast, Table 3 shows that the metrics of economic performance for Coal Plant and Oil and Gas counties in 2019 are similar to national averages. The non-population-weighted metrics (included in the appendix) show vastly higher GDP per capita levels for Oil and Gas counties, driven by the presence of major oil and gas infrastructure in very small counties.

GDP per capita in the counties with the most carbon-intensive jobs (ECF top 10%) is about 50 percent higher than the national average and more than double that for Small Non-Fossil-Fuel counties. Many of the highest ECF counties are small counties with rapid growth of oil and gas production over this period. Despite their relatively large economic output, the residents of these high ECF counties may not be fully sharing in the spoils: while wages per capita in the highest ECF countries are well above Small Non-Fossil-Fuel counties, they are below the national average, and poverty and unemployment rates are relatively high.

Figure 5 shows how economic performance changed in these categories of counties over the 15-year period from 2004 to 2019. The data is indexed at the beginning of the period, with each subsequent year displaying the percentage change from 2004.

While the prior section showed severely degrading economies in certain coal mine counties in the decade following coal's peak in 2009, at an aggregate level, GDP and wages per capita grew over this period in the Coal Mine and Coal Plant counties, albeit slowly compared to national trends. Similarly, trends in unemployment and poverty rates largely mirrored the national and small-county averages, with the metrics improving throughout the 2010s, although less rapidly in Coal Mine counties.

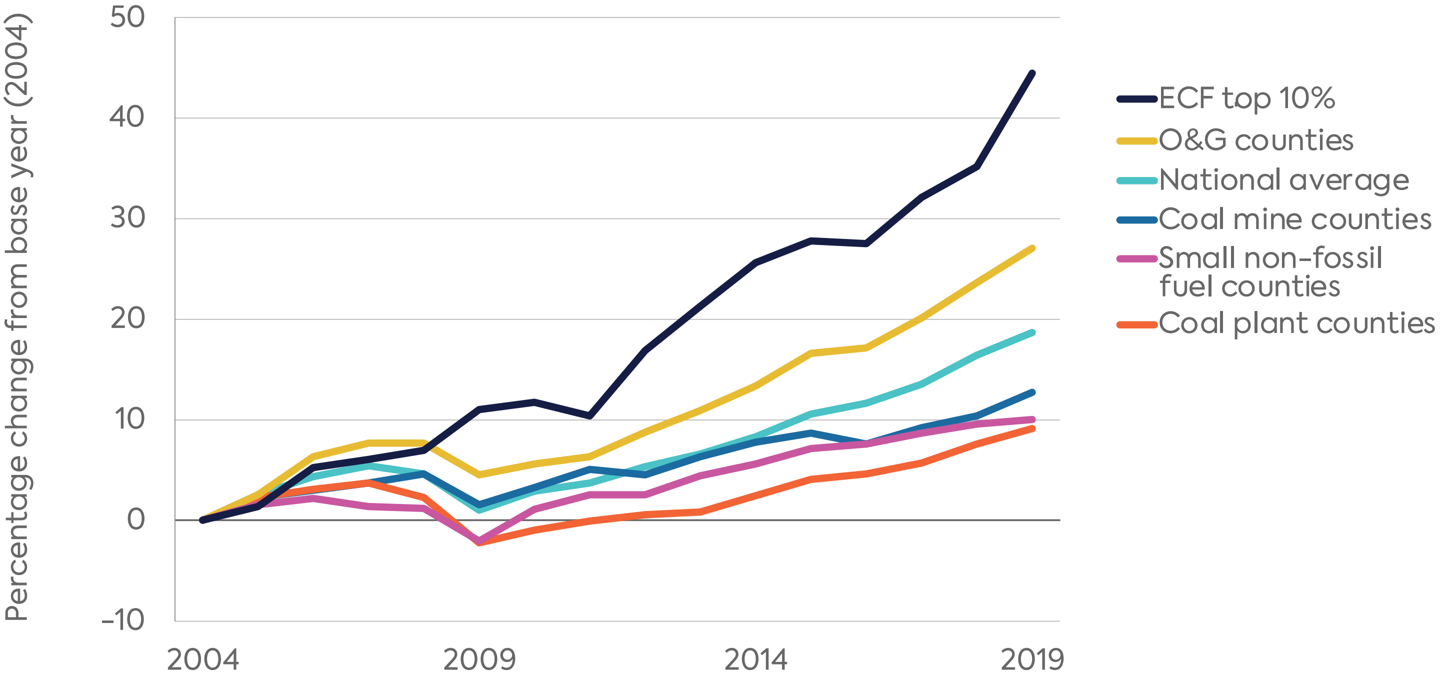
In contrast, Oil and Gas counties experienced relatively strong growth in GDP and wages per capita following the shale revolution of the late 2000s. Economic performance in ECF top 10% counties was even stronger: GDP per capita for this category grew at more than twice the rate of the national average between 2004 and 2019, and wages per capita grew nearly twice as fast as the national average.

Aggregating data from the entire country will miss important subnational trends, particularly given distinct differences across fossil fuel–dependent regions of the country. While overall trends in the Oil and Gas category are driven by large increases in production in regions such as the Permian Basin in Texas and New Mexico, production has declined in other regions, such as central California and northwestern New Mexico.

