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MAKING SENSE OF ENERGY TRANSITIONS LOCALLY: A STUDY OF THE SHIFTING  
SHALE GAS LANDSCAPE IN NORTHEASTERN PENNSYLVANIA

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Dr. Robin M. Leichenko

And approved by

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## **ABSTRACT OF THE DISSERTATION**

Making Sense of Energy Transitions Locally: A Study of the Shifting Shale Gas  
Landscape in Northeastern Pennsylvania

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Over the coming decades, it is likely that many places around the United States and around the world will be transformed by new efforts to produce unconventional fossil fuels. Before this development is fully underway, it is important to better evaluate how these technologies are grounded in the character of particular regions. This study sets out to gain a foothold into the ways that new unconventional energy projects and particular places are co-shaping one another. I argue that this objective can be realized by engaging and deepening dialogue between research on socio-technical transitions and research on the community experience and regional economic geographies of resource and industrial development. The overarching research questions here are: How are niche projects and regime dynamics shaped by local context. In turn how are local conditions shaped by energy projects? How do they co-evolve as socio-technical projects? I examine these questions through a case study of shale gas development in

northeastern Pennsylvania, which is a new place of energy development that is only recently gaining research attention. A main objective of this dissertation is to address the need to better understand transitions by investigating interactions between shale energy technologies and northeastern Pennsylvania as a region and place.

The dissertation first analyzes the history and geographic patterning of the shale mode of producing energy, highlighting the way major shale operators deploy business models and technologies that one local development official characterized as "itinerant factories." This term underscores the pace and scale of an extraction campaign, the impulse to standardize development across places, and its migratory volatility. Over five years, northeastern Pennsylvania experienced this migratory volatility as a drilling boom followed by a significant downturn in activity. The second part of this dissertation analyzes data collected through two rounds of interviews with local participants in northeastern Pennsylvania. Evidence assembled from interviews documents social perspectives on the shale gas regime, place transformation, economic development, and the challenges of governance. The research supports the proposition that making sense of energy transitions locally can be improved by linking research on socio-technical transitions with research on the community experience of energy development.

## DEDICATION

In loving memory of my father,

Pavel Vancura

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Over the course of this project, I have been fortunate to have the support, friendship, and mentorship of so many engaging, smart, and good people. Without this foundation, this dissertation would not have been possible.

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## CHAPTER 1: INTRODUCTION

When I first arrived in Northeastern Pennsylvania in the late summer of 2010 to try to better understand the ‘boomtown’ experience in an emerging core of shale gas production, I had an implicit vision of change. Since 2008, thousands of wells had been drilled and hundreds of millions of dollars had been invested in mineral rights and drilling infrastructure in the area. Based on images portrayed in media and my impression from shale-related events in New York City, I expected either a bucolic patchwork of rolling hills, fields, and forests with drilling rigs hidden and nestled in like barn silos at the edge of a field, or a landscape wrought of muddy clearings and the engines and steel of industrialization, with drilling rigs and technologies reaching from fields like skyscrapers across a city. The issue of shale development had come to inhabit powerfully contrasting representations of its effects.

I developed a different impression when I arrived in the so-called “Susquehanna core” of drilling. From some of the highest hills and broadest lookout points in Bradford County, such as Marie Antoinette Lookout in Asylum Township (so named because the area was settled by loyalist refugees from the French revolution), the landscape indeed appeared as pastoral working farmland. But along the roads going into Towanda, the largest town, the evidence of older established industries and active retail activity showed its presence. And the evidence of drilling was everywhere, but more subtlety wrought.

To notice it at first, one had to be attuned to the content of billboards, each of which from miles outside of Towanda—the county’s only larger town, and the county capitol—advertised various drilling services or lease services. One had to notice how the density of large trucks increased on the roads entering town, or question why traffic in a small town was slow for blocks. Tankers, equipment trucks, and SUVs emblazoned with the logos of energy and drill service companies busily shuttled between the town and the surrounding rural areas. Along the network of county roads outside Towanda, widened dirt access roads shot off from the main routes up hills into fields and forests, where the tops of rigs could be seen poking out like some of the taller trees, often concentrated in clusters over a few miles. Sometimes, perhaps coming around a bend in the road, a new well pad or rig would burst from a clearing or the top of a hill.

At the time, the town of Towanda was a commercial nexus within a geological ‘sweet spot’ of the Marcellus shale, which subsequently came to be known in some corners as the “Susquehanna core.” As I began to move about the town and region and engage with the commerce and communication of town life, the business and busyness of the gas economy and society became ever more apparent. The Towanda region had become a crossroads of sort for the industry as it fanned out across the surrounding farmland. As such, it was the closest point of concentrated economic activity. Poking into shops along the main drag of Towanda’s commercial district offered a peak into the transformations taking place. Retail stores had modified their merchandise to capture the needs of new populations. A shoe store now showcased a wall of the heavy work boots routinely requested by energy

workers. Other retailers were tailoring their wares to the purchasing power of newly wealthy residents. The display cases of a downtown jewelry store were dotted with drilling ornaments ranging from engraved money clips to diamond-encrusted pendants in the shape of a drilling rig. At the headquarters of the Daily Review, the town's paper, staff had laid out a copy of their new weekly "Northeast Driller" supplement section.

Data collected during my fieldwork—interviews, focus groups, and participant observations—helped flesh out these initial impressions of busyness. By the end of 2011, by anecdotal estimates, more than half of landowners in Bradford County had leased their lands. Vacant office space and warehousing were in short supply as industry-related businesses expanded into the area. The influx of new populations and expanded landowner income were piping new money through many service-based businesses. Motels and campgrounds were full months in advance. Restaurants and bars had hired new workers and extended hours. Each person I spoke with had stories of personal and community change. There was a widespread sense among those I interviewed that this anecdotal evidence of local business success and new landowner wealth was indicative of a transformational and wide-ranging effect on livelihoods.

But equally palpable was that all the activity was introducing new forms of volatility, uncertainty, and pressure on relations in the community, whether social, economic, natural, or other relations. People, places, and groups increasingly were differentiated along new lines of risk and benefit. A subset of landowners had grown rich from bonus and royalties, but others had not. People talked about families being

dislocated from housing pressures. Mobile homes with license plates from Oklahoma and other places around the country were setting up under informal conditions in yards across the county, to the annoyance of neighbors. Some residents worried that their neighbors and family members had hardened and changed. Increasingly I came to see that some of the most worried expressions were less about drilling and more about the industrialization that accompanied drilling, and the related anxieties about changes in rural landscapes, community, and attachments to a rural economy.

