Bringing Climate Politics Home: Lived Experiences of Flooding and Housing Insecurity in a Natural Gas Boomtown

Abstract

As the extraction of shale gas and oil transforms localities, these places emerge as important if understudied sites of contemporary carbon politics. In this paper, we develop a new approach for examining lived connections between fossil fuel extraction and climate change. We propose the concept of *carbon mobilization* to describe the multiple stages of fossil fuel extraction and combustion that may be experienced separately (as an economic boom, climate disaster, or air pollution, for example) or simultaneously, in locally distinctive combinations – but until now have been considered separately in most scholarship and public policy. We explore lived experiences of carbon mobilization in Bradford County, Pennsylvania, a community that, in the last decade, has gone through a shale gas boom and bust and has suffered from severe flooding. Interviews with social service providers and county leaders indicated that connections between the fossil fuel industry and climate disaster manifested most saliently around housing security—particularly the loss of housing due to floods and economic insecurity related to boom-bust cycles. Economic changes that gas development brought to the community made flood resilience more challenging for some, and easier for others. Perhaps surprisingly, the natural gas industry was a "double winner," benefitting from climate disaster by gaining a reputation for helping with flood recovery. We suggest that while global climate discourse may not resonate locally in communities that host fossil fuel extraction, people make locally-salient connections

between different stages of carbon mobilization, and these connections have important public policy and social justice implications.

Keywords:

Climate change; resource politics; boomtowns; housing; flooding; resilience

Introduction

In August 2018, a series of intense downpours inundated Bradford County, Pennsylvania. Quickly, dozens of the small creeks that are ubiquitous in the rural landscape escaped their banks, and debris rushed down stream channels, flooding roadways, cracking the foundations of houses, spoiling fields of crops just beginning to ripen, and destroying bridges. At least 400 homes and 17 businesses were affected, and losses totaled an estimated $30 million (Hallikaar, 2019). The residents of Bradford County, especially those in the county seat of Towanda and the towns located in what locals call 'The Valley,' had seen periodic flooding of the Susquehanna River, which runs through the heart of the county. But these flash floods were surprising. Not only did they come on quickly, but they also affected people living far from the river bottom – rural residents who had never experienced flooding before. In fact, these floods were consistent with predictions of the effects of climate change in Pennsylvania: a higher number of more intense precipitation events, leading to increased flash flooding (USGCRP, 2018).

When we visited the county some eight months later, the effects of the floods were still visible on the landscape, from downed trees and flattened grass to washed out bridges, piles of debris, and houses made unlivable and left to molder, their occupants moved elsewhere. On our second day in Bradford County, we stood with the county grants director on the main road in the

small municipality of New Albany (population 365). Buildings around us remained abandoned, some full of flood debris, and at our backs were the remnants of a bridge that had once connected a series of a houses to the main road. As we stood talking about the flood impacts, our words were drowned out by several large red and grey trucks rumbling by, bearing the Halliburton insignia. For the residents of New Albany, this sight was unremarkable, as a natural gas boom has been occurring here since 2008. Yet, for us, it was jarring to see these sentries of the gas fields juxtaposed with the debris of a flood that seemed to illustrate the perils of climate change.

In this article, we explore how residents of Bradford County, a community that has gone through a shale gas boom and bust over the last decade, experience and interpret *connections* between climate change impacts – specifically flooding – and fossil fuel extraction. While one might expect that fossil fuel infrastructures such as well pads, drill rigs, tailings ponds, and pipelines would be the flashpoints for boomtown climate politics, we find that the home is frequently where is most keenly felt. Indeed, in our study, connections between the fossil fuel industry and climate disaster manifested especially around housing security—particularly where the loss of housing due to floods intersected with economic insecurity related to boom-bust cycles.

Researchers have long grappled with questions about the globalization of environmental discourse and the variegated ways that people in particular localities experience and interpret 'global' transformations like climate change (Jasanoff and Martello, 2004; Taylor and Buttel, 1992; Tsing, 2000). The recent expansion of oil and gas development into previously inaccessible shale formations brings new focus to these concerns. Most literature on shale boomtowns has focused on the local phenomena that residents experience (pollution, economic disruption, population changes, etc.) (Burfoot-Rochford and Schafft, 2018; Finkel et al., 2013;

Jacquet et al., 2018; Perry, 2012; Schafft et al., 2014; Stedman et al., 2012). Yet outside of the boomtowns, there have been protests against the climate impacts of shale development, often focusing on infrastructure that connects boomtowns with other places, such pipelines and petrochemical facilities. Do people living in shale oil and gas boomtowns understand their climate change experiences in ways that align with global climate discourse, or do they interpret climate events (such as severe storms or droughts) in ways that reflect their local relationship with the oil and gas industry? Can understanding these locally-felt connections advance more effective climate policy and activism?

In addressing these questions, we introduce the concept of *carbon mobilization*: the multiple stages of fossil fuel extraction and combustion that may be experienced separately (as an economic boom, climate disaster, or air pollution, for example) or simultaneously, in locally distinctive combinations. The co-location of multiple stages of carbon mobilization produces complex configurations of "winners and losers" (O'Brien and Leichenko, 2000). For instance, local leaders and social service providers in our study explained that the economic impacts of gas development made flood resilience harder for some, and easier for others. They identified "double losers," for whom economic changes combined with climate changes to create major housing hardships. Surprisingly, we also found that the natural gas industry was a "double winner," benefitting from climate disaster by gaining a reputation for helping the community recover from the floods. This suggests that fossil fuel producers may, paradoxically, enhance their so-called 'social license to operate' by providing resources that enhance climate adaptation (at least in the short term). Fossil fuel companies thus may be able to maintain economic and social relations of dependency in host communities, in part *because* of climate change, rather than in spite of it (Nost, 2019).

We begin with a discussion of the everyday politics of North American boomtowns, followed by an explanation of our research methods. Next, we discuss the findings that are sketched out in the previous paragraph. Our study suggests that people make locally-salient connections between different stages of carbon mobilization, even when global climate discourse does not resonate locally in communities where fossil fuels are produced. These connections have important implications. It is often assumed that urgent action to halt climate change requires the cultivation of a planetary consciousness (Heise, 2008). But people make connections between the fossil fuel industry and climate impacts in locally-specific ways, rooted in lived experience. Fossil fuel producing communities may not adopt global climate change discourse, but still desire changes that align with climate justice – such as ensuring safe housing for all.

The everyday carbon politics of North American boomtowns

Significant local disruptions are associated with the 21st century North American energy boom and the extraction of oil and gas from shale (Eaton and Kinchy, 2015; Jacquet et al., 2018; Perry, 2012). Scholarship on shale oil and gas boomtowns has discussed how people experience and negotiate local environmental issues such as water contamination and air pollution (Kinchy, 2017; Matz et al., 2017), as well as social disruptions such as population growth and rising housing costs (Brasier et al., 2014; Schafft et al., 2018). Because of intersecting social identities and the distinctive characteristics of particular places, people in boomtowns have "differing levels of exposure to the risks and opportunities associated with development" (Schafft et al., 2019). This is likely true of boomtown experiences of climate risks, such as flooding, drought, and heat waves, but little has been written on this subject.

We expect that boomtown experiences of climate change will be uneven and locally specific, because 'climate' is a contested, multiple, and experientially-situated socio-natural

hybrid (Adger et al., 2013; Brace, 2010; Goldman et al., 2016; Harris, 2017; Hulme, 2016; Popke, 2016; Rice et al., 2015). For research on climate impacts, "the overall challenge is to effectively account for, and in so doing to valorize and legitimate, the diverse range of climate knowledges, practices and experiences, and to recognize that what climate change means emerges through the embodied, practical engagements that people have with their environments" (Popke, 2016: 3). Vulnerability and resilience to climate change are not formulaic measurements but value-laden concepts that pose normative questions with implications for contemporary inequalities and the enactment of different futures (Brown, 2014; Cretney, 2014; Cutter, 2016; MacKinnon and Derickson, 2013; Meerow and Newell, 2019).

This approach to climate research reveals new possibilities for climate action. As Rice and colleagues (2015: 254) write, "valuing people's everyday experiences of climate change and diverse ways of knowing climate (even when they might be scientifically imprecise) provides the possibility for people and communities to act on climate change through the knowledge and experience they already have." As an illustration, Rice and colleagues (2015) found that residents of Southern Appalachia envisioned and enacted socioeconomic transformations not as a result of scientific knowledge or legislative leadership but in response to cultural values and their own non-scientific observations of a changing climate. In this case, democratic action on climate change resulted not through the application of global scientific expertise but through the valorization of local experience (Rice et al., 2015).

Surprisingly, there are few studies of boomtowns that examine the experiences of climate change or emergent concepts of vulnerability and resilience. Not only are boomtowns increasingly common; they are also the site of extraction of the fossil fuels whose combustion leads to climate change. Thus, it is important to examine how people in these locations

understand the connections between fossil fuel extraction and climate change – and resist or acquiesce to the continued removal of carbon reserves from the Earth.

Moreover, boomtown experiences of climate change have the potential to illuminate broader debates on the scalar dynamics of climate politics. There is a noted spatial tension in literature on place and climate consciousness. On the one hand, people cultivate strong attachments to their 'home' places, and thus some authors argue that this is the appropriate scale for mobilizing climate consciousness and producing climate knowledge (Hulme, 2010; Nicolosi and Corbett, 2018). On the other, some argue that a *global* sense of place, or a "sense of planet" is strongly correlated with concern for climate change (Devine-Wright et al., 2015; Heise, 2008). People can experience and conceptualize climate change at different scales, noticing local impacts while imagining themselves as global environmental citizens, for instance. However, how these scales of analysis and experience interact is not well understood, and is likely context-specific. Similarly, different temporal aspects of climate change are experienced simultaneously in boomtowns. Present-day extraction and the 'future' impacts of emissions are felt at once, illuminating tensions between the immediacy and deferral of climate change (Bowden et al., 2019). Studying boomtown experiences of climate change can provide insight into these scalar tensions because the effects of fossil fuel extraction are experienced both as local, direct impacts and as the result of global processes of climate change. Thus, new dimensions are added to the complex interplay of local and global awareness and attachment that informs climate change perceptions.

We propose the concept of *carbon mobilization* to aid in analyzing how experiences of fossil fuel extraction and climate change are connected, as part of one multi-scalar process – both spatially and temporally. Carbon mobilization is a term used by ecological scientists to describe

fluxes of carbon between different matters and environments. We use the term somewhat differently to describe the socio-natural process by which the carbon in fossil fuels undergoes various forms of extraction, transportation, processing, storage, combustion, and eventual release into the atmosphere, setting into motion various effects along the way. This idea enables us to analytically separate people's lived experiences of industrial changes (the gas boom) and climate change (recent severe floods), to explore how their connections are locally constructed and experienced. Our use of carbon mobilization builds on other attempts to conceptualize the process of carbon extraction and combustion more holistically, while highlighting that in extractive regions, the many stages of carbon mobilization – such as boom and bust cycles, air pollution from combustion, and climate change – happen simultaneously (Bridge and Le Billon, 2017). Yet people in such places do not experience these combined effects uniformly, and some stages of carbon mobilization may be more salient than others.

We follow calls to identify winners and losers when it comes to climate change impacts, knowledge, and governance, rather than seeing these as neutral phenomena (Betteridge and Webber, 2019; Cutter, 2016; Nost, 2019; O'Brien and Leichenko, 2000). Here, our approach builds on O'Brian and Leichenko's (2000) influential research on "double exposure" to climate change and economic globalization (Leichenko et al., 2010; Leichenko and O'Brien, 2008; O'Brien and Leichenko, 2000). They argue that both climate change and economic globalization result in new sets of winners and losers, and that because these processes occur simultaneously, some people will become "double winners" or "double losers" based on these compounded effects. The language of winners and losers is helpful for drawing attention to those whose needs are likely to most often be overlooked: the "double losers" who have been negatively impacted by both gas development and flooding. It also reminds us that some surprising beneficiaries

might emerge. In our case, we find that gas companies, perhaps counterintuitively, appear as "double winners" from the compounded impacts of gas extraction and climate change. Yet, we also follow O'Brien and Leichencko (2000) in emphasizing that who is considered a "winner" or "loser" varies with context, scale, and perspective.

This brief review has located boomtowns as sites where the scalar and temporal politics of carbon are experienced and amplified. Matters of responsibility, agency, knowledge, and embodied harm related to the extraction and distribution of carbon and its impacts form the basis for carbon politics in boomtowns and beyond. To fully appreciate these carbon politics, climate change and fossil fuel extraction must be conceptualized as parts of the same process – carbon mobilization – and as having intersecting and multi-scalar impacts. Having outlined some conceptual elements that help us understand the stakes of considering the carbon politics of boomtowns, we now move to an empirical example that highlights boomtown housing as a site where these politics come into relief.

Context and methods

We took a case-study approach, which allows us to "examine not only the complex of life in which people are implicated but also the impact on beliefs and decisions of the complex web of social interactions" (Orum et al., 1991: 9). Bradford County, in northeastern Pennsylvania, is the site of our study. Thanks to the development of the Marcellus Shale, Pennsylvania has become one of the largest natural gas producers in the US, second only to Texas according to US Energy Information Administration statistics. The state's natural gas production increased steadily from 2007 to 2011, but has recently slowed, due largely to dwindling natural gas prices (Kelso, 2019; Legere, 2019). Bradford is among the Pennsylvania counties with the highest density of shale gas wells, and where cycles of boom and bust have left a marked impact on

towns and businesses. Furthermore, in the last decade, residents have suffered from serious river flooding and flash flooding, the kinds of weather events associated with the growing intensity and unpredictability of the climate crisis (USGCRP, 2018). For these reasons, Bradford County provides a rich case in which to explore how people experience multiple stages of carbon mobilization.

Bradford is among the largest counties in Pennsylvania, but it is sparsely populated, with a population of around 60,000 and only three towns with more than 2,000 residents.[1] The 2019 American Community Survey estimates show Bradford County to be whiter (96.7%) and older (median age 44.5) than the general US population. Most residents are politically conservative, with over 60% of voters registered as Republicans, according to Pennsylvania Department of State statistics.[2] The county is historically a region of family dairy farming and natural resource extraction (primarily coal and timber).

With the shale gas industry came an influx of out-of-state workers, the construction of new hotels and 'man camps,' thousands of heavy trucks on the road, and major landscape disturbances. Economic growth was welcome at a time when Pennsylvania's rural communities were facing significant hardships. Although direct employment by drilling companies accounts for a tiny proportion of jobs, it brings employment for truck drivers, steel workers, restaurant workers, and others. Since the beginning of the boom, these jobs have waxed and waned with drilling activity in the state. In addition to jobs, the county has benefited from impact fees that are paid by the drilling companies to the state and returned to the county governments. In 2018,

[1] Sources: American Community Survey demographic and housing estimates (2019) and Statistical Atlas (https://statisticalatlas.com/county/Pennsylvania/Bradford-County/Population#figure/place).

[2] Source: https://www.dos.pa.gov/VotingElections/OtherServicesEvents/VotingElectionStatistics/Pages/VotingElectionStatistics.aspx. As of January 4, 2021, there were 37,284 voters in the county, with 23,520 registered as Republicans.

the county received over $6 million in impact fees, according to the Pennsylvania Public Utilities Commission.

Development of the Marcellus Shale is associated with many environmental and public health concerns. Wastewater management is a significant environmental challenge (Colborn T, Kwiatkowski C, Schultz K, Bachran, 2011; Entrekin et al., 2011; Maloney et al., 2017). Other local environmental problems arise from increased truck traffic, construction processes, and air emissions from natural gas infrastructure (Michaels et al., 2010; Wylie, 2018). Nationwide, anti-"fracking" activism has brought widespread attention to the dangers of the industry for people exposed to it, and in some parts of Pennsylvania community activism has stymied the construction of pipelines and other infrastructure (Jalbert et al., 2017; Sicotte and Joyce, 2017). Furthermore, recognition of the climate impacts of shale gas development has led to recent proposals for regulatory changes in Pennsylvania, although some environmental groups have called for more significant steps, such as replacing all fossil fuels with renewable energy in the next fifteen years (Sisk, 2019).

Our research strategy was to interview people who worked in positions relevant to emergency responses to flooding and preparations for flood resilience. One of us (AUTHOR) had previously conducted field work in the county, close to the start of the gas boom. This enabled us to easily identify relevant organizations and individuals. We reached out to contacts in the County Commission, Department of Community Planning & Mapping Services, the Department of Public Safety, the Conservation District, the Emergency Management Agency, the Housing Rehabilitation Department, Penn State Cooperative Extension, the American Red Cross, and United Way. We contacted them by email, explaining that we were conducting "a research study that explores how people living in oil and gas boomtowns think about, prepare

for, and adapt to flooding caused by heavy rainfall." We soon learned that many of these agencies and organizations work closely together, and several of our contacts suggested group interviews, often including additional people that we had not previously identified (such as homeless shelter and food pantry staff). We agreed that this would be an effective way to gain a broad overview of the work on flood resilience that is occurring in the county, including an understanding of how the different leaders and experts work together. As a result, we conducted three individual interviews and three group interviews, with a total of 19 participants. The three group interviews can be summarized as: a) emergency social service providers, b) county commissioners, and c) emergency planners. The individual interviews were with people having additional forms of expertise related to flood response in the county. Aside from one unstructured interview that involved a tour of flood sites, the interviews took place in meeting rooms normally used by the participants in the course of their work (e.g. a conference room where social service providers have their monthly meetings). These interviews provided a comprehensive view of county leadership on the issue of flooding but did not provide us with firsthand perspectives of flood victims.