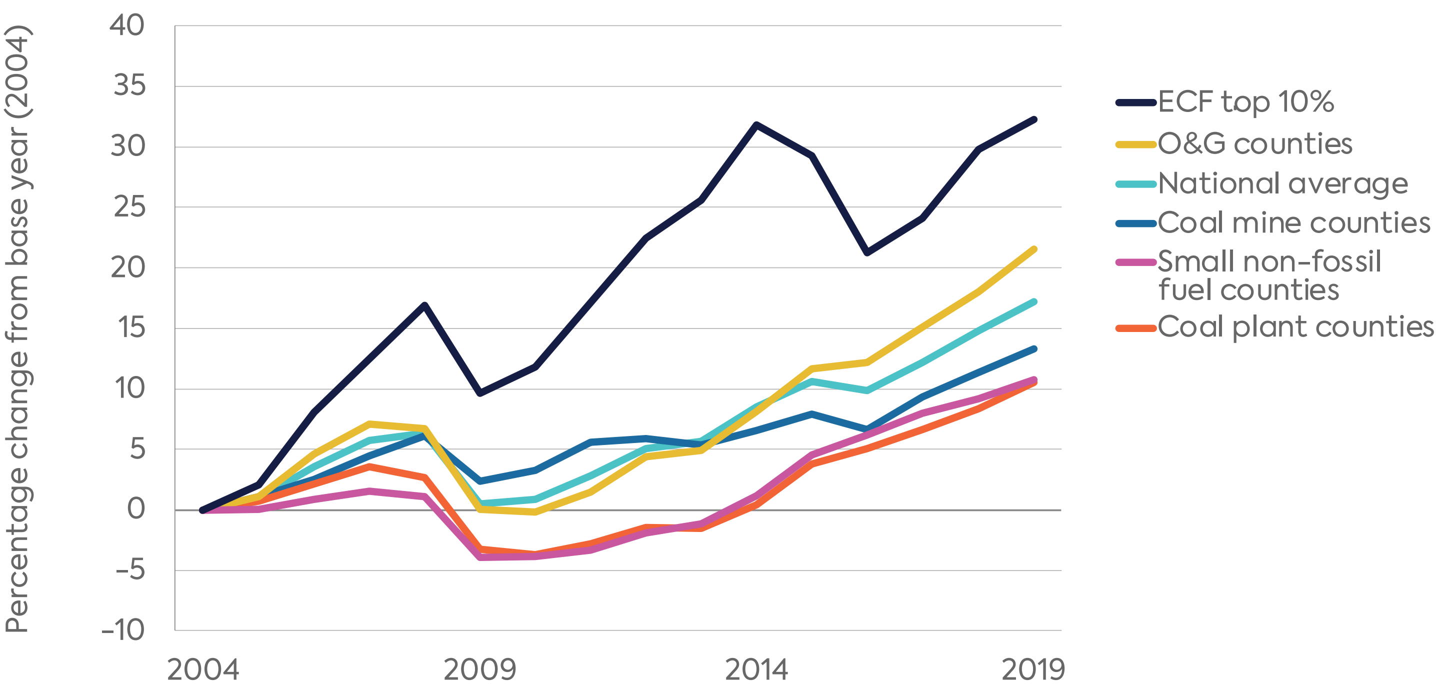
In addition, local economies in large parts of Appalachia have persistently struggled since the mid-20th century, so coal-dependent counties in this region may experience fundamentally different economic issues than coal-dependent counties in other parts of the country. An examination of subnational trends will be a priority of future research.

Figure 5: Economic performance across categories of US fossil-fuel-dependent communities, 2004–2019