Overarching this was ambiguity about the present and future activity of the industry. People were experiencing a whirlwind of activity that seemed to have a mystifying form. As one resident put it, the rigs were moving so fast that he sometimes wondered if operators knew what they were doing. Through my own personal frustration with a lack of information and clarity about the patterns of drilling and industrialization, I came to think more about the industry and the way it manages commercial risks. Operators in the Susquehanna core are competing in a volatile marketplace amid considerable geological uncertainty about gas well performance. In mid-2008, natural gas prices hit the apex of a multi-year price spike and the Susquehanna core and the town of Towanda emerged as part of a larger series of carbon boomtowns and boom regions. But by 2010, natural gas prices were a third of what they were in 2008. Though domestic production has been at an all-time high, the industry has rapidly shifted drilling to new areas to take advantage of higher oil prices. Accompanying this commodity market volatility, there are more fine-grained uncertainties that distinguish costs of drilling from one small area to

the next. In these ways the geography of commercial risk comes to define complicated patterns of uneven development.

The observation that there is high risk is a reminder that shale is an experimental and niche form of production in an ongoing historical process of change in the natural gas “regime” (Geels 2007). From one angle the roots of shale production trace to the earliest days of natural gas production. And its latest incarnation is the outcome of a generation of changes in technologies, institutions, and business organization, which have re-engineered the natural gas regime to enable it to rapidly scale production. But from another angle, it only recently is being tested at the scale of “mega energy” projects. Indeed, production in northeastern Pennsylvania at the time of my research was only a few years old, a transplantation from its roots in Texas.

The transplantation of drilling into a new ‘resource frontier’ has been accompanied by visions of a shale juggernaut extending across the Appalachian chain throughout Pennsylvania into New York State, Ohio, and West Virginia. These ideas of a juggernaut have helped propel both utopian and dystopian visions of the shale future. An upsurge of regional “discourse coalitions” (Hajer 1995) arguing for institutional practices that might promote or prevent these futures has become a defining aspect of state policy in the region.

In other words, community-oriented actors were living, working, leasing, and making decisions in a complicated set of conditions: There was ambiguity about the current and future character of drilling and the stages of development that communities might experience. There was regional politics that exerted pressure



on localities through state policy changes. And because there was little experience with energy of this type, there were substantial voids in knowledge, institutions, and practices among those tasked with making contact with the industry and forming institutional relationships with regime actors. Landowners, businesses owners, and local government officials were at the center of this ambiguity. These practitioners had authority to provide services or render contracts but they had little understanding of how to do this. There was little past experience and social memory to guide them.

The themes introduced over the last few paragraphs--the community experience of energy change, the history and ambiguities of production, the learning of roles and responsibilities, the politics of development—these form the backbone themes of the current study. In the next sections, I lay out the research questions, methods, and outline of the dissertation.

### **1.1. Problem statement and research questions**

The purpose of this dissertation is to increase our understanding of the social and technological origins of energy shifts and the experience of regional energy development in the context of such shifts. I have argued that this objective can be realized by engaging and deepening research around sociotechnical transitions and the geographies of resource and industrial development. I bring these literatures into dialogue through a case study contextualizing shale gas development in northeastern Pennsylvania. The case study also addresses the absence of description and analysis of the geographies of shale development.

The overarching research questions here are: *How are particular niche projects and regime dynamics shaped by local context. In turn how are local conditions shaped by energy projects? How do they co-evolve as socio-technical projects?* Better dialogue between transitions perspectives and place perspectives can help answer these questions. There are a few sub-questions related to this that guide the case study research and organize this dissertation:

1. How is the shale regime organized through resource rigidities, technologies, and institutions? How did the practices of a shale “socio-technical regime” come to produce the space of the “Susquehanna core”?
2. What ideas and politics have been associated with the transformation of the natural gas system and the development and diffusion of shale practices?
3. How do regime actors manage the spatial distribution of commercial risks through practices that create uneven development?
4. What is the community experience of development?
5. What groups of practitioners are at the local ‘point of contact’ in steering gas development? What are their matters of concern, and how do they understand, learn, and practice their role? What ideas and imaginaries about regional development guide practitioners thinking?

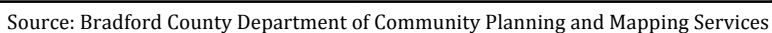
## 1.2. Site, data, and methods

In this section, I detail the research design and introduce the case study region.

### 1.2.1. *Regional case study introduction - Situating the Susquehanna core*

Since the mid 2000s, industry regime actors have extended shale practices from Texas's Barnett shale, where these practices were initially adapted from ongoing sandstone drilling practices, and transplanted them across the country to new production zones, or shale plays, as they are often called. These include plays within the Haynesville Shale in Louisiana, the Fayetteville Shale in Arkansas, the Bakken Shale in North Dakota, and the Marcellus Shale in Pennsylvania and other states. During pilot research, I sought an area that was subject to significant shale gas exploration and community activity around facilitating industrialization, in effect a 'front line' of efforts to establish shale sheds across the United States. Production data and anecdotal evidence of community perceptions suggested that the area around Towanda, Pennsylvania in the Susquehanna core of drilling was the right fit.

The "Susquehanna core" is a term commonly used to describe a play of concentrated drilling that has developed since 2008 in the Northeastern corner of Pennsylvania's portion of the Marcellus shale. Here the most rigorous drilling has taken place within the boundaries of Bradford County, which is where the majority



The Susquehanna core largely overlaps the area of the Endless Mountains, which is part of the Appalachian chain and shares a continuous topology on the Alleghany Plateau with the Catskill Mountains to the East. The political boundaries of the “Endless Mountains” region are often considered the four-county area of Wyoming, Sullivan, Bradford, and Susquehanna. Including Tioga County, the region is sometimes referred to as the Northern Tier, paralleling the bordering counties of

New York State's Southern Tier. The four-county area of the Endless Mountains is frequently described as sharing histories, industries, and recreational activities (Stacy 1999).

With 177,000 residents in 4000 square miles, the region has a low population density and is largely rural (Census 2010). Residents of the area live in smaller towns spread among farms and a few larger centers. Northeastern Pennsylvania historically was an agricultural and foresting core and peripheral to energy extraction. The landscape and social characteristics of this resource regime were a defining aspect of the region's social and economic form and of a rural pastoral identity and way of life that many respondents identified with strongly.

Four cities just outside the region are larger commercial and residential centers--Elmira and Binghamton, NY to the north; Williamsport, PA to the west; and Scranton/Wilkes-Barre, PA to the Southeast (NTRPDC 2013). Bradford County, where most of my interviews took place, has two smaller centers, both much less populated than Williamsport, one of which is the County capital of Towanda (Endless Mountains RCDC 2009). Towanda is a small town located at a regional transport crossroads and a center of surrounding business activity. It was rapidly became a node in the expanding gas industrial system.

### 1.2.2.

### *Energy systems analysis and discourse analysis*

The first two empirical chapters of this dissertation (Chapters 3 and 4) focus less on the Susquehanna core as a place and more on the system of natural gas and its changes. To frame my general understanding of the natural gas system, I drew on

secondary sources such as historical accounts of the natural gas system in the United States (Castaneda 1999; Castaneda and Smith 1996) and Appalachia (Waples 2005). In these chapters, I also made use of a variety of primary and secondary sources, ranging from archival material, published reports, media sources, business public filings and investor reports, industry analyst white papers, transcripts from meetings, government & industry publications, and newspapers & press releases. These documents were reviewed for themes that were highlighted in the literature related to energy transitions and shifts, including changes in the industrial regime, technological innovation, and the broader energy landscape.

Reflecting the emphasis in chapter 5 on the role of storylines and discourse coalitions as a driver of ‘landscape’ changes in energy systems, these documents also were read to help reveal key analytical entry points put forward in the ‘argumentative discourse analysis’ approach of Hajer (2005; 1995). I sought out particular sites or events historically that stood out as emblematic moments in the stabilization of a transitions storyline of natural gas and its institutionalization as policy.

Methodologically, Hajer's approach suggests three co-constituting analytical subjects that form a foundational point for analysis of social change around a particular set of institutional issues: storylines and metaphors, discourse coalitions, and institutionalization. Storylines and metaphors are simplified schema that stand in for broader and more complicated rationalities and frame the sorts of knowledge claims that are considered within a particular discourse. For example, the idea of natural gas as a “bridge” fuel is a metaphor traced in the study here. Discourse

coalitions are groups of actors who share the usage of a particular storyline in the context of shared practices (to institutionalize these storylines in policy, for example).

Hajer distinguishes between discourse structuration and discourse institutionalization as the two criteria for judging how influential a discourse has become. Discourse structuration occurs when many people use a set of ideas to make sense of the world and conceptualize a domain of interest (reducible to storylines). Discourse institutionalization occurs when the set of practices and ideas constituting the discourse become stabilized into institutional assemblages and policies (Hajer 1995: 60-62). Hajer argues that a dominant discourse is one where both criteria are fulfilled. Since policy discourses are performed, the power and stability of a discourse has much to do with the credibility and acceptability of storylines, along with the interpersonal trust among and between coalitions. To the extent that one coalition's storyline gains acceptability and credibility and there is trust in the coalition uttering it, the likelihood of it framing institutional decision-making increases.

### *1.2.3. Background research on the region*

The second half of this dissertation moves more from the 'ground up,' focusing in depth on perspectives and experiences transforming the place I just described into a space of production. To help frame my understanding of the region and inform data from interviews, I drew on local histories, planning and policy documents, local press reports, newsletters from local organizations, and online message boards and comments. A qualitative reading of news articles was completed during the period

2010-2012 to supplement the information in the interviews. The bulk of news articles were retrieved from Access World News. My search criteria consisted of Boolean searches for articles on a combination of the terms shale, gas, drilling, and Marcellus. My geographic selection criteria included news articles from papers located within the Endless Mountains region. Major regional and national newspapers--among them the New York Times, Philadelphia Inquirer, the Wilkes-Barre Times Leader—were selectively searched independently.

#### *1.2.4. Participant observation*

Participant observation was also a component of the research. I attended a series of public meetings and hearings that have informed my understanding of regional discourse coalitions articulating anti-fracking arguments. I attended two city council meetings in New York City on shale development, three question and answer sessions following screenings of the movie *Gasland* in New York and New Jersey, and a handful of public events convened by interested groups such as the Natural Resources Defense Council and New York Bar Association. I also observed meetings of a number of local agency and township events in Bradford County that were open to the public. Finally, understanding of shale issues also has been enhanced by conversations with a number of people not participating as part of the sample, including members of the research community and informal conversations with energy company officials who chose not to participate in interviews.



### 1.2.5. *Interviews*

The bulk of the analysis in the empirical chapters was drawn from interview data and focused on social perspectives and experiences related to transition practices. Recalling the earlier section in this chapter, I make a heuristic and methodological distinction between storylines/discourse and social perspectives. The former represent more formal communicated positions with an institutional-orientation to them. In the history sections, I traced these through media and secondary research as evidence that they have ‘traveled more widely’ into forms of collective expression.

In the empirical chapters analyzing interviews, I also refer to storylines. Here these refer to institutional-facing positions (whether directed at institutions of private property or institutions of local government policy) that have been taken-up widely by many people and have taken up residence in policy-facing communication and settings.

Mindful that there can be overlap, particularly in the context of the vocabulary in discourse analysis around subject positions and subjectivity (Hajer 1995), I refer to social perspectives as a reflection of the grounded experience of individual people in their relationship to place and community. Here I am interested more in the idiosyncratic experiences of everyday life in social and community context.

Where possible, I did seek to uncover common themes that might be the beginning of common optics of reduction—or narrative storylines. Amid the uncertainty and preponderance of multiple pathways of change taking place, a few such storylines were beginning to distinguish as ‘gelled’ storylines, including a

governing storylines of “influence by inches,” (chapter 6), and a regional adaptability storyline of economic “linkages,” and a storyline of rural “locality” (chapter 8). But social perspectives are not reducible to these storylines. Indeed, many social interviews helped demonstrate the way these storylines were doubted within actor groups, that many articulating these storylines were better at it than others or doubted the appropriateness.

Interviews were conducted during rounds of fieldwork in late 2010 and early 2011—and follow-up in 2013. In total, I conducted semi-structured interviews with 29 people. Of the 29 interviews, I conducted 22 interviews in and around Bradford County in the Susquehanna core. I also additionally convened some of these respondents in three small focus groups—one with landowners, one with county workers, and one with town officials (Table X). A round of follow-up interviews with 7 respondents in 2013-2014 has offered an opportunity to examine evolutions in respondents’ experiences. Rutgers’ Institutional Review Board approved this protocol under #E11-018.

Respondents were selected using snowball sampling. The sampling design worked outward from a number of key informants that I identified in news articles or sought out while ethnographically ‘getting a feel’ for things during my visits in the field. It is important to clarify what this snowball sample is and what it is not. I see my sample as a loosely aligned community of practitioners who were working to shape shale development in the region of the Susquehanna core, concentrated in and around the town of Towanda. I define “community” in conceptual terms as social ties along some shared axis, in this case gas transition. Each informant varied

with respect to their relationship to the physical geography of extraction and their roles (by residency, land ownership stakes, business locations, family and friend geography). Nor is each member focused on the development of one particular planning initiative or developing one guiding vision.

Two characteristics of this network give it internal cohesion. First, each member is aligned with some set of practices entangling the region more tightly to a gas economy—landowners negotiating leases, business owners linking to industry, town and county officials servicing industrialization. Second, each member is tied to at least two other informants through practices of learning, cooperation, or planning practices focused on industrialization in the immediate vicinity of Towanda. The open-ended aspect of the interviews meant that interviews self-identified what they would share, prioritized areas of involvement in shale development and prioritized topics of discussion about the effects. My research emphasizes social perspectives, not personal opinions based on affiliation, but for the sake of disclosure, categorical affiliations are identified below:

<b>Occupation/Position</b>	<b>Focus group?</b>
Landowner	Y
Landowner	Y
Farmer/Landowner	Y
Landowner	
Landowner/local business owner	
Landowner/local business owner	
Local business owner	
Business development professional	
Farmer/municipal official	Y
Municipal official	Y
Municipal official	Y
Industry representative	
Industry contractor (pipelines)	
Industry contractor (pipelines)	

Local business owner	
Ag extension worker	
Municipal official	Y
County official	Y
County official	Y
County official	
County official	
Environmental advocate	

The bulk of the data was collected at the apex of the drilling boom in 2011. The key interview questions involved perceptions, experiences, and expectations of shale development, including understandings of the community effects, industry operations, local capacities to respond, benefits, emerging risks and controversies, and the nature of their engagement with development.

The data were coded inductively and processed using NVivo. The sampling proceeded until themes become salient and no new positions emerged. I catalogued dominant matters of concern in five local systems, loosely using as a conceptual guide distinctions made by Gramling and Freudenberg (1992). In their framework for assessing community energy experiences, they identify transformations to six local systems: physical, cultural, social, political/legal, economic, and psychological. I settled on coding scheme that identified five systems, including one additional category on the character of industry drivers. These five are social, economic, land and mineral, local government and planning, environment and health. This catalogue is categorized in Appendix 1. The catalogue can be seen as the ‘raw data’ that I used throughout the dissertation, but predominantly in Chapters 6-8.

In addition to cataloguing matters of concern, I also analyzed how respondents saw changes to these systems in relation to personal and community

experiences, learning, and value positions. I analyzed what responsibilities for these matters of concern people were imagining, what actions were being selected locally to manage them, and how responsibilities were constrained in practice.

### **1.3. Organization of the dissertation**

In this section, I not only describe the content of each chapter but also lay out the central arguments and themes of this dissertation. Chapter 2 reviews literature on energy shifts, energy and society, and community experiences of resource development as a way to frame essential themes of this study and set the terrain for this study's contributions to the literature.

In Chapter 3, I trace the question of 'where did shale come from' to regional technological adaptation in Texas and also new business practices imagined by natural gas regime actors as a way to rapidly transplant and scale production. I first describe a general history of shale and the technology of horizontal fracturing that has figured so prominently as a subject of policy storylines. I describe how regime actors adapted this existing technology for use in shale gas because of long-term pressures on mature gas production fields.

Taking a prominent role in the second section of the chapter is the unruly and spatially inconsistent character of shale rock. Shale is not a "simple and consistent" rock. The trouble with developing gas from shale, now and as it always has been, is that the promise of its abundance is undercut by its inconsistent

temperament. There is a temptation to “unconventional” production from shale: the gas permeates large rock formations and can be produced from nearly any well that is dropped. This differs significantly from “conventional” gas production, where “dry holes” are a fact of the known risk landscape. But within a geological formation of shale, the character of this rock varies significantly along dimensions that can express themselves over small areas. As these conditions vary, shale may yield high amounts of gas in one well but just the opposite a short way away. In spite of significant advances in visioning and modeling, these inconsistencies present significant commercial risk. In new plays such as Marcellus, this is amplified by the fact that nobody had really even tried prior to a few years ago.

I describe how this translated on the eve of Marcellus shale production into a variety of competing business models within the regime. The mobility and flexibility of industry practices are front and center here. These business models imagined rapid and large-area drilling campaigns that optimized production and established economies of scale to manage the risks of variations in well performance. They also imagined rapid deployment to respond to sudden periods of commodity price volatility. I argue that this mobility and flexibility is an adaptation arising from unique preconditions in the United States, some inherent to the long history of private mineral rights ownership, others like deregulation of natural gas markets more recent. These pre-conditions have been associated with the new business practices central to those efforts imagined to manage commercial risk. Twenty years ago, Freudenberg (1992) remarked on the increasing large scale of extraction and processing. As this case study, demonstrates, however, not only has scale increased

in natural gas extraction, but also the industry speed, mobility, and modularity (Appel) of social and technological organization within the regime. It can rapidly adapt and re-organize in new locations around new technologies, as the case of shale demonstrates.

Accompanying the pre-boom in the Susquehanna core in 2008, regime actors articulated visions of abundance in the newly imagined space of Marcellus production. These visions have framed a scale and scope of impacts articulated by emerging discourse coalitions as both utopian and dystopian futures of development. In chapter 4, I describe a history of these new storylines as the stabilization and destabilization of an older 'natural gas transitions' "storyline" (Hajer 2005) positioning natural gas as a "bridge" fuel system. I trace this idea in part to the 1970s, when regime actors responded to pressures on the regional gas regime in the Southern United States by taking up ideas about federal re-structuring of natural gas markets and state support of niche modes of gas production. Actors argued that with state support natural gas could be a "bridge" to those future technologies that would realize full energy security. I also trace the historical arc of arguments that have promoted natural gas as a technological fix for 'burner tip' environmental issues. Historically, the transitions storyline has helped make sense of natural gas as a solution within both energy security and environment issue areas. Natural gas was both a bridge away from coal and energy insecurity.

New storylines associated with shale have affected the authority and credibility of the transitions storyline from both directions: environmental and security. I track the arguments of these storylines and highlight two effects of the

new arguments. First they destabilize the transitions storyline with implications particularly for the way the role of the federal government is repositioned as a manager of energy transitions. Second they have found success institutionally in the contrasting policy approaches of the executive administrations of New York State and Pennsylvania. Concentrating as it does on a case study in Pennsylvania, the chapter then turns to an illustration of severance tax debates in the state to demonstrate a policy issue that has institutionalized the abundance storyline. These debates had bearing on the way that local actors might fund resilience actions or broader development approaches as a response to local transformations.

Chapter 5 trains a geographic lens on the shale mode of producing natural gas through a description of the experience of development in the Susquehanna core between 2008-2014. First, I trace the illustrious historical geography of gas production in western Pennsylvania and the way it reached only marginally into the northeastern part of the state prior to the shale boom. I then categorize the stages of experience with development in the emerging Susquehanna core around the commonly described stages of pre-boom, boom, and post-boom.

In the remainder of the chapter, I complicate a reading of the post-boom experience by examining the way that commercial risk management practices in the industry translate into uneven development. Increasingly apparent are the way that the migratory facility of the industry, significant volatility in commodity practices, and uncertainties over small areas associated with well performance creates the conditions in which a fairly rapid *cycling* of pre-boom, boom, and post-boom stages may take place at different rates in different places, sometimes over small areas and



rapid time periods. One respondent implicitly captured this experience by referring to this shale style of production as the operation of “itinerant factories.” The experience of development associated with the itinerant factory is not a linear trajectory of pre-boom, boom, and post-boom as much as a spatial-temporal “flickering” of activity. The idea of flickering builds on Freudenberg’s (1992) idea that a “cost-price squeeze” on industry activities creates regional and community-level economic ambiguities in mining and extractive communities. By building into this idea a spatial component, I describe flickering as an emerging experience of uneven development in the Susquehanna core.

The transition from chapter 5 to chapter 6 is a point of pivot in the dissertation. In earlier chapters, I came at the Marcellus shale mostly ‘from above,’ examining for example how characteristics of production—mobility, speed, and modularity—were organizing a new space called the “Susquehanna core.” Methodologically, these sections are dominated by document analysis, with some contextualization offered through quotes from those I interviewed within the region. In the remaining chapters, these interviews come forward on the stage. I consider the Susquehanna core not as a space of production, but as lived place with its own history and relationships that predate production.

The fact that the shale regime is transplantation rather than an industrial adaptation or diversification has a few related implications that frame analysis in the subsequent chapters. First, the spatial organization and diffusion of the industry is very different. In contrast to the incremental adaptation in Texas that took advantage of established practices and institutions of modern high-volume energy

development, in northeastern Pennsylvania, the industry was experienced as a novelty. Therefore, local contact was made amid local voids in existing knowledge, institutions, and practices, which amplified the experience of ambiguity and uncertainty related to the inherent commercial risks that accompanies resource production.

Second, and related to this, it also means that the key local actors involved in decision-making related to negotiating the industry's 'terms of access' were ignorant of how exactly to do it. Landowners did not understand the institution that they were called on to perform. Local officials were 'awestruck,' as one put it. The demands on practices, institutions, and existing services—all this was new. The fact that there was so little previous energy development is good ground for examining how exactly local and regional actors come to develop a sense of their roles and practices. As chapter 7 on landowners describes, some did it better than others.

Third, rather than an amplification of existing pathways as in Texas, the introduction of a shale development pathway was a transformative development. It was transplanted into existing development pathways. These pathways—notably rural resource uses such as agriculture and forestry, were both strong place identifiers in Northeast Pennsylvania but also the focus of much pre-existing anxiety about how to create economic resilience to ongoing stress.

These intersecting themes contextualize chapters 6, 7, and 8. In these chapters, I draw on interviews with community actors in the Susquehanna core to help describe the experience of contact with the industry and industrialization. Chapters 6 and 7 ask who are the dominant actor groups 'making contact' with the

regime? Two local actor groups with particular responsibility for governing disturbance and risk were landowners and local government officials. These groups were invoked as authorities with established relations of responsibility. The empirical chapters are designed around the question of how are their responsibilities and practices imagined? And what was their experience learning and practicing these roles? Chapter 8 asks whose transition is it and presents two contrasting storylines about rural development, one centering on “linkages” and the other around rural “locality.” In the next paragraphs, I describe these chapters in more depth.

Chapter 6 is organized around the presentation of a storyline of governance that I refer to as “influence by inches,” drawing on the words of one respondent. I argue that it was a guiding vision for local government actors as they engaged with changes in local and regional systems. It helped make sense of local government’s role in the context of a series of ambiguities and a range of constraints on their actions by emphasizing immediate, tangible problems through learning and communication. These ambiguities included the patterns of current and future activity and ambiguities about how local systems were responding.

Another few reasons this storyline made sense: Actors were unable to make certain types of problem legible, meaning more immediate and highly legible policy issues such as road repair were taking precedence over more challenging problems related to itinerant populations, for example. This immediacy was reinforced by a lack of resources available for example to compensate workers and hire new staff to address such issue areas. At the time, nor was there was a state impact fee or

severance tax to compensate demands or build capacity for resilience or adaptation efforts. Local practices also were constrained by ongoing efforts of industry-focused actors to consolidate management and regulations to the state. Furthermore there was limited local support for more robust action in a region where “zoning is a bad word.”

I draw on an extended illustration of the planning department’s hindered efforts to construct a leasing database, which also ties back to issues of ambiguity about future activity. The need to design such a product stemmed from a need to bring transparency to an industry that was not transparent. Ironically, the onslaught of demands from the industry for spatial data unrelated to this had recently been dictating the time of workers in the planning department and further constraining more creative products.

Through leasing practices, landowners are prominent gatekeepers to a host of community transformations, including physical and landscape transformations and social and economic relations. In chapter 7, I describe an ideal of land stewardship that was articulated by many as a set of values for how landowners should engage in leasing practices. In this discourse, landowner’s were described as empowered negotiators who wielded large influence over decision-making and also indirectly shaped the learning behaviors of actors in the industry.

In practice, the experiences of landowners reflected a much greater diversity than this. Based on interviews, I distinguished three ‘types’ of landowners who engaged in different practices of leasing with corresponding different outcomes. First were those landowners who were influenced by a culture of ambivalence about

the leasing process based on their personal and the region's historic experience with infrequent and low-risk energy leases. A second subset engaged in some informal learning and networking and more actively negotiated a lease, but prior to the emergence of a legal support network. A third subset became active with landowner's group and engaged in a lengthy process of social learning and negotiation. The implications of these differences were becoming increasingly apparent. The issue of royalty calculations, for example, an issue resolved in stronger leases, was at the time of my follow-up interviews a significant local anxiety and source of increasing discontent toward the industry, and a vehicle for increasing awareness about growing inequality related to development.

As just described, in Chapters 6 and 7, I elaborate on storylines and discourse associated with the responsibilities of two actor groups. I also described the practices that they engaged in. Chapter 8 also deals with two important actor groups with scripted responsibilities and practices—namely business owners and rural citizens—but the chapter is structured less centrally around their experience. Instead, I organize the chapter around a broader theme in which they were situated, namely an emerging politics of regional development.

In the first section, I contrast a storyline and practices on building local economic “linkages” with the experience of business owners and job entrants, who experienced these linkages as more or less risky and coupled. Paralleling the organization of chapter 7, in this section I compare this storyline to the divergent experience among business owners and argue that this divergence has long-term implications for the capacity of the community to maintain identity and not become

overleveraged. In the second section, I introduce a “locality” storyline about a rural sense of place that was articulated by some respondents. This was an expression of values of rural ways of life, rural landscapes, local relationships and also was situated in pre-existing anxieties about the decline of rural development pathways.

This chapter marks a return to themes put forward earlier. In Texas, the roots of shale diffusion arose from the challenge faced by many producers to maintain profitability on acreage that over decades was not returning the same performance as previously. The experience in place was not industrial and technological transplantation but adaptation. The situation in the Susquehanna core is more akin to what Martin and Sunley (2006) refer to as industrial transplantation. Central to the regional politics of shale is how its development trajectory “fits” with pre-existing pathways of development and whether it seems to work. Both of these are interpretive questions about ‘whose regional energy transition is it anyway?’ This question, the key findings, and general themes that have emerged in this analysis are the basis for the concluding chapter (chapter 9).

## CHAPTER 2: TRANSFORMING ENERGY AND SOCIETY

This dissertation sits squarely in a large body of interdisciplinary literature that might be termed the transformation of energy and society, briefly reviewed in this section. At the outset, some definitions are in order. Energy transformations are sometimes pictured as “transitions” in stability and polarity over long periods in large-scale energy systems, such as from organic to mineral forms of energy or from coal to oil. Over long time periods, such changes have been associated with enormous political, economic, social, and cultural transformations (Jones 2010; Smil 2010; Geels 2007; Nye 1998; Melosi 1985). Others have defined transitions in less linearly absolute terms as more narrow, near-term, and relative “shifts in the nature or pattern of how energy is utilized within a system” (Araujo 2014). By this definition, recent examples would include the increase use of wind in the Netherlands from 1% to 33% of electricity consumption from 1980 to the present. Or Winskell (2002) described the “dash for gas” in the UK. Also here would include Germany’s efforts to phase out nuclear power following the Fukushima accident. Within this framing is the shift to shale gas in the United States, which from Marcellus shale alone recently accounted for 18% of national supply, up from less than 1% in 2005.

An energy system is also a social system. Forms of political, economic, and cultural life are interwoven with particular uses of technology, such as those for producing, transporting, and using energy. Literature in social and technological systems characterizes this coupling as the co-evolution of society and technology (Miller et al 2013; Geels 2005; Hughes 1987). The implications here are that energy transitions and shifts are intertwined with changes to social life.

Miller et al (2013) note that social changes associated with energy shifts can range from relatively incremental to large-scale societal changes. On one end are piecemeal changes such as workforce reorganization accompanying new hardware at an electricity plant to integrated and dependent systems such as Louisiana oil and gas production, where contextual changes in markets for example can precipitate cascading social, economic, and environmental crises.

These social dimensions of energy change are receiving increasing attention. The “social dimensions of energy transitions” (Miller et al 2013), “human dimensions of energy transitions” (Webler and Tuler 2010) and “geographies of energy transitions” (Bridge et al. 2013) are a significant part of the “emerging field” of energy transitions (Araujo 2014) and the growing ‘subfield’ in geography of energy and society, reviewed by Pasqualetti (2014). The “emerging field” is overwhelmingly geared toward renewable energy and transitions to sustainable energy. I suggest here that attention to destabilization and adaptation of fossil fuel pathways is also important, particularly in the case of fuels such as natural gas, which historically has been situated as one part of the solution to sustainable futures.



Given my emphasis in this study on regional energy systems, two sets of literature are useful to bring together. The first is a set of perspectives on social-technical innovation and the other is a more diverse set of literature in economic geography and sociology, particularly perspectives on regional economic geographies of industrial production and resource production. I combine these literatures with research and frameworks on discourse to sensitize transition approaches to the role of ideas and argumentation as drivers of change.

### **2.1. Technological innovation studies and regional economic geography**

An energy system is in part a “mode of production” (Walker and Cass 2007; Shove and Walker 2007) and a “socio-technical regime” (Geels and Schot 2007), meaning there are sets of relationships, practices, discourse, and rules that arrange industry and society around a given resource. A “regime” here is taken to mean a wider set of actors than just industry ‘players.’ Policy makers, scientists, interest groups, and discourse coalitions also contribute to the patterning of technological development (Geels and Schott 2007). Taking insight from Actor Network Theory (Latour 2005), we can see a regime as a network or assemblage of relations among human and non-human objects. Non-human objects—whether plants, animals, infrastructure, minerals, documents—have the capacity or agency to enable or constrain relations between people, nature, and technologies.

By this way of thinking, a particular regime can be considered with reference to the “rigidities” of a resource, which are negotiated when an object in nature is transformed into a commodity (Barnes and Hayter 1992). Each commodity has

characteristics that generate unique challenges and opportunities. Overcoming these creates unique temporal and spatial rhythms to production. With natural gas, these include its “unruliness,” a term that nicely describes the way its physical properties evade simple ways to contain and transport it as a commodity (Bridge 2010).

A mode of production also implicates forms of public life. The prospects of democracy, citizenship and public processes are coupled around the physical properties of a resource and the forms of energy infrastructure, technologies, ownership and labor that are deployed to make it into things we use (Bridge 2011; Mitchell 2009; Walker and Cass 2007). In historical context, Mitchell (2009) argues that the rigidities of coal production, notably the narrowness of the point of extraction at the mouth of a coal mine, generated great potential for controlling access to the whole network. Therefore, it simultaneously became a place where centralized labor strikes were especially potent but also became the target of massive efforts at corporate centralized control. By way of another examples, some argue that difficulties storing renewable energy power re-asserts locational and transport constraints that can co-constitute more local forms of governance. Walker and Cass (2007) complicate this picture by demonstrating the variety of ways renewable energy can be governed, but they still stay close to the central idea that these forms are tied to the character of the energy resource.

Energy regimes can have “momentum.” In his history of the early development of the electricity system, Hughes (2003) used this term to describe the way systems of people and technologies can become stable and resilient to change

over time as actors increasingly reproduce practices in line with existing ideas and institutions (i.e, conventions, norms and established rules). The term was subsequently used to describe other cases of technological inertia, such as carbon lock-in (Unruh 2000).

In some cases, a large socio-technical system has momentum and is highly resilient to disturbance. In other cases it is ripe for destabilization. The question of how momentum is or is not shifted is the central question of studies of energy shifts. An influential framework from “innovation studies” that has been applied to energy systems is the Multi-Level Perspective (MLP), which sees change in socio-technical “regimes” as the function of pressure from two directions—niche technologies and landscape pressures—which in varying configurations can destabilize and potentially shift the regime (Geels 2002). Landscape pressures may include changes in markets, regulations, infrastructure, user practices, industrial networks, cultural meaning and scientific understanding (Araujo 2014). For example, the performativity of economics (MacKenzie et al. 2007) is particularly important to understanding economic behaviors in liberalized energy markets. Price volatility in these markets is a key pressure on the adaptive practices of natural gas producers.

As a brief aside on terminology, the word “landscape” is also commonly deployed in the geographic and resource literature mentioned in the next section. In that literature, landscape usually refers to a feature of place. In the MLP, landscape refers to those contextual factors that pressure a regime. In MLP, the term is metaphoric and not linked to any particular scale or place. For the sake of clarity, I will generally refer to *contextual* factors rather than “landscape pressures” as used

in the MLP framework, reserving the idea of landscape to describe the more specific definition of it as a mode of place.

To return to the idea of transitions, Geels and Schott (2007) illustrate a few typologies of sociotechnical change: *Transformation* involves regime actors and outside groups exerting institutional pressure on existing regimes. Technological *substitution* involves new firms that introduce novel technologies that compete with incumbent practices. *Reconfiguration* involves adapting existing practices through components from suppliers elsewhere in the chain. *De-alignment and re-alignment* involves erosion and destabilization of pathways, loss of faith and legitimacy, followed by the emergence of multiple new entrants who compete for resources, legitimacy, and attention.

Recent attention has also turned to the idea of regime incumbency as the “flip side” of regime transitions (Turnheim and Geels 2012). Geels (2014) notes that regime resistance can take a variety of strategic forms. Actors may draw on instrumental, discursive-framing, material, and broader institutional strategies to resist change and build resilience over time.

Central to efforts to form a more geographical vision for transitions analysis has been shifting away from thinking of energy change as ‘sited’ at institutional or state scales (national being the most common) to consider social dimensions of energy dynamics at other scales, such as infrastructure, cities, or regions, and their interconnections across scales (Spath and Rohrer 2014; Bridge et al 2013; Raven et al 2012). Focusing on these entities in a scale sensitive manner better demonstrates the unevenness of transitions and the way dynamics of change may be

concentrated across space (Raven et al. 2012). Cities and small area regions also may be the scale at which energy innovation clusters (Spath and Rohrer 2014; Bulkeley 2010).

Essletzbichler (2009) offers a framework for a multi-scalar and regional perspective in transitions, arguing that the broad contours of 'landscape, 'regime' and 'niche,' might be applied as a more general heuristic to examine dynamics at multiple scales and the way that outcomes at one scale may be conceived as modifying the landscape or contextual dynamics elsewhere. The shale transition in Texas looks very different from that in Pennsylvania. As explored in Chapter 3, in Texas, an established regime reconfigured existing practices and adapted technologies to shale. In Pennsylvania, the industrial regime was a new entrant. To draw on the typologies offered by Geels and Schott (2007), in Texas shale technologies were developed as a technological substitution within a mature industry. In Pennsylvania, the experience does not quite fit these pathways, though in some ways, there were elements of de-alignment and re-alignment in relation to existing development pathways.

## **2.2. Geographies of industrial and resource production and the community experience of energy development**

Two strands of research in economic geography can be valuably put into dialogue with each other to help sensitize socio-technical innovations literature with geographic perspectives. The first is research on the regional economic geography

of industrial production. The second is economic geography of resource production and a wider set of affiliated research largely from sociology on community experiences of energy development. This section reviews this research.

Drawing on the work of Murphy and Smith (2013), it is helpful initially to bring forward from this literature the concepts of place and region. These concepts are drawn on heavily in research on the community experience of resource development and industrial development and can help enhance transitions research. Place has a long history in geographical thought. Murphy and Smith (2013) draw on Devin-Wright's (2009, page 427) useful definition of place as the "physical aspects of a specific location as well as the variety of meanings and emotions associated with that location by individuals or groups." Region is a distinct concept from place in that it is a social-spatial unit constructed by culture and institutions that has historical durability that extends beyond any one individual's understanding of place.

Research in economic geographies of industrial production considers the way past decisions about industrial organization are carved into a region (Pike et al 2010; MacKinnon et al 2009; Martin and Sunley 2006; Massey 1998; Grabher 1993). Economic, social, and institutional relationships, as well as outlooks and organization can calcify over time. The sedimented weight of these configurations can prevent actors from taking actions and make it costly economically and socially to assemble new pathways of development.

Some research considers how these calcified pathways may be unstuck. Martin and Sunley (2006) underscore potential sources for path creation using a

few typologies. First, new technologies and industries may emerge from within a region; a diverse base of local industries may stimulate constant innovation and change to avoid lock-in of a particular configuration. Second, there may be a “transplantation” from elsewhere, which then forms the basis of a new pathway of regional growth. Third, “diversification” involves an existing industry going into decline but redeploying and extending its core technologies within a region as the basis for new entrants. Fourth, the “upgrading” of existing industries involves the revitalization of a region’s industrial base through new technologies, services, or products. This literature on the place and region of industrial change correspond well with the more innovations and technology focus of the MLP. A transplantation pathway most closely mimics the situation in the Susquehanna core.

Research on the geography of resource production complements the industry focus of the literature presented in the previous paragraphs. Like that literature, it also draws on themes of region and place. Some of this research refers to resource frontiers (Barney 2009) or resource peripheries (Hayter et al. 2003). It also aligns with research on the experience of development put forward in boomtown literature (Jacquet 2009), addictive economies (Freudenberg 1992), and resource curse literature (Auty 2007). In the next section I review some of the major themes from this literature that apply well to the case study in this dissertation.

### *2.2.1. Boomtown development experience*

Gramling and Freudenberg (1992) distinguish the community experience of energy development by three stages: a pre-development phase, a development or

boom phase, and a post-development or adaptation phase. They argue further that energy development generates impacts on six local systems: physical, cultural, social, political/legal, economic, and psychological. The pre-boom phase may be associated with considerable anticipatory activity that changes these systems, including under-the-radar leasing campaigns or environmental or growth coalitions transforming the legal context.

The boom phase is the most studied stage. In his historical analyses of the political economic mechanisms pulling Canadian resource towns into the demands of urban core markets, Innis memorably referred to the periods of extraction accompanying cycles of commodity boom and bust as “cyclones” (Barnes et al. 2001). The metaphor draws attention to the rapidity, volatility, uncertainty, and disturbance of extraction activities. Energy booms in the 1970s and 1980s sparked considerable research into the profound social and institutional disruption that can take place under such conditions in rural areas. While growth in investment and population are often just what local officials have been working to achieve all along, the challenge of a boomtown is that the timing and pace of these changes is overwhelming (Jacquet 2009). New populations and money circulate into the community so quickly that services, infrastructure, and the social relationships built around these, become overwhelmed. Overcrowding may be associated with ‘social disruption’ including crime and family breakdown (Wilkinson et al. 1982). Small governments may not be able to offer “goods, services and intangibles” and may not be equipped to expand or transform to cope (Gilmore 1976). Furthermore, the inflexibility of existing infrastructures and services may operate as a constraint on



accessing the benefits of new investments, which can lead to conflict over how to ramp up capacity.

Research on resource peripheries and frontiers emphasizes the importance of place attachments to shaping how such changes are experienced. Development is a process that is negotiated locally in place. People may resist, accept, or seek to influence development, sometimes to greater or to lesser effect. An important lesson from the literature is that historically and culturally grounded notions of place infused into concepts such as “community” or “rurality” often are powerful conceptual terrain through which people form the ideas, perspectives, and emotions used to negotiate consent or opposition to development projects.

Other research helps identify some contextual factors of a region that can indicate inherent resilience to boomtown development, including a community’s history of energy extraction, level and nature of development, economic diversification, and demographics (Brasier 2011; Jacquet 2009). Diversified economies tend to be more resilient to disturbance because they are better at “dissipating negative effects across an array of economic activities and places rather than concentrating and reinforcing them” (Pike et al. 2010). During a population boom, having a diverse portfolio of existing businesses can reduce risk and also prevent money leakage out of the community, since it is faster and less expensive to expand services if the initial infrastructure costs have already been sunk. Other socio-cultural or institutional factors also are important, including elements such as social capital, capacity for learning, social organization, and planning; wealth production capacity and its distribution; and local business ownership.

### *2.2.2. Post-boom development experience*

Freudenberg (1992) describes the multiple ambiguities often created during energy development, including resource exhaustion, volatility in commodity boom and busts, and specialized “overadaptation” responses that may hinder efforts to diversify in other directions. Longitudinal studies that follow communities post-boom suggest that there are wide variations in outcomes as the boom phase transitions into development and post-development phases.

Long, sustained resource booms may be associated with periods of “structured coherence” in a place when the forms of production and consumption congeal around common economic linkages and industries in such a way that “capital can circulate without the limits of profit” (Harvey 2012:329). Barnes et al. (2001:2130) remark on similar dynamics historically in single-industry resource towns in Canada. In the staple system, the town “serves as a fulcrum point between the resources themselves and the global metropolises that require them.” Resource dependency can be associated with stability and growth, particularly when there is tight coupling of a regulatory state, resource community, and industry (Walker 2001).

During extended periods of boom, structured coherence might last long enough to provide extended livelihood well being with well paying jobs and equitable development. Barnes et al. (2001) document historically such stability in resource regions dependent on the forest sector. Structured coherence underpinned long periods of stability in Canadian resource-dependent forestry towns before commodity pressures triggered industry restructuring associated with widespread

community disruption. In energy cases, Forsyth et al. (2007) and others have described widespread support for oil and gas in places such as the Gulf Coast. Louisiana, at the height of its dependence in the 1970s, was among three adjacent states producing approximately two-thirds of the nation's gas. Oil and gas revenue from extraction underpinned a powerful base for social welfare, including as a means to build public infrastructure and community services, whether hospitals, sewer lines, or textbooks. By the 1970s, oil and gas provided 40% of the state's revenue (Burnett 2010). Some examples of such state-led social and economic welfare approaches continue into the present.

In some cases, long-term booms may manifest as a more insecure “flickering” of activity. Freudenberg (1992) described the “cost-price squeezing” that takes place in mining regions as changing commodity prices pass on this volatility to local economies. When a commodity price drops below a break-even price, mining activity slows, and when prices rebound, activity also recovers. This “flickering” or “fluttering” of local mining operations creates instability of employment and economic activity in place. Uncertainty associated with this flickering may also hinder growth of indirect businesses that would need stability and certainty to make investments (Wilson 2004). Again, as important throughout, the degree of such flickering is in part a function of the material character of the resource accessed and the way its particular idiosyncratic characteristics contribute to the social and technological organization of production.

More dystopian scenarios are also possible. Freudenberg refers to the “developmental channelization” that can take place when a economic resource

trajectory becomes so specialized, entrenched, and built around an ambiguous resource that it might “effectively preclude other developmental options” (Gramling and Freudenberg 1996).

### **2.3. Whose transition? Values, ideas, and institutions in transition politics**

In this section, I build on the earlier sections by considering research and frameworks that put ideas, interpretations, institutions, and politics front and center as drivers in changing energy systems. These are themes that are woven throughout the dissertation and can add further to the ways we think about energy transitions.

There is increasing attention to social and political conflict in changing energy systems (Laird 2013). Research about the factors that explain community support and opposition for certain energy experiences have a long history. For example, in their comparison of opposition and support to offshore oil development in California versus Louisiana, Freudenberg and Gramling (1993) identify a few historical, biophysical and social factors that tend to distinguish patterns of regional support or opposition to energy development including, "differences in average educational levels, the patterns of social contacts, the pre-oil significance of extractive industries, and the potential for overadaptation."

A handful of studies of Marcellus shale communities initiated during the time of my research set out to test, examine, and update some of the community "contextual factors" identified as important in the boomtown literature to

contributing to expressions of support or opposition. Jacquet (2009) identifies some of the factors as population structure, the form and function of local government, land ownership patterns, and historical context. In accordance with these factors, several studies have examined how perceptions varied based on mineral rights ownership, the ability of communities to absorb increased population growth, and their current level of gas development" (Wolske and Hoffman 2013).

But efforts to model perspectives about energy development using metrics of support or opposition may lose site of the way complexity and ambiguity is central to the experience of change and the equivocal nature of perceptions that people often have. As Hajer (1995) notes, people often form ideas about an issue area not based on absolute core beliefs but from muddled and sometimes contradictory value positions. Ultimately, support and opposition are abridged expressions of more complicated perceptions ground in idiosyncratic experