



Perspectives

Adaptation, culture, and the energy transition in American coal country

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ABSTRACT

The U.S. coal industry has experienced economic decline over the past several decades, which has resulted in a loss of mining jobs and severe economic hardship in many coal communities. Recent efforts to relax environmental regulations are ostensibly intended to help relieve this hardship and to revitalize this industry. Based on evidence gathered from focus groups and interviews conducted in U.S. coal communities, we argue that coal communities that have experienced mine closures have already begun an economic and social transition, one that is based on reshaping their culture and sense of identity, and false promises to return coal jobs can be destructive to the progress that has been made.

1. Introduction

The United States is undergoing an energy transition. An energy transition is marked by a shift from an economic system dependent on one set of resources and technologies to another [1]. In the present case, the shift is from dependence on carbon-intensive energy resources to lower carbon alternatives. While historic energy transitions have often taken up to a century to unfold [2,3], the current U.S. transition is evolving at a relatively rapid pace.

Certain areas and industries may be lost in such a transition [4] and the coal industry has been one of the primary sectors affected adversely. Early signs emerged of coal industry transition and decline [5,6] as recently as two decades ago due to advanced mechanization, declining mining productivity, and environmental regulations [7]. Over the last decade, however, as domestic electricity demand has declined and market substitutes such as natural gas, wind, and solar have dropped in price, the coal industry decline has become precipitous.

Within his first three months in office, President Trump signed a bill to repeal a regulation protecting streams from coal mining waste and an executive order to rescind limits on greenhouse gas (GHG) emissions from existing coal power plants (i.e., the Clean Power Plan), lift potential restrictions on coal mining on federal lands, and remove the mandate to include the social cost of carbon in regulatory benefit-cost analyses. These and other actions fulfilled campaign promises he made to bring back U.S. coal jobs. It is unlikely, however, that these policy changes will drastically affect the country's current energy transition. While environmental regulations have been an important factor in the energy transition, they are not the primary reason for the recent decline

of the coal industry. Thus, proposed efforts to remove environmental regulations, all else constant, will not change the near- or long-term economic trajectories for coal communities.

Based on insights gathered from focus groups in Appalachian coal mining communities and interviews with professionals working within these communities, as conducted in the summer of 2016, we present an argument in this Perspectives article that many within Appalachian coal communities understand that coal is a declining industry, and that it is important to seek out new economic opportunities and redefine their identity. Significant efforts are already underway on both a community and individual level to adapt to these changes, and signaling that coal should remain an important part of the U.S. fabric can impede momentum.

This article stresses the importance of asking questions about the distribution of benefits and burdens resulting from the U.S. energy transition. The article complements a growing literature on the "just" transition, which emphasizes the need for the transition to be experienced equitably across groups and communities [8–11]. The article also underscores the importance of understanding what is transpiring in declining communities, and the manner in which such communities approach or perceive the energy transition.

2. Background: the decline of the U.S. coal industry and economic vulnerability

Both U.S. coal mining and electricity production jobs, as well as coal production are declining. Coal mining jobs have decreased approximately 71% since 1985, with an estimated 170,500 jobs in January

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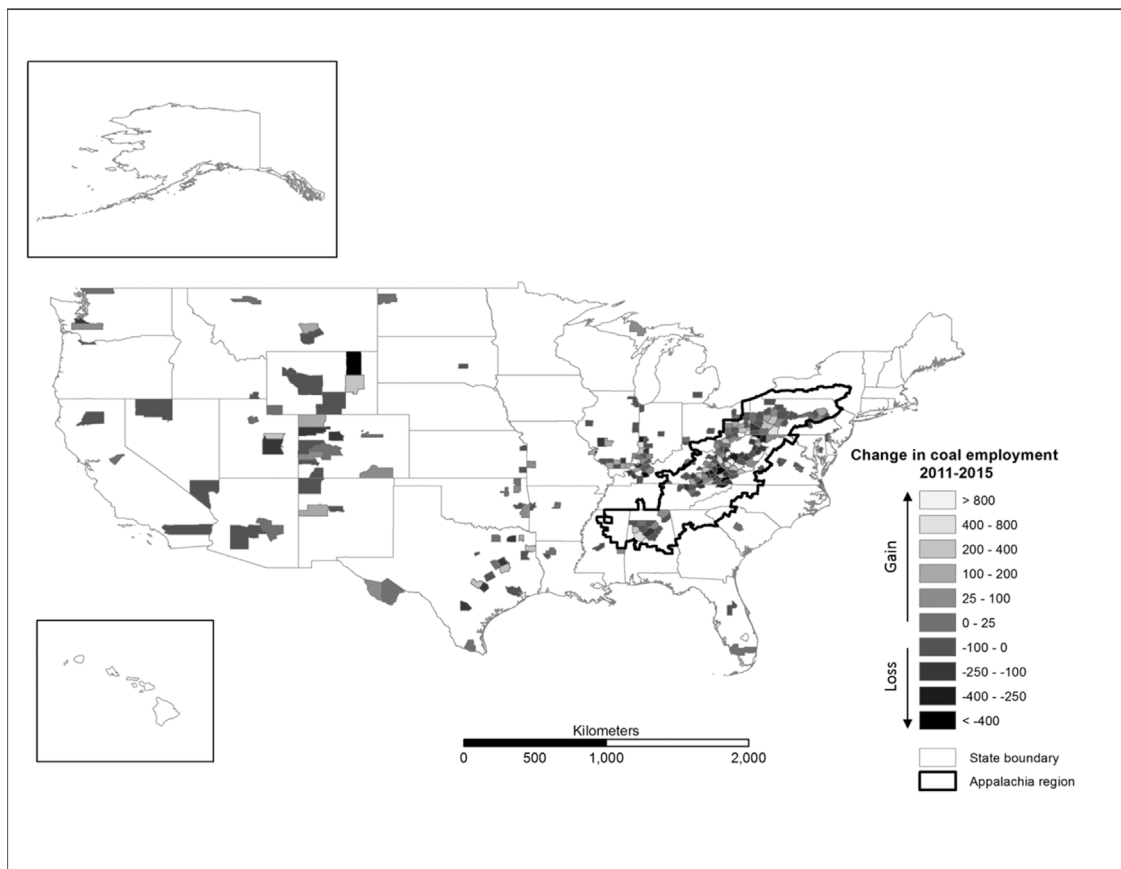


Fig. 1. Change in U.S. Coal Employment between 2011 and 2015.
 Source: [30].

1985, and 50,000 in January 2017 [12]. Coal production peaked in 2011 and has dropped dramatically since then [7]. Fig. 1 displays the difference in coal employment between 2011 and 2015, the most recent year of available data. Despite some gains in jobs in certain counties, this map highlights that Appalachia, the focus of this Perspectives article, was one of the hardest hit regions.

These declining trends are due to a confluence of factors. Among the earlier contributors were (1) rising prices for coal due to declining mining productivity, the need to dig deeper for usable coal deposits, and rising costs of sub-surface coal mining [13,7,14]; (2) the mechanization of coal mining in which, even as production has expanded, technological improvements have led to higher worker productivity and fewer jobs [5]; and (3) environmental regulations [13,14], especially the sulfur dioxide limits in the Clean Air Act of 1990 and the subsequent decline in demand for Appalachia's high-sulfur coal [6]. A recent analysis argued that environmental regulations have played a role in the decline of the coal industry, but that the role has been quite modest relative to other factors. This study estimated that recent environmental regulations only accounted for about 3.5% of the total 33% decline in U.S coal production [15].

Three additional trends have played a particularly important role over the past decade. First, U.S. demand for electricity has been relatively flat since falling drastically at the end of the last decade during the Great Recession. Forecasts suggest that it is not expected to appreciably increase for decades to come [16].

Second, the price of market substitutes has fallen considerably. As a result of the U.S. shale gas revolution, natural gas prices are well below the price per unit of coal across most of the country. The cost of wind and solar generation has also declined significantly due to technological improvements [17] and there is little to suggest that these price trends will change considerably in the future. To illustrate the challenges to

the current U.S. market for coal, Fig. 2 maps counties according to the resource that would produce the lowest levelized cost of electricity (LCOE) in the construction of new power plants based on a set of assumptions available in Rhodes et al. [18]. This map shows that even with a zero social cost of carbon, coal is not economically competitive for electricity applications anywhere in the country. Although an LCOE metric is not the perfect measure to compare across different types of resources—particularly between dispatchable and non-dispatchable resources—nor does it account for the need to have back-up resources for intermittent sources, it provides some evidence about the relative competitiveness of different energy resources.

These price differentials have important implications for utility and infrastructure planning. Electricity investments tend to be long-term, since power plants are built to last 30–40 years. As utilities and power producers invest in new facilities, they will weigh the cost of different energy resources, both present and based on future projections. As of January 2017, out of the approximately 110,000 MW capacity that is under development or planned through 2027, approximately one percent is coal. Meanwhile, between 2012 and 2015 alone, 34,000 MW of coal-fired power generation capacity went offline [19].

Third, many countries are adopting low-carbon alternatives and have committed to the Paris Climate Agreement, as displayed in Fig. 3. Although the President Trump has declared his intention to withdraw the United States from the agreement, many U.S. state and local governments have noted their continued commitment to renewable energy development and GHG abatement. A large number of other countries have also committed internally to the pursuit of renewable energy through renewable portfolio standards and feed-in tariffs [20]. Canada and Finland have banned coal generation by specific target years and all EU countries save Greece and Poland have committed to no more new coal power plants after 2020. The International Energy Agency

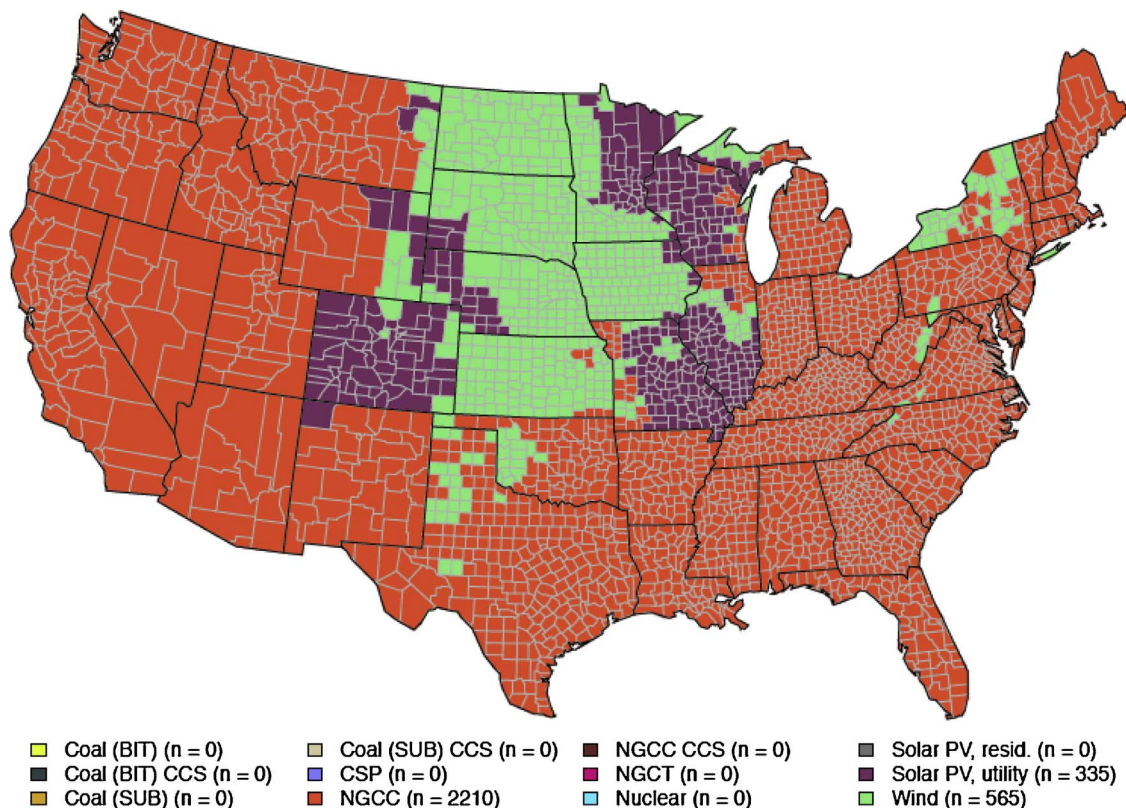


Fig. 2. Minimum Levelized Cost of Electricity by Technology and County.

Notes: BIT = bituminous, CCS = carbon capture and storage, SUB = subbituminous, CSP = concentrated solar power, NGCC = natural gas combined cycle, NGCT = natural gas combustion turbine, PV = photovoltaic, resid. = residential, n = number of times an energy resource appears on the map as a least-cost option.

Source: [31,32].

forecasts that total global demand for renewable energy sources will continue to rise while the demand for coal will stall [21].

These trends suggest a bleak long-term forecast for coal as a market commodity, regardless of retrenchment of relevant U.S. environmental regulations [22]. Moreover, for a number of reasons, coal communities

are particularly vulnerable in the face of an evolving energy transition. Due to the historic nature of economic development within coal mining communities, they are especially prone to economic hardship in boom to bust periods. U.S. coal communities are marked by a dependence or resource curse [23], which is defined as a tendency for communities

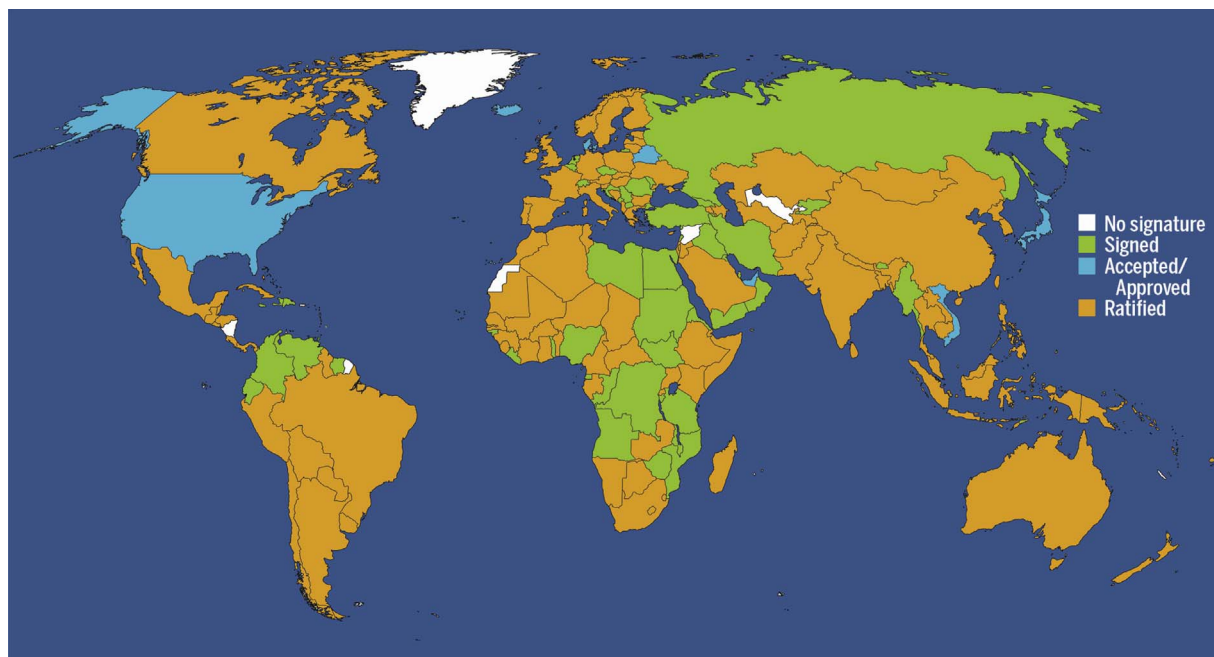


Fig. 3. Country Commitments to the Paris Agreement.

Source: [33].

that rely heavily on certain extractive resources to become “addicted” to these resources and to develop overly dependent or specialized economies.

Many coal regions have had mono-industry economies for over a century. Higher wages for the resource commodity crowd out growth in other industries [23]. The nature of coal mining jobs, which are highly unionized and high paying, tends to reinforce this dependency and provide little incentive for regions with coal resources to diversify their economies and employment opportunities, or foster entrepreneurship [24]. Such mono-industry economies make it more difficult for communities to adapt to shocks [25,26] due to a lack of alternative labor market options and a consistent underinvestment in education [27]. In addition, when coal extraction declines, it also affects the entire community, since their local governments rely on severance taxes to support education and other public services.

Not only do these communities offer a dearth of economic opportunities, but individuals within these communities may limit their own educational attainment. The allure of a low-skilled, high-paying profession often results in coal miners beginning their careers before completing high school [23,28]. Lower levels of educational attainment across coal miners and their families further render them susceptible to shocks, and limit the potential for adaptability in the face of economic decline.

3. Methodological approach

This analysis draws from in-depth focus groups and interviews conducted with individuals that reside or work within the range in Appalachia identified in Fig. 4. Questions in the focus group focused on whether and how respondents conceive of the energy transition, what implications this transition has for their personal circumstances, and how they have fared as the transition has evolved in their own communities. The focus group sessions were followed by a short survey that participants completed before departing. The interview questions addressed perceptions of an energy transition, how the respondent was involved in this transition, and what they had observed within their communities.

The interviews and focus groups were conducted in July 2016. Interviewees were identified via extensive online searching as well as preliminary phone calls to ask for contacts. Subsequent respondents were identified via snowball sampling. For the focus groups, we partnered with local organizations that worked with former coal miners and coal mining communities in one way or another. Both focus groups and the majority of interviews were conducted in person. The focus groups lasted around one hour. As compensation for focus group participants, we offered \$25 gift cards to the local grocery and household store, which, in the case of both focus groups, was a Walmart. All sessions were recorded with the permission of the participants and then transcribed.

The two focus groups had slightly different groups of participants. The first focus group ($n = 9$), conducted in Williamson, West Virginia, included some unemployed former coal miners, as well as additional community members including the wife of a coal miner and part-time retail workers, among others. These participants did not formerly know each other. The second focus group ($n = 16$), conducted in Ghent, West Virginia, consisted of a group of former coal miners that had been laid-off but returned to a technical training program. These participants already knew each other from this program. In total, 25 individuals participated in the focus group session. Table 1 provides basic descriptive statistics about the focus group participants.

Interview participants included those that worked for training or educational programs, economic development units, social enterprises, community-based and/or religious organizations, industries that seek former coal miners as employees, foundations that support revitalization activities within the region, analysts, and those that work within the media industry. Table 2 documents participants’ professional

affiliations. We interviewed a total of 23 experts. Interviews lasted an average of 38 min.

In the Supplementary information, we provide quotes from the interviews and focus groups that support the arguments made in the present analysis (Supplementary information Tables 1 and 2). These tables are not exhaustive but, rather, are intended to provide illustration of the various themes highlighted in the section below. In addition, in the Supplementary information we present word counts and percentages of respondents that mentioned key words covered in this analysis (Supplementary information Table 3).

4. Local perceptions of the energy transition

Interviews and focus groups conducted within Appalachia revealed important insights about how communities are adapting in the current energy transition. These results highlight the importance of culture, shifting mindsets, and community efforts. They also underscore just how potentially damaging it is to make promises about reviving the coal industry.

4.1. Coal as culture

Mining employment in many coal regions dates back over a century. Many of the respondents that participated in this study noted that their grandfather and great-grandfather both worked in the mining industry, so it was a natural decision for them also become a miner. This history and personal identity makes it difficult to accept change, as one focus group respondent noted, “People don’t like change, especially around here, they been doing the same thing for 150 years, why would they change now?”

The historic roots of coal not only steer individuals toward the profession but also shape the broader culture within these communities. Scholars have identified previously that a strong sense of identity to extractive industries is common [5], and we found significant evidence of coal culture in Appalachia. Coal was frequently framed as the common bond—or identity—that held the entire community together. This sense of identity is amplified by strong attachments to location, landscape, and personal networks, which not only makes it challenging for individuals to generate a conception of self that transcends coal, but also makes it particularly difficult psychologically for individuals that need to leave Appalachia for new employment opportunities. One respondent explained:

There is also a sense of grief that comes along with it, you know, coal mining is really a part of the culture here and it’s interwoven into the way people feel about themselves and their own identity and their identity as a community. And so to lose that so quickly is really, it creates a sense of grief among people about losing their way of life and a piece of their culture that is really engrained and a part of who they are.

4.2. Community adaptive capacity

Despite the prominence of coal in the culture of these communities, many respondents recognized that a transition was underway. The majority of respondents conceived of this transition as permanent, as one focus group participant noted about the future of coal: “I can tell you what my grand-daddy always said, no matter how many times you beat and kick that dead horse, it’s not getting up to plow again.”

The coal industry decline has affected individuals and families differently. Yet a fairly consistent story emerged from the focus groups and interviews about how former coal miners have fared. Many began by noting that their unemployment came suddenly and unexpectedly. Once their jobs disappeared, many lived off of their savings, credit, or unemployment benefits while seeking employment or waiting until their former positions were reinstated.



Fig. 4. Research Study Area.

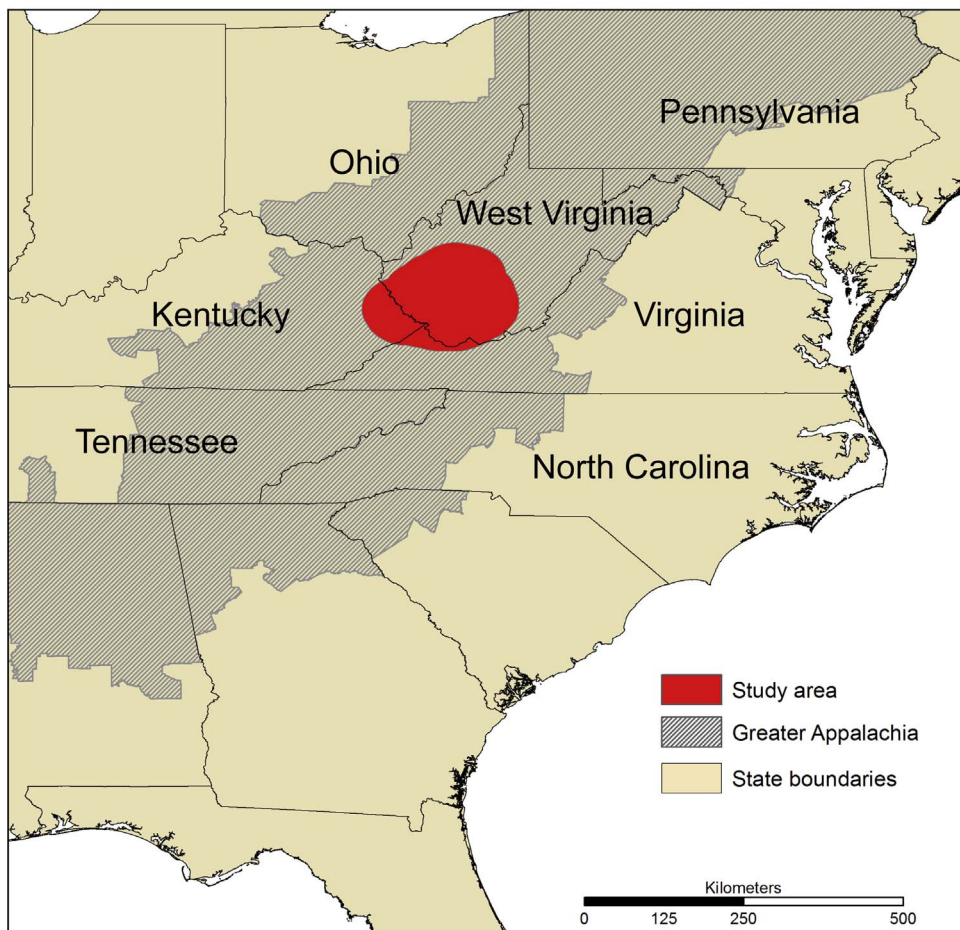


Table 1
Focus Group Respondent Descriptive Statistics.

Category	Average or Percent of Total
Male	84%
Age	33.3
Number of years lived in current community	27.2
Number in household	3.8
Income	
20k or less	28%
21k–40k	20%
41k–60k	24%
61k–80k	16%
80k and above	12%
Employment	
Currently working	20%
Retired	8%
Either in training program or not working	72%

For those that enter training or community college programs, the challenge is to stay financially afloat before the opportunity arises again to secure an income. Many of the experts that work within the community colleges discussed the bartering system that students have devised to exchange items such as eggs and produce, and one respondent

Table 2
Interview Respondent Affiliation.

General Type of Organization in which Interviewee Works	Number of Respondents
Economic development organization/council	7
Social enterprise or activism	2
Community or religious organization	1
Technical training/education	4
Industry seeking employees	4
Foundation engaged in coal community issues	1
Analyst and/or academic	2
Media	2
Total	23

noted that he/she has loaned students money on several occasions for interview clothes.

The new professional opportunities mentioned by the respondents include electricity lineman, solar installer, wind installer, truck driver, or working within the tourism or construction industries. Not all of these jobs, however, are available locally, with some requiring them to travel for hours to get to their work site and to spend several days at a time away from home. These conditions highlight the lack of alternative economic opportunities within many coal communities.

Unemployed workers must then contend with the difficult challenge of waiting to see if future opportunities arise or to uproot what can be deep community linkages by moving to seek job opportunities elsewhere.

When the transition began, it was marked by much anger and resentment. Many noted, however, that anger has been replaced by excitement about new opportunities, and the recognition that the transition is real and inevitable, even if challenging. As an example, one respondent commented on the attitudes of solar installation trainees toward the energy transition: “Honestly, I think most of them are really excited...You could ask a lot of them, and they’ll say that. Coal is probably not coming back, or if it is, it’s not what it once was, so I’m going to learn as much new and exciting things as I can, I want to get a degree, so I’m more hireable later on.”

Another respondent described the evolving optimism: “I think West Virginia is always a collective of its geography. The hills and the valleys, the highs and the low, the good and the bad, I think there is – at times I have tremendous optimism that we will see our way through this and I think that optimism is shared...At other times, I think it’s going to be really hard, this is going to be a difficult...transition.” What then leads to a change in mindset in which an individual switches from a perspective of anger to one of motivation?

4.3. Shifting mindsets and seeking new opportunities

Many respondents discussed how a primary component of an individual’s or a community’s ability to adapt is to embrace the move away from a culture of coal rooted in dependence to one focused on new opportunities and community engagement. For many study participants, this vision highlighted the importance of rebuilding with new objectives. One respondent articulated this vision by explaining, “I think longer term, it is an opportunity despite all the pain that people feel to finally diversify our economy, to be healthier, and diversify how we create energy ourselves, to be a kind of a healthier, more vibrant place.”

Individuals noted that the changing culture and rising optimism was particularly driven by younger generations. One respondent explained, “I’m beginning to see some real enthusiasm, particularly among young people in small communities in West Virginia, to begin looking for something beyond, something beyond coal.” And another noted:

I think slowly but surely, you kind of go through all these stages of mourning. So there’s still those that think coal will come back. But there’s more than ever in my lifetime many that say it’s not coming back, at least not how it was and so there is, definitely more among the younger than among the older, but there is kind of this excitement and possibility, that now coal is gone and we can rebuild our economy into what we want.

Many respondents noted that this remaking of image and economic opportunity has been a collective effort, and that these new bonds contribute positively to the community. An interviewee articulated these sentiments as follows:

The phenomenon ... has been very good to observe. A lot of community groups, a lot of technical systems providers, a lot of university folks, and a lot of nonprofits, and even some businesses that have begun to collaborate now. Around what are the opportunities, possibilities for working in these coal-impacted communities. We... wouldn’t have seen this two years ago, much less 5 years ago or 10 years ago. Everybody was in their own domain and weren’t necessarily talking to each other... And I think to see positive, sort of small positive successes grows even larger success.

These varied accounts underscore that significant change is already underway in Appalachian coal communities. As many come to terms with the future prospects for coal, the tenor has, at least for some, turned from anger to excitement, and the result has been important

momentum toward individual and community adaptation.

5. Discussion and concluding arguments

As the coal industry continues to decline, it is important to consider how best to support the communities that have traditionally relied on coal jobs for their livelihoods. Promising coal communities a return of their jobs has the potential to fill them with false hope, which can threaten the very progress that has been made to date as individuals and communities work to redefine their collective identity and create new, dynamic, and promising opportunities for their future.

It is, of course, important to note that if, despite all present trends, there is a substantial and sustained resurgence in demand for coal, the decline of the industry might slow and could lead to at least a temporary delay in the economic and social transition of U.S. coal communities. One might even argue that with a revival of the coal industry, those that live and work in these communities would be better off than they are currently. Yet, one of the central arguments of this article is that rolling back recent environmental regulations will not lead to a significant resurgence of the coal industry in the United States, since these regulations have played only a minor role relative to slowing demand for electricity and the availability of cheaper and cleaner sources of energy.

Rather than repeal environmental regulations that benefit many Americans, including coal communities themselves [5,29], and may only result in modest impacts on the long-run vitality of the coal industry [22] government efforts should help these communities find and harness new economic opportunities. These regions require targeted efforts aimed at economic and human development, and an emphasis on health and education, professional opportunities, and public services. This transition will, by no means, be easy. But, supporting coal communities through the broader energy transition, and offering them the opportunity to recreate their sense of identity and culture, is critical.

Across the diverse communities we examined and stakeholders we interviewed, we found a mostly consistent thread of acceptance and awareness of the energy transition. Respondents understood that the coal industry is in decline, and that the United States is transitioning toward lower carbon energy resources. But it is striking that so many individuals addressed the innate cultural perceptions inherent in their communities as a fundamental challenge—this presents a vexing problem for policy makers and decision-makers because arguably it is easier to implement a job training program through investment of financial resources than it is to change long-standing mindsets of individuals with deep ties to a place and economic past.

Although this study is based on a small and deliberate sample, and the findings may not be generalizable to other coal communities or declining communities more generally, our analysis points to the importance of moving beyond political rhetoric to careful consideration to how individuals and communities may be adversely affected by the energy transition. Moreover, the article emphasizes the importance of understanding how they can cope and adapt, and how new opportunities can be created and embraced among those most affected. We believe it is imperative that scholars focus more attention on identifying and evaluating approaches designed to help those adversely affected through the transition.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.erss.2017.10.007>.

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