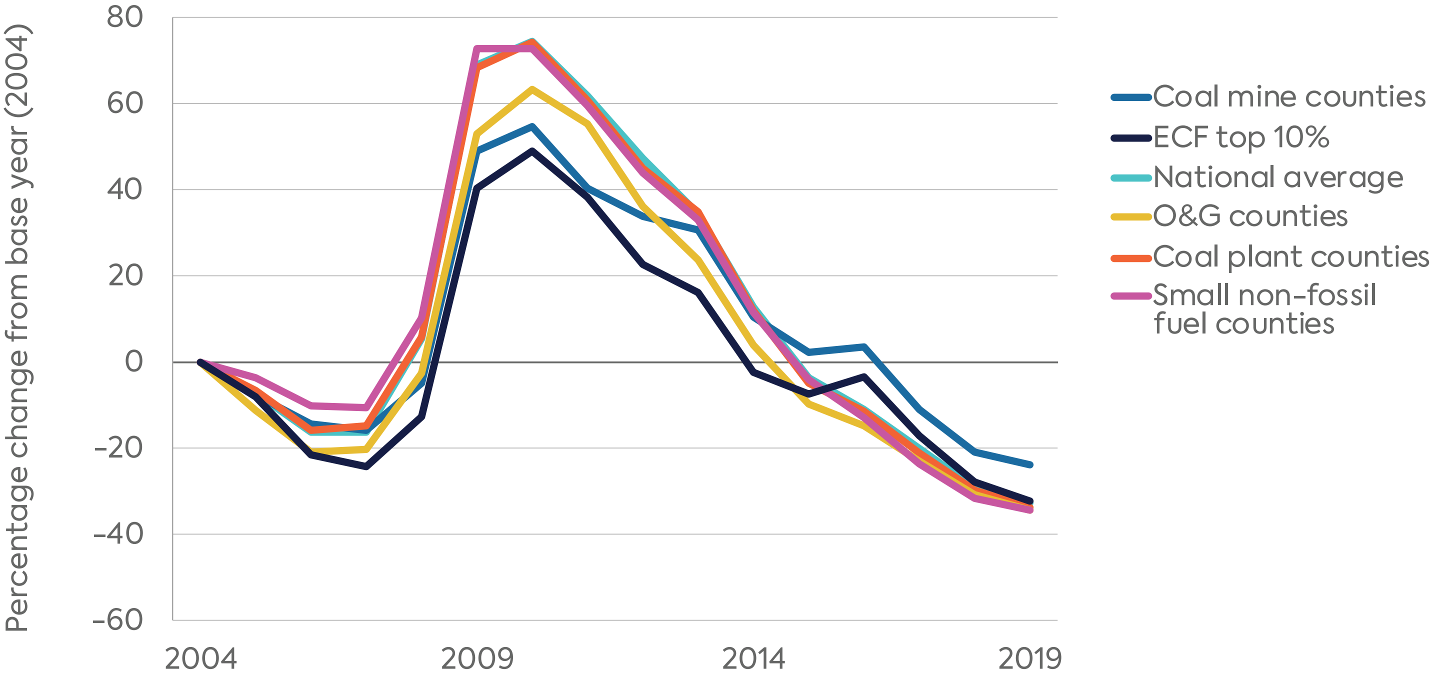
GDP per capita



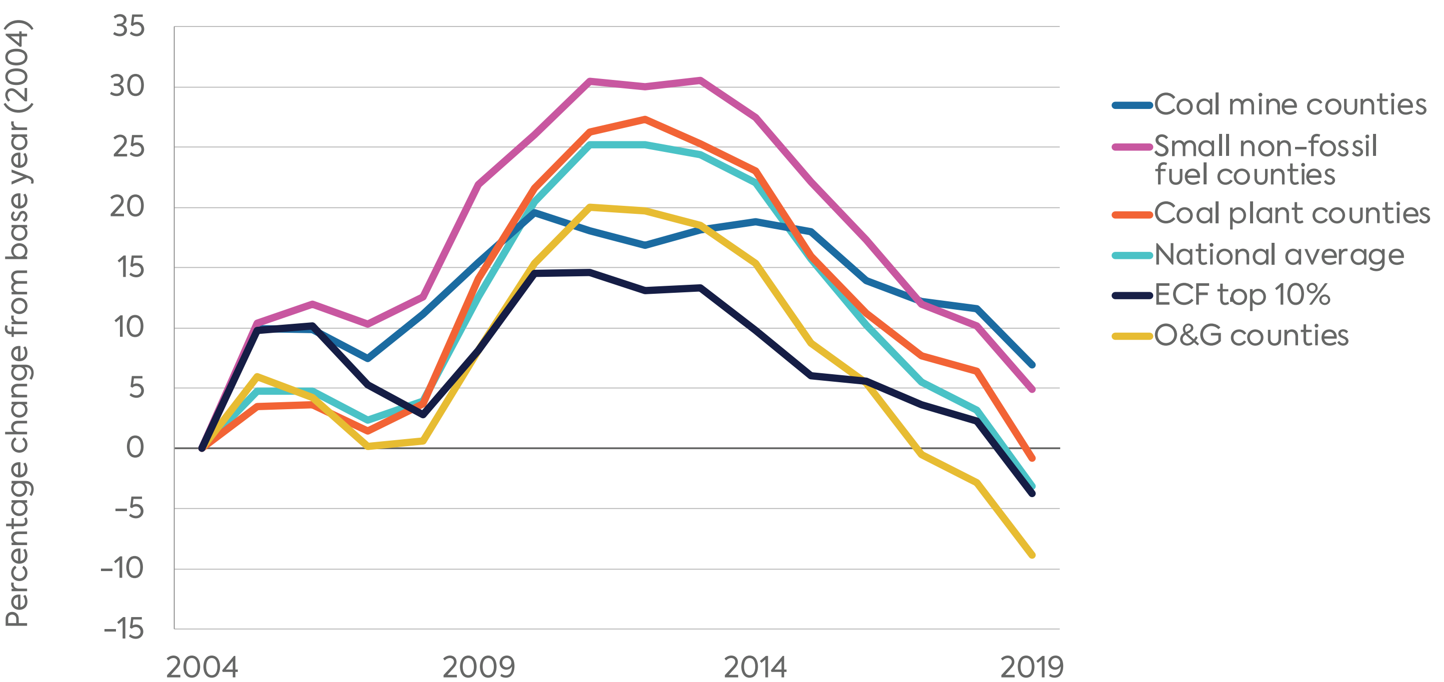
Wages per capita



Unemployment rate



Poverty rate



Note: Each legend is ordered to match the highest to lowest number in 2019.

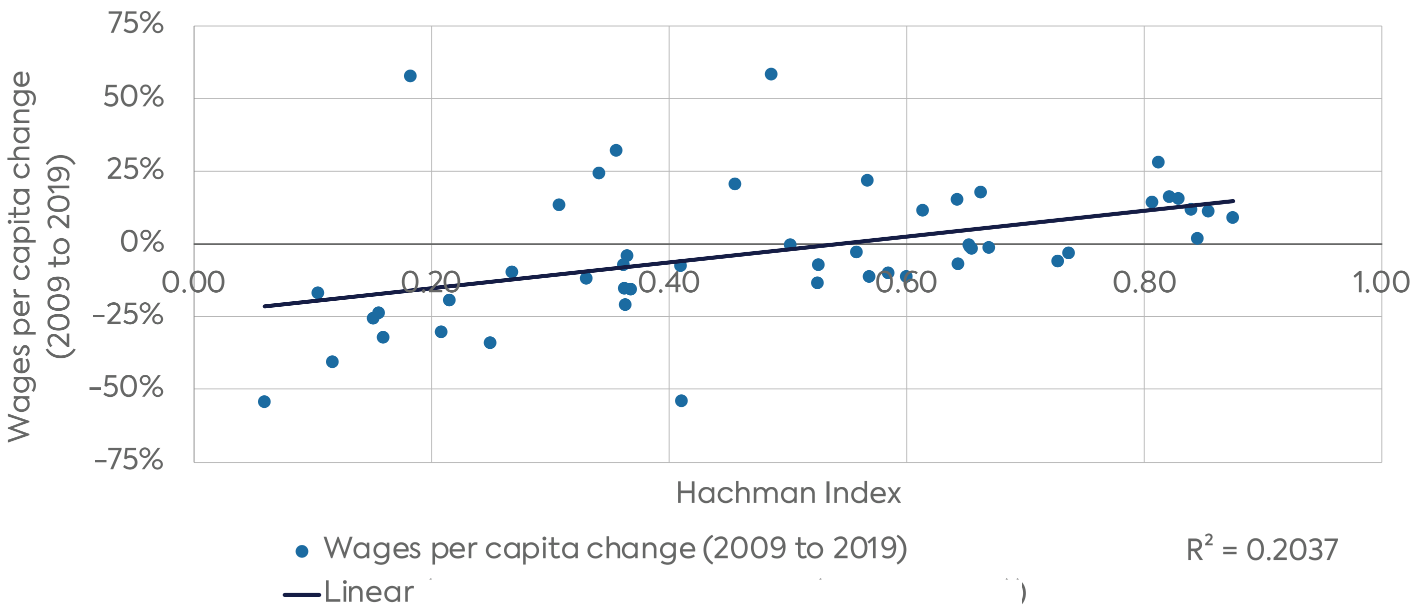
Source: See Table A1: St. Louis Federal Reserve. (2023), Bureau of Economic Analysis. (2023 a, 2023b), Bureau of Labor Statistics (2023a, 2023b), United States Census Bureau (2024).

Finally, we use the dataset compiled for this report to explore whether more economically diverse counties have been more resilient in the face of recent declines in the coal industry. The analysis includes 50 US counties that arguably experienced the largest losses in coal production between 2009 and 2019; in these counties, annual production declined by over 500,000 short tons and by over one-third of 2009 production levels.

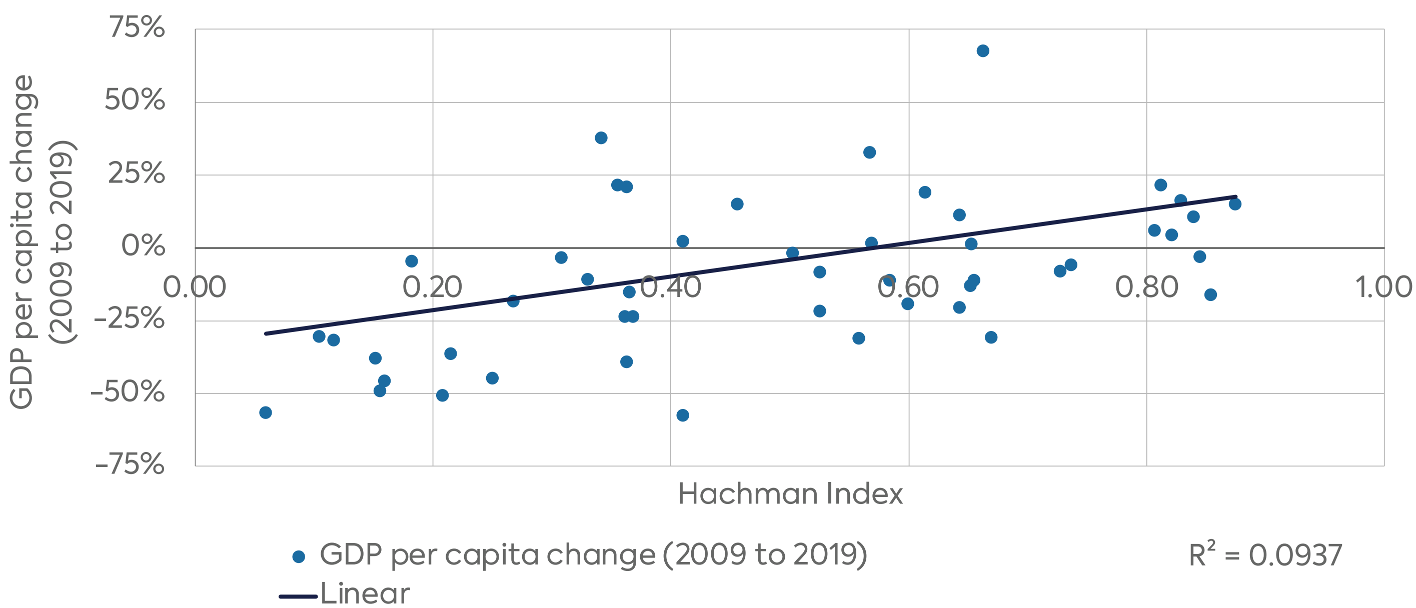
Figure 6 displays changes in economic performance in these counties between 2009 and 2019 (x-axes) and economic diversification levels (y-axes), reflected by the Hachman Index scores. It shows a positive correlation between economic diversification and higher GDP per capita and wages per capita. The largest economic struggles are found in counties with the least diversified economies, although many other factors influence these economic outcomes as well. Notably, similar correlations were not found between economic diversification and changes in the unemployment or poverty rates over the same period.

Figure 6: Correlations between economic diversification and economic performance in US counties with large coal production loses, 2009–2019

Change in wages per capita and Hachman Index



Change in GDP per capita and Hachman Index



Source: Economic diversity metrics are Hachman Index values averaged between 2003 and 2017, per Noor and Erickson (2023); see Table A1: Bureau of Economic Analysis (2023a, 2023b), Bureau of Labor Statistics (2023a).

Next Step: Tracking Support for Fossil Fuel–Dependent Communities

Establishing a baseline of economic performance across US fossil fuel–dependent communities, as performed in this report, is a necessary first step in evaluating the effectiveness of new measures to support these local economies.

Recent federal laws have included unprecedented levels of support for the economies of fossil fuel–dependent communities, including programs targeting these communities. Table 4 provides an overview of new federal programs at least partially targeted to fossil fuel–dependent communities, and their rough levels of current funding (Clarke et al. 2024).

Fossil fuel–dependent communities are also eligible for broader programs in recent federal legislation. For example, many investments in the Bipartisan Infrastructure Law and the CHIPS and Science Act are specifically designed to boost economic development throughout the country. The Inflation Reduction Act includes nearly $10 billion for the US Department of Agriculture's Empowering Rural America program and $250 billion in new lending authority for the US Department of Energy's loan program office (Kaufman 2023).

(Subnational and NGO support for fossil fuel–dependent communities has increased in recent years as well, including in Colorado, California, Illinois, and New Mexico [Clarke et al. 2024; Colorado Department of Labor and Employment 2020; Kriz 2023; Candelaria et al. 2019; California Governor's Office of Planning and Research 2024].)

Many of the new federal programs are just getting off the ground. For example, in April 2024, the Environmental Protection Agency announced $20 billion in funding for clean energy projects in local communities around the country (Joselow 2024). It is therefore premature to assess the spending of these new programs, let alone their effectiveness. In subsequent research, we will gather data on such federal programs that aim to support local economies in fossil fuel–dependent communities. Combining data on economic performance from this report with new federal funding will enable analyses of the effectiveness of federal spending in these communities

Table 4: Funding from recent US legislation tied to place-based policy in fossil-fuel-dependent communities

Program	Focus on fossil communities	Funding
IWG on Energy Communities (1)	Exclusive	$5 million/year
Health and Human Services Focus on Energy Communities (2)	Exclusive	~$25 million/year
DOE Clean Energy Demonstration Program on Current and Former Mine Land (3)	Exclusive	$500 million
Assistance to Coal Communities (4)	Exclusive	~$550 million
DOE Advanced Energy Manufacturing and Recycling Grant Program (3)	Exclusive	$750 million
Appalachian Regional Commission (3)	Partial	$1 billion
Brownfields (3)	Partial	$1.5 billion
Carbon capture demonstration and pilots (3)	Partial	Over $3 billion
Hydrogen hubs (3)	Partial	~$4 billion
Advanced Manufacturing Tax Credit (5)	Partial	$4 billion for coal communities
Orphaned oil and gas wells (3)	Exclusive	$4.7 billion
DOE Energy Infrastructure Reinvestment Loan Program (5)	Exclusive	$5 billion credit subsidy (up to $250 billion loan authority)
Abandoned Mine Lands (3)	Partial	~$11 billion
Energy Community Tax Credit Bonus (5)	Exclusive	Likely tens of billions

Note: 1: Established in Executive Order 14008. 2: Authorized under the Consolidated Appropriations Act of 2023. 3: Authorized under the IIJA. Appalachian Regional Commission has ongoing funding, with $200 million in appropriations in FY 2023. 4: $552 million was funded under various American Rescue Plan programs and the Build Back Better Regional Challenge, with ongoing funding of $50 million per year. 5: Authorized under the Inflation Reduction Act.

Source: Clarke et al. (2024).

Appendix

Table A1: Data sources

Metric	Source
Coal, oil, and gas production and capacity	Raimi, D., and S. Pesek. 2022. "What Is An 'Energy Community'? Alternative Approaches for Geographically Targeted Energy Policy." *RFF*. https://www.rff.org/publications/reports/what-is-an-energy-community-alternative-approaches-for-geographically-targeted-energy-policy/.
Historical coal production	Energy Information Administration. 2022. Historical coal data. https://www.eia.gov/coal/data.php.
Inflation rates	St. Louis Federal Reserve. 2023. "National Accounts: National Accounts Deflators: Gross Domestic Product: GDP Deflator for United States." https://fred.stlouisfed.org/series/USAGDPDEFAISMEI.
Population	Bureau of Economic Analysis. 2023a. "Employment by County, Metro, and Other Areas." https://www.bea.gov/data/employment/employment-county-metro-and-other-areas.
GDP	Bureau of Economic Analysis. 2023b. "GDP by County, Metro, and Other Areas." https://www.bea.gov/data/gdp/gdp-county-metro-and-other-areas.
Annual wages	Bureau of Labor Statistics. 2023a. "Quarterly Census of Employment and Wages." https://data.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables.
Personal income	Bureau of Economic Analysis. 2023c. "Personal Income by County, Metro, and Other Areas." https://www.bea.gov/data/income-saving/personal-income-county-metro-and-other-areas.
Poverty	United States Census Bureau. 2024. Poverty data tables. https://www.census.gov/topics/income-poverty/poverty/data/tables.2023.List_767579338.html#list-tab-List_767579338.
Unemployment	Bureau of Labor Statistics. 2023b. "Local Area Unemployment Statistics—Tables and Maps." https://www.bls.gov/lau/tables.htm#mcounty.
Employment carbon footprint values	Graham, K., and C. Knittel. 2024. "Assessing the Distribution of Employment Vulnerability to the Energy Transition Using Employment Carbon Footprints." *PNAS* 121, no. 7. https://www.pnas.org/doi/10.1073/pnas.2314773121.
Hachman Index values (economic diversity metric)	Noor, S., and C. Erickson. 2023. "Effects of Industrial Diversity on Economic Stability: A Panel GARCH Process to Predict Economic Stability." *Review of Economic Analysis* 15. https://openjournals.uwaterloo.ca/index.php/rofea/article/view/5315/5751.

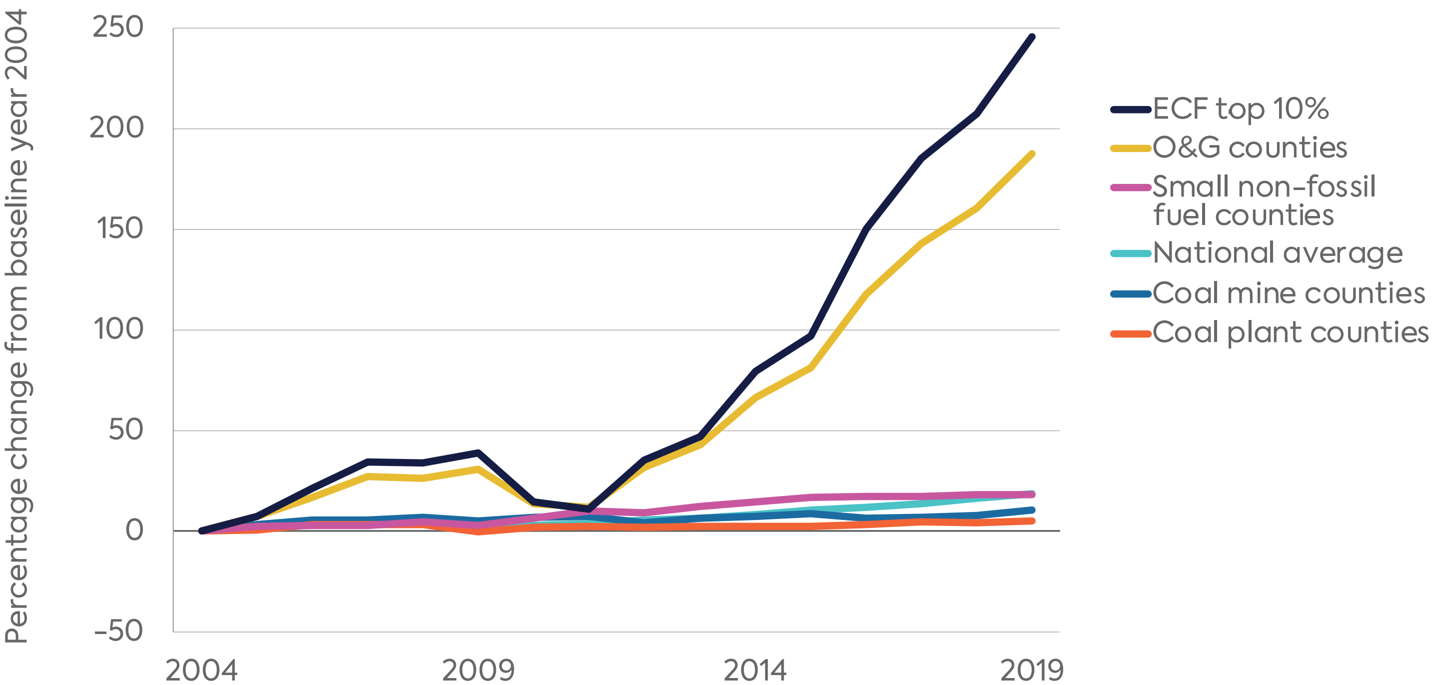
Table A2: Non-population-weighted economic performance for categories of US fossil fuel dependent counties, 2019

	Coal Mine	Coal Plant	Oil & Gas	ECF Top 10%	Small non-fossil-fuel counties	National average
Number of counties	93	390	779	313	1,487	3,144
Average county population	49,720	193,177	103,286	22,746	25,630	76,336
GDP per capita ($)	40,985	54,567	170,227	367,187	38,752	60,930
Wages per capita ($)	12,852	18,674	14,697	17,041	12,368	15,126
Personal income per capita ($)	37,692	44,119	42,198	43,134	40,358	51,966
Poverty rate	18.0	13.3	15.5	14.6	14.7	12.3
Unemployment rate	5.1	3.9	4.0	3.9	3.9	3.7

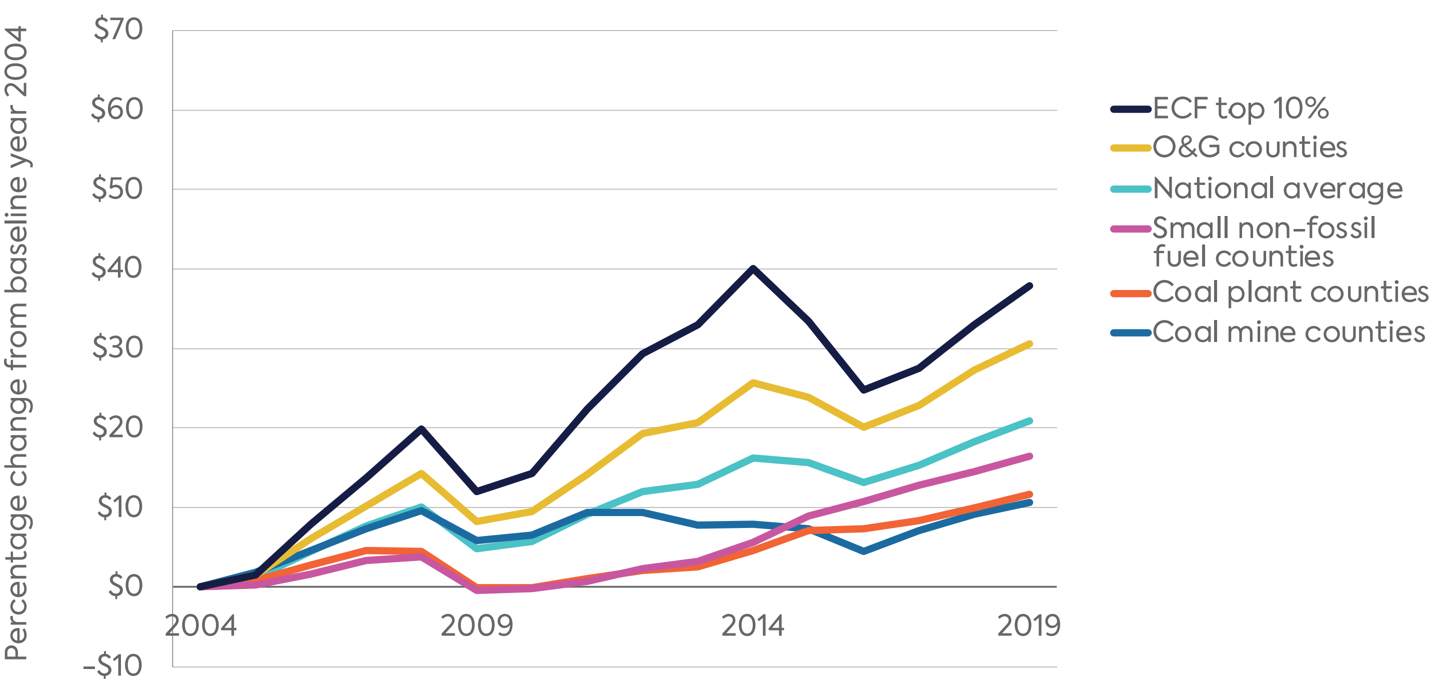
See Table A1: St. Louis Federal Reserve (2023), Bureau of Labor Statistics (2023a, 2023b), Bureau of Economic Analysis (2023b, 2023c), United States Census Bureau (2024); Graham and Knittel (2024).

Figure A1: Economic performance across categories of US fossil-fuel-dependent communities, 2004–2019

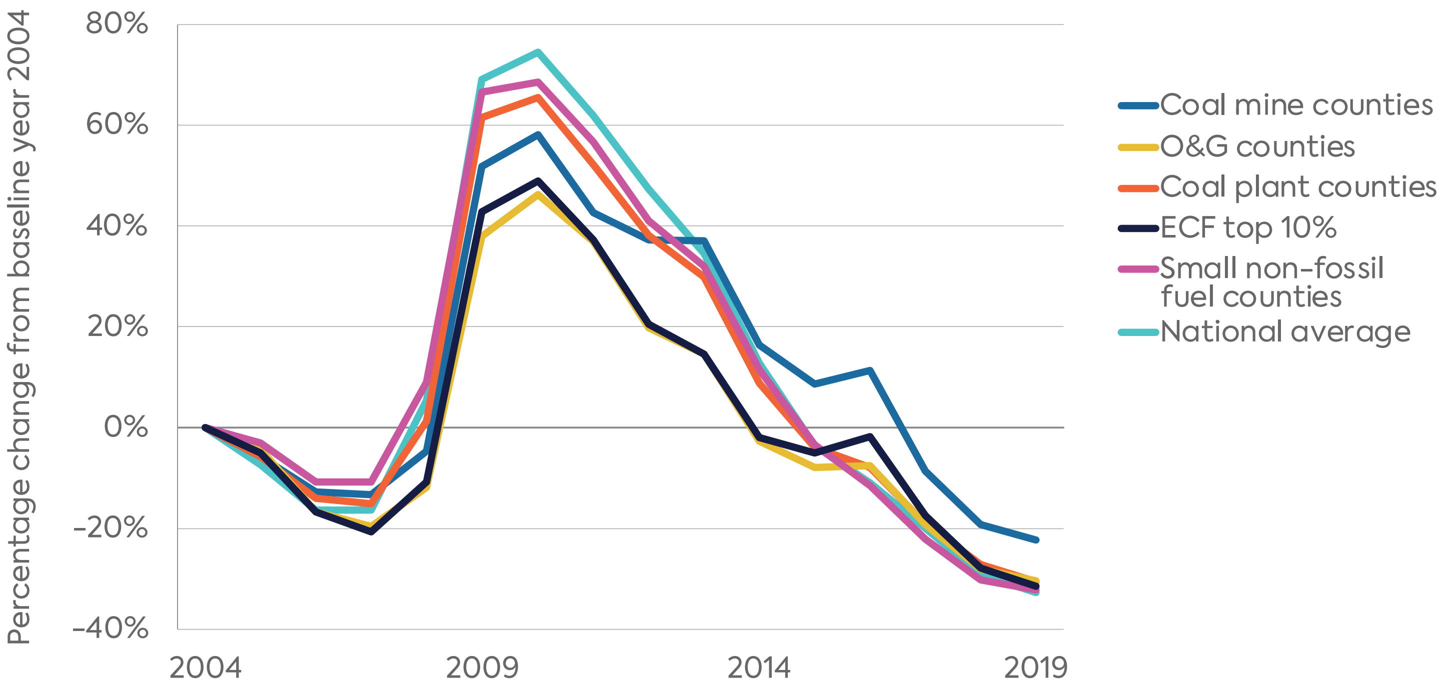
GDP per capita



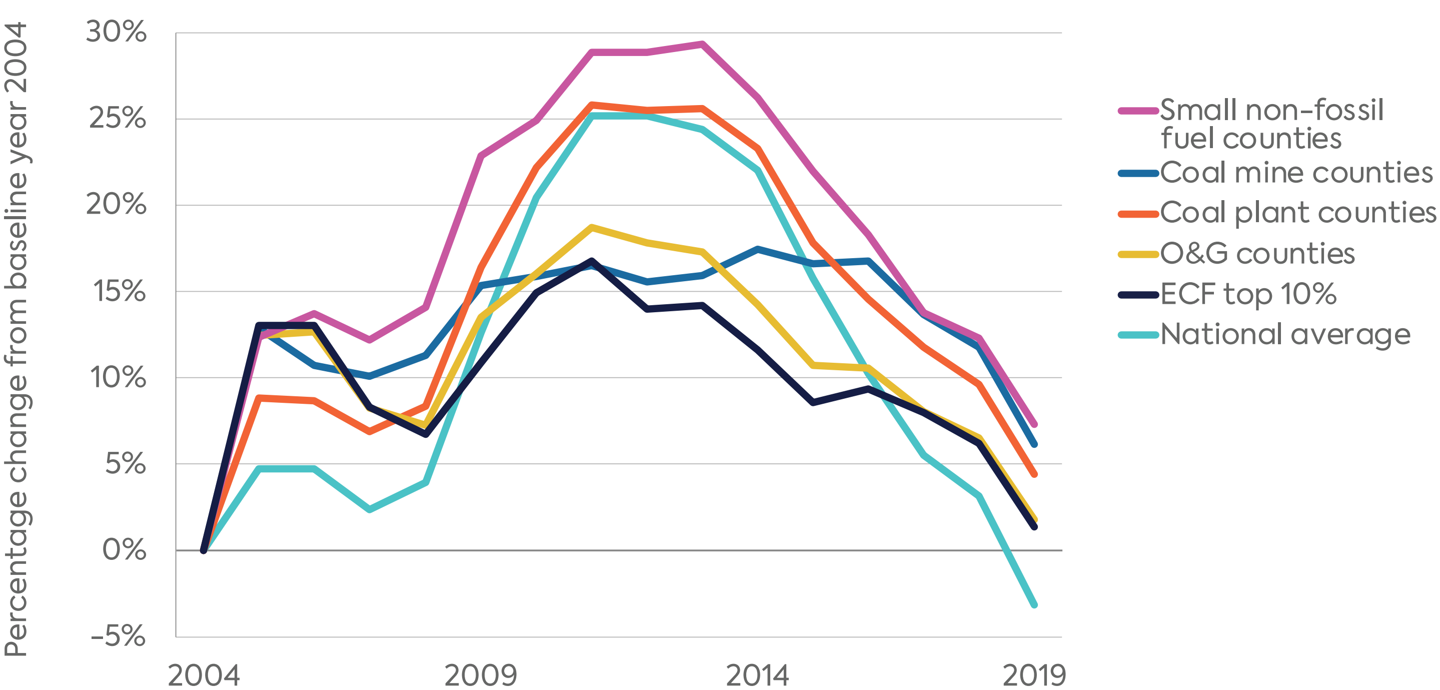
Wages per capita



Unemployment rate



Poverty rate



Note: Each legend is ordered to match the highest to lowest number in 2019.
Source: See Table A1: St. Louis Federal Reserve (2023), Bureau of Economic Analysis (2023b), Bureau of Labor Statistics (2023a, 2023b), United States Census Bureau (2024).

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Notes

1. Until recently, the US federal government has targeted relatively few resources to economic development in fossil fuel communities. The Obama administration proposed a coordinated federal government strategy, called the POWER Initiative, with the goal of easing the economic effects of the energy transition in coal-dependent communities, but Congress neglected to fully fund the initiative.
2. Note that certain measures in recent federal legislation target some oil and natural gas–dependent communities as well, such as the bonus clean energy tax credits for "energy communities" in the Inflation Reduction Act. And some federal agencies and programs are focused on holistic development strategies, including the Economic Development Administration, the Appalachian Regional Commission, and the Interagency Working Group on Coal and Power Plant Communities and Economic Revitalization.
3. In each of these cases, multiple units retired at the same location. Note that the authors did not attempt to capture situations in which multiple power plants retired at different locations in the same county.

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