Each interview lasted between one hour and 90 minutes. Aside from the interview that occurred during a county tour, the interviews were semi-structured, using an interview guide that focused on the following themes: 1) the previous year's catastrophic flash floods, 2) preparation for future flooding events, 3) the expertise and organizational resources that they rely upon when dealing with flood preparedness and recovery, 4) the effects of natural gas development on the county's capacity to prepare for and recover from floods. We recorded the interviews and transcribed them immediately, adding our contextual notes. Together, we coded the transcripts, first using open codes (to describe the content of each statement) and then focused codes linked

to our emerging analytical framework. Throughout, we took a grounded theory approach, continually reviewing our empirical data against published literature to arrive at the double exposures framework and the concept of carbon mobilization as a way to conceptualize these dual pressures on housing (Charmaz, 2001). We then systematically reviewed and summarized the interview excerpts that were coded for each of the main themes, which allowed us to reach the conclusions described below.

Interviewees spoke openly about a wide range of issues that concerned them. We learned that there have been major debates regarding 'cleaning' the streams (removing sedimentation, logs, etc.), and that farmers faced significant losses because of the floods. Some people spoke of frustration with the lack of adequate forecasting resources for the region, and we repeatedly heard about the community's distrust of the government and avoidance of government assistance. But across all of the interviews we were struck by the repeated references to struggles people are facing with respect to housing.

The subject of housing was notable because it revealed the convergence of pressures resulting from the natural gas boom-bust cycle and the intensification of heavy downpour events. The home is a particularly important site where multiple dimensions of carbon mobilization are lived simultaneously. The cheap availability of fossil fuels is entrenched in the pattern of single-family homes and automobility (Huber, 2013). The home is where climate identities are felt and formed (Dowling, 2010), and it is often targeted as a site of responsibility for environmentally sustainable consumptive practices, although this fails to account for larger structural causes of climate change (Gibson et al., 2011). Households also have been a locus of concern for environmental politics associated with fossil fuel development. For example, fracking-related contamination of domestic water supplies gained national attention through the film *Gasland*

(2010) and in other media, as well as within host communities. Yet households are more than places of consumption or environmental damages; they are the conventional site of social reproduction, and "they are social assemblages – *homes* – in which families bond, people invest emotions and undertake all kinds of identity work" (Gibson et al., 2011: 4). When they are flooded or otherwise damaged and destroyed, so too are key relations of care disrupted (Sims et al., 2009). Therefore, it should not be surprising that, in this study, the home emerged as central to lived experiences and interpretations of climate change.

In the sections that follow, we address each of the relevant 'exposures' separately (gas boom and bust, climate change), before showing how their intersection produces double losers, some offsets, and a surprising double winner.

Housing effects of the natural gas boom

The development of the Marcellus Shale in Bradford County has had profound implications for people living in all kinds of residences, from owners of large farms to people experiencing homelessness. These housing situations are a key part of the web of social interactions that shaped their experiences of the Marcellus Shale development.

On our tour of some of the flood-impacted areas of the county, our guide, who manages a program that helps with housing rehabilitation, explained the broader economic context. Having moved to Bradford County about five years earlier when house prices were high, she explained that now her mortgage debt is greater than the value of her house. As for renters in the county, she reported people being evicted because their landlords wanted to rent to gas industry workers instead, because they could pay higher rents. She went on:

> So now we've got homeless [people]. And the housing stock here is not any better. We have an active list of housing rehabs and we're actually going to run out of money before

> we get to some of the people on the wait list. So it's a fine balance for me because I'm [telling people] "the housing rehab isn't to make your housing stock better, it's so that code enforcement doesn't condemn your house." So that's how bad it is. I don't see the success in the gas industry here now.

Later, she elaborated that low-income county residents did not see their conditions improve in the gas boom. Rather, she said, "It's made their lives harder, because everything's run up, cost wise. And just, I think the poor got poorer […] there's a huge hole and they're just not digging themselves out."

It is commonly imagined that landowners in the northeastern US are profiting from the exploitation of their mineral rights. Indeed, in contrast to regions where 'split estate' situations prevail, when the Marcellus Shale gas boom began, most landowners in Bradford County owned the rights to the natural gas in the shale under their property and were thus able to lease them in exchange for royalties and sometimes signing bonuses. However, these economic opportunities are limited by a number of factors. First, economic benefits tend to accrue to the largest landowners. Although most residents of the county are landowners, 69% of property owners have fewer than 10 acres of land (Kelsey et al., 2012). Second, even for larger landowners, widely fluctuating natural gas prices have frequently resulted in low or nonexistent royalties. Issues with un- or underpaid royalties have been well documented, and local leaders informed us that in 2019 some drilling companies were actually sending bills to landowners, claiming that gas revenues did not exceed expenses associated with gas production (Lustgarten, 2013). Third, while producing wells can improve property values, property values are often negatively impacted by proximity to active gas drilling sites, especially if the homes rely on groundwater (Gopalakrishnan and Klaiber, 2014; Muehlenbachs et al., 2015). Nevertheless, for some larger

landowners the additional revenue allowed some to make minor home improvements or to survive other financial setbacks. For instance, one farm advisor shared his perception that the income from gas wells was “modest,” but that these payments helped dairy farmers survive during a five-year period of severe economic stress.

Gas development not only failed to deliver widespread positive impacts to the housing situations of property owners. It also brought overwhelming challenges to renters – about 25% of households in the county (Kelsey et al., 2012). Prospective first-time homeowners encountered significant obstacles. A study of several gas-producing counties in 2015 found that there were few to no "starter homes" on the market (Williamson and Kolb, 2015). Older homes required expensive rehabilitation, and first-time buyers were frequently unable to get needed loans for these repairs (Williamson and Kolb, 2015: 21). Furthermore, developers were not building new affordably-priced homes because they did not find them profitable. Finally, there was a lack of available land for building new homes, since landowners, speculating on potential profits from mineral and surface rights, were frequently unwilling to sell parcels of their land (Williamson and Kolb, 2015: 22–23).

Yet staying in rental housing became economically challenging for those living through the gas boom. As explained in one study:

> The ramp up of Marcellus development caused a shortage of rental housing units, with low income individuals and families being most affected. As housing became in short supply, prices rose. The better quality apartments were taken by gas employees at high rents. Everyone else had to settle for living in lower quality apartments with higher rents, causing a housing crisis that forced those in the lowest quality housing out of the rental

market into couch surfing or other forms of homelessness. (Williamson and Kolb, 2015: 1)

Although the situation stabilized since the initial height of the boom, rents remained high and good-quality affordable housing was still in limited supply, with many properties actually declining in value as a result of having been rented to gas workers (Williamson and Kolb, 2015).

People in the social service sector in Bradford County corroborated this statewide study with local observations. They asserted that wages were not keeping pace with rental costs. Most people were not employed in the gas industry and could not afford rentals aimed at gas workers. Many of those who did secure higher paying jobs during the gas boom had lost them during the bust. In such cases, we were told, people could not keep paying the rent on the homes that they leased when they had higher-paying jobs. One person who works with low income residents said that it was "virtually impossible to stay here if you're on one income, like working at the Dandy [Mini Mart]." This was especially true for those who do not qualify for low income housing, or remain on a waiting list for housing assistance. Our informants described long waiting lists for Section 8 housing or public housing units. This problem is explained in a 2018 study:

> Housing voucher amounts have to fall within "fair market rent"—a calculation based on rental cost data from the preceding several years, but prices had risen so quickly that rental prices for the preceding years in no way accurately reflected rental prices at the height of the housing demand. …In many cases, families who did receive vouchers were unable to use them, as they could not find rental properties that fell within the price range covered by the vouchers. Additionally, the office's overall budget for vouchers remained the same, meaning fewer families overall could receive vouchers. By 2014, fair market prices had finally caught up with current housing costs. Nonetheless, regional demand for

Section 8 vouchers was so high that the housing office was forced to close the vouchers wait list for the first time in nearly 30 years (Schafft et al., 2018: 523–524).

The high price of rental units has led to rising rates of homelessness - a previously uncommon phenomenon in the county (Schafft et al., 2018: 523). In 2010, James Meehan, the regional housing coordinator for a program that serves Bradford and surrounding counties, testified to the Pennsylvania Senate Urban Affairs and Housing Committee that the regional homeless rate had increased by 20%. He explained: "Small counties without homeless shelters historically use hotels as temporary housing resources. Hotels in our region are booked full with gas industry workers leaving some Homeless Assistance Programs with nothing to offer homeless individuals and families" (Meehan, 2010). He further indicated that victims of domestic violence were returning to abusive homes because they lacked other housing options, and a growing number of children were being placed in foster care because their parents were unable to provide safe housing. Bradford County does have one small homeless shelter, but for many, losing secure housing means moving from couch to couch or sleeping in a car.

Climate change impacts on housing

We now turn to another stage in carbon mobilization, the production of climate change, experienced as changing rainfall patterns. From a scientific standpoint, the links between the processes of natural gas extraction and flooding are evident. Natural gas extraction produces high levels of methane, a greenhouse gas 80 times more potent than carbon dioxide and prone to leakage along the supply chain (Alvarez et al., 2018). This challenges narratives of natural gas as a 'clean' fuel and draws attention to the climate impacts of its extraction and processing, not simply consumption/combustion.

The climate impacts of fossil fuel development are experienced globally, including in the places where extraction takes place. Climate change has clear links to changing patterns of flooding in Bradford County. Even when they did not frame it as climate change, research respondents noted trends in precipitation and flooding that correspond to observations and predictions from the 2018 National Climate Assessment for the region (USGCRP, 2018). Although it is impossible to pin any one flood event on climate change, evidence suggests that periods of heavy rainfall that lead to flash flooding are becoming more frequent and more intense, and that this trend is likely to continue (NOAA National Centers for Environmental Information, 2017; USGCRP, 2018). In addition to flash floods resulting from periods of intense rainfall, higher temperatures combined with heavier precipitation will likely result in increased risk of flooding from earlier snow melt (USGCRP, 2018). The 2018 floods are indicative of these broader changes, and many respondents in our research mentioned the deviation from predictable river flooding as a notable and surprising element that made both flood prediction and recovery more difficult.

Both river and flash flooding are exacerbated by climate change; this is recognized at the federal level as the Federal Emergency Management Agency (FEMA) flood maps for Bradford County have been updated at least twice in the last decade. Whilst residents had become familiar with river flooding (especially following the 2011 floods of this nature) the flash floods of 2018 were unexpected. As one emergency manager stated, “flash flooding is totally different from river flooding because there is no warning time, and people aren’t prepared for it.” Another respondent said, “anyone could be victim of flash flood, even if you haven’t seen it [before].” This dynamism of flash flooding vulnerability is well noted elsewhere (Cutter et al., 2018; Ruin et al., 2008; Terti et al., 2015).

Effects on housing were among the most pressing impacts of the 2018 floods. Around 400 homes were affected. Moreover, 19 access bridges across small streams were also destroyed, effectively preventing dozens of families from easily reaching their homes. Flood damage to housing infrastructures includes waterlogging, structural damage due to fast-moving debris, harm to foundations, damage to gas tanks, and mold. Those with flood insurance received a payout, but, due to the novel nature of flash flooding, many who were affected had not previously perceived a need to purchase flood insurance.

Smith and Birkland (2012) explain that recovery should not be considered a linear process. Recovery "is more accurately described as a complex array of overlapping, often uncoordinated activities," and this was evident in Bradford County (Smith and Birkland, 2012: 156). A dedicated team from various local agencies coordinated immediate and long-term flood recovery, and liaised with state and federal agencies, especially FEMA and the Pennsylvania Emergency Management Agency (PEMA). However, the 2018 floods did not receive a national emergency declaration, and thus FEMA did not provide individual financial assistance for flood recovery. Bradford County is not exceptional in this regard; indeed "most U.S. disasters are small, localized events that do not meet federal disaster declaration criteria and therefore do not receive federal financial assistance" (Smith and Birkland, 2012: 148). The recognition that severely damaging floods occur without reaching the threshold for federal assistance has shaped the recovery and mitigation response.

For some households that had experienced significant and/or repeated housing damage, federal buyouts from FEMA or HUD were presented as the best option. At the time of our visit, 63 households had been identified to potentially receive buyouts. The goal of buyouts is to voluntarily move people out of vulnerable structures in the flood hazard zone; FEMA sees

buyouts not as flood recovery but as mitigation. In the buyout process, state and local government officials work with homeowners to identify potential properties, determine eligibility, and apply for the program. Potential projects must comply with various regulations, including having an approved hazard mitigation plan. If projects are approved, and homeowners 'opt in,' their houses are purchased using federal funds for their pre-flood market value (Greer and Binder, 2017). The process of buyouts is not uniform and several years can elapse between the disaster and inhabitants successfully using buyout funds to secure new housing (Muñoz et al., 2016). Buyouts do not exist in a social vacuum; they shape and are shaped by conditions of inequality and vulnerability, as well as relations between homeowners and local government officials (de Vries and Fraser, 2012; Muñoz et al., 2016). The availability of affordable housing, and the capacities of households to withstand delays and negotiate complex processes are only some of the factors that impact whether buyouts are an attractive or feasible option. Therefore, while buyouts were presented as the best option for some residents, they are certainly not without complication.

Wider resilience efforts, including stream management, were also being undertaken by natural resource managers and community planners. These efforts were controversial, and resource managers told us that residents were eager for engineering interventions such as streambed excavation and debris removal, but less keen for more transformational adaptations to climate change. Furthermore, as we describe below, these county leaders felt their community could only address local issues; little could be done about climate change. In sum, questions of adaptation (or acquiescence) to flooding were complex, and likely to become even more so as precipitation patterns change in the region. Although many interviewees agreed that it was best to keep homes out of the floodplain, adjusting to a changing floodplain geography posed more

challenges and elicited conflicting ideas of what should be done. Moreover, respondents keenly noted that the challenges of living with a changing environment were fully social and political, especially when they involved the potential displacement of people who had occupied the same land for generations.

Intersecting exposures

In previous sections, we outlined how residents of Bradford County are doubly exposed to the impacts of natural gas extraction and climate change (in the form of flooding). In this section, we show what can be gained when we interpret the intersections of different stages of carbon mobilization with the double exposure framework. Leichenko and colleagues (2010: 967) explain that "one process can influence the capacity to respond to shocks and stresses associated with the other process."

We first considered this double exposure in terms of impacts on gas infrastructure. Flooding can clearly have deleterious environmental and human health impacts when it occurs at the site of natural gas extraction. One county employee said, "You would hope that [the drillers] are forward thinking enough that they're not going to punch a four-million dollar hole in the ground if it's in the flood zone." Environmental permitting generally prohibits gas drilling from flood zones, but other vulnerable infrastructures may be located there. Further, the unpredictable nature of flash floods and outdated floodplain maps may mean that some installations are flooded. The flooding of pits where fracking wastewater is stored, which are not prohibited from floodplains, especially poses risks (Atkinson and King, 2012). Additionally, the sudden onset of flash floods could result in lack of preparation, for example stranding vehicles carrying dangerous chemicals on flooded roadways. However, our respondents said little on these topics. In conversations with social service providers, some debated whether the infrastructure of the gas

industry could complicate flood response. Some suggested that "there's a lot of controversy" on that point, while others placed faith in regulations and rules. It seemed that the vulnerabilities of gas infrastructure is a sensitive topic in the county (given a contentious history of spills and well blowouts), and the group interview format was not suitable for exploring these potential concerns.

Another possibility is that potential impacts to natural gas infrastructure were a less tangible concern than the pressing impacts to housing and the need for continued flood recovery efforts since 2018. Many people with whom we spoke repeated the phrase "neighbors help neighbors" when speaking of flood response in Bradford County. Yet, these social networks did not extend to services and organizations that that were perceived as connected to government. To the frustration of some county government officers, a strong discourse of self-reliance permeated the community. Islam and Walkerden (2015: 1707) argue that "for longer-term recovery, disaster victims usually need support through *linking* social networks, for example from local government, NGOs, and other community-based organizations." However, in this case, people generally distrusted or refused help from government agencies and staff.

Our informants shared valuable, but contradictory, insights about how gas development may have affected these necessary linking social networks. One county employee involved in flood prevention projects described his difficulties getting people to sign contracts for scheduled work, speculating that this was due to previous negative experiences with gas industry "land men" coming to their doors with contracts to sign. He believed that people who saw first-hand negative effects of gas development were "resistant to further change" and "don't want to make that mistake again." Conversely, many interviewees stated that people in the county had a strong aversion to government assistance, and looked more favorably to aid from the gas industry. A

leader of a charitable organization said, “A lot of time you have people who aren’t asking for help, aren’t going to the agencies. But gas companies have helped with this.” She mentioned that the gas companies even went door-to-door to find people who needed help after the floods.

O’Brien and Leichenko’s schematic of “winners” and “losers” helps to make sense of the shifting geographies of risk and responsibility surrounding housing in Bradford County. From our research, it was evident that those who had been disadvantaged by the gas boom were “double losers,” struggling the most to recover from flood impacts. While the physical geography of flash flooding clearly impacts exposure patterns, respondents almost uniformly cited poverty as the main factor inhibiting individuals’ recovery, exacerbated by the lack of individual federal funding that would have come with a national disaster declaration. In a report that addresses the 2011 floods, Williamson and Kolb (2011) highlight the limited options for Bradford County residents whose homes were destroyed, including moving in with relatives, using temporary shelters that had been established in fire halls and churches, and camping out. Likewise, few options were available to residents after the 2018 floods, and as in 2011, the floods intensified pressures on housing caused by the gas boom. When asked who had capacity to recover from floods, research participants indicated that wealth played a major role. In a context where the gas boom has produced what local residents refer to as ‘haves’ and ‘have-nots,’ the individual economic impacts of the boom affected flood recovery. For example, people who owned more land gained more gas royalties (even if these were not as generous as expected), so they had an economic cushion to aid in recovery.

The unpredictable and spatially variable nature of the flash floods in 2018 compounded these issues as people on lower incomes were less likely to have purchased flood insurance or made flood-proofing improvements to their homes if they had not experienced flooding before.

While frequently touted as the best option from both within and outside of the county, federal buy-outs were an imperfect solution to the problem as there was little available housing that could be purchased with buy-out funds. Consequently, most people who took buyouts did not purchase new homes in the area but rather went to apartments or low-income housing – although these forms of housing are also in short supply. For some people, lack of financial resources meant that they had to leave the area altogether when their homes were destroyed by the flood.

Individual inequalities were echoed in inequalities between different municipalities within the county. New Albany is a small town that was hit especially hard by the floods. One county commissioner said: "New Albany is the quintessential poor community. Not poor in community spirit. But they got about 150-200 homes. They take in $14,000 in property taxes, not enough to pay a secretary. It was pounded three times in a row, it lost its library… lost their sewer system, and park." Another commissioner said in reference to New Albany, "I don't foresee how they can be recovered for a decade. How can they fully recover?"

Yet, we also observed that some impacts of climate change were at least partially "offset" by the local natural gas industry, a phenomenon also noted elsewhere (Angell and Stokke, 2014). Communities with extensive flood loss and small tax bases relied more heavily on county, state, and federal funds, along with impact fees from the gas industry. At the county scale, the presence of the natural gas industry strengthened the county's capacity to respond to flood emergencies in several ways. First, county commissioners explained that the county was able to assist municipalities with recovery, using revenue generated by the gas industry. For instance, the county commissioners asserted that the county was able to pay for the repairs to New Albany's sewer system from gas revenues.

Second, gas workers provided essential labor during flood cleanup efforts. For instance, during the 2011 flood that submerged much of Athens Township, and in the aftermath of the 2018 flash floods, gas workers were directed to assist with the recovery effort. Multiple people we interviewed said that this enabled the community to recover much more quickly than other flooded communities where the gas industry was absent. They did note, however, that the gas companies billed the county for the workers' hours; their aid was not altruistic, although some still perceived it to be.

A third example illustrates how gas revenues might offset the housing shortages associated with flooding. Previously-mentioned impact fees are redirected toward the gas-producing counties through various mechanisms, including a program that funds housing rehabilitation. According to its website, the Pennsylvania Housing Affordability and Rehabilitation Enhancement Fund (PHARE) is intended to "assist with the creation, rehabilitation and support of affordable housing." Through PHARE, $5 million collected through Marcellus Shale Impact Fees are being directed annually to municipalities across the state where shale gas wells are located, to address the need for affordable housing. Bradford County has received such funds to help with housing rehabilitation. Impact fee revenues also fund a statewide Flood Mitigation Program, which distribute revenues generated by the natural gas industry across the state. Nonetheless, it is also worth considering how counties without oil and gas development figure into our analysis of winners and losers. Climate change will intensify flooding across the state, whether or not counties can count on natural gas royalties and the natural gas workforce to aid with recovery.

Our interviewees generally regarded the natural gas industry as helping, rather than hurting, the county's flood resilience. Many mentioned the efforts of gas company workers in

aiding with flood cleanup and saw that those who had financially benefited from the industry were more able to recover in the longer term. While we might expect that flood events would cause people to be wary of an industry that contributes to global climate change, in each instance of 'helping' with local flood recovery, the natural gas industry built social capital within the community, further cementing the county's reliance on gas development and enhancing public perceptions of the gas companies and workers. The tightening of ties between the gas industry and the county means that alternative paths of economic development – and critiques of the gas industry's climate impacts – become less likely. Thus, gas companies used the flood events to strengthen their social license to operate.

While scholarship on social license to operate is still relatively young, it describes how extractive industries secure community assent in excess of government regulation (Gunningham et al., 2004; Prno and Slocombe, 2012). By securing a social license to operate, mining companies minimize "social risks," including protests, blockades, and negative media and political campaigns that mark this increasingly contested industry (Bridge, 2004; Prno and Slocombe, 2012). There are many ways that companies obtain a social license to operate, including a range of practices seen to align with current development goals and standards for community participation, along with more coercive measures (Ofori and Ofori, 2019; Zalik, 2011). When companies contribute to flood recovery assistance, they help to secure their social license to operate, paradoxically benefitting both from extractive activities and climate change impacts. Moreover, by representing themselves as ethical stakeholders in the management of climate impacts, fossil fuel companies can shape the terrain of possible actions, in ways that "leave intact economic relationships that generate vulnerabilities" (Nost, 2019: 35). Thus, the

very impacts that should sow doubt toward the sustainability of fossil fuel extraction actually become opportunities for the industry to further cement their place in local communities.

Social license to operate is both increasingly important and not guaranteed in the Marcellus, as in other sites of extraction worldwide (Prno and Slocombe, 2012). Zalik (2009) and others have demonstrated that social license to operate is attained through heterogeneous mixes of coercion and consent; through both philanthropic initiatives and security apparatuses. In Bradford County, one county official distinguished the "good operators" as those that have a "permanent presence."

> They have people whose job it is to go to the Chamber of Commerce meetings, be with the conservation district, sponsor this event. They're going to be a big player in our Earth Day celebration this month. And I get it, they may not be altruistic in nature but they're doing the right thing anyway so who cares. They ingrain themselves in the community, and you can count on them to let you know.

In this case, the ways in which consent is obtained through assistance with flood recovery can be explained as mobilizing a form of "corporate oxymoron." In Benson and Kirsch's (2010: 45) formulation, corporate oxymorons are discursive constructions - such as 'sustainable mining,' or 'safe cigarettes,' deployed to "to conceal the contradictions of capitalism and promote business as usual." In the case of Bradford County, flood recovery led by 'gas industry climate allies' is expressed in actions rather than words, but the effect is to "ingrain themselves in the community."

This may explain why scalar tensions emerged when we asked local leaders whether they used the terminology of climate change in their work with flood-affected communities. People seemed reluctant to articulate connections between local gas development activities and global

climate change; likewise, flood events were framed at the local scale. None of the people we interviewed spoke explicitly about climate change with the communities they served. One elected official said that he believed the changing weather patterns were cyclical, and furthermore insisted that natural gas development was not the cause. However, this was the only instance of climate change denial that we encountered; others said they understood that climate change is the reason for more destructive rainfall patterns. A county scientist said that in his job he communicated to people that more intense and frequent rainfall is the "new norm," but that he avoids the polarizing term "climate change." A county commissioner concurred, saying that people in the county recognize the emerging risks, but that, "there is a whole different discussion when it comes to saying is there something we could do about that, as opposed to just preparing for it." An emergency management officer elaborated: "If you broad brush [increased flood risk] as climate change, it's not a local issue, and there's nothing you can do about it." He described the perception that climate change is "somebody else's problem, we're all victims. Nothing we can do about it, it's too big." In contrast, emergency preparedness was something that could be addressed locally. Flood preparation efforts focus on local response and adaptation, rather than preventative efforts to slow the production of greenhouse gases.

When we asked people about climate change, we noticed that only one of the people we interviewed drew unprompted causal connections with gas development, further evidencing the scalar tensions and disconnects at work. Goldman and colleagues (2016: 32) have noted that "conflicts over knowledge about climate are usually about a lot more, about ontological differences." Here, we suspect that relationships with the gas industry make people reluctant to articulate causal connections between local natural gas extraction and global climate impacts.

Indeed, most people we interviewed emphasized that gas development had been *helpful* for coping with the local impacts of flooding.

In this context, the natural gas industry emerges as a "double winner." Despite multi-scalar environmental harms, the industry retains its hold on specific geographies, not only through the (uneven) distribution of benefits such as jobs and royalties, or even through discourses of 'clean fuels' but also by constructing climate change as something separate from its operations. When climate change and fossil fuel extraction are understood as producing separate but overlapping impacts, the fossil fuel industry can position itself as proactive, helpful, and even necessary to climate disaster recovery.

Conclusion

Our results affirm recent literature that shows vulnerability, exposure, adaptation, resilience, and related concepts to be subjective, dynamic, value-laden, and temporally and spatially situated rather than static descriptors of entire communities (Brown, 2014; Cretney, 2014; Cutter, 2016). Putting this literature into conversation with the notion of carbon mobilization, we are better able to understand the lived impacts of multiple and intersecting processes of fossil fuel extraction. In Bradford County, temporal scales of climate change are collapsed as boomtown residents experience the effects of different stages of carbon mobilization at once, and these 'double exposures' are especially felt at home. This case study—while perhaps unique—can provide insight into a set of conditions that will affect more people as fossil fuel extraction expands further into communities and climate change continues apace. Boomtowns are key sites for understanding the spatial and temporal scalar politics of climate change, as imaginaries of global processes inform local relationships between gas companies and host communities – and vice versa.

While climate activists and policymakers have perhaps rightfully written off conservative oil and gas producing counties as unlikely to contribute to the fight for climate justice, we believe these findings suggest an alternative way to think about climate politics in such places. The county leaders we interviewed expressed little hope of halting or slowing climate change—preferring to focus on 'local' efforts at resiliency. Yet, as we noted, threats to housing stability did not only stem from flood events; they were also widely recognized as a consequence of the gas industry's uneven economic effects on the region. This means that rather than merely "bouncing back" to the status quo, resiliency requires alternative relationships with the energy industry, as experienced at the local scale. While gas drillers may deepen their ties to the community by providing assistance and resources in climate emergencies, such gestures would likely seem insufficient if other economic opportunities were available.

One implication of our research is that climate policy, housing policy, energy policy, and rural development policy are deeply intertwined and should not be treated as separate arenas. All three policy areas must be oriented toward securing safe and affordable housing conditions for people who are disadvantaged both by climate change impacts and boom-and-bust cycles of resource extraction. Furthermore, when viewed from the perspective of those displaced by simultaneous boom-bust cycles and floods, it becomes clear that a goal of energy policy should be to develop energy sources that not only reduce climate impacts but also support economic stability for the communities that host energy infrastructure. Without policies that advance a hopeful vision for life in places like Bradford County, local leaders and individual landowners will have few choices but to support continued extraction of fossil fuels, with its harmful boom-bust cycles and climate impacts.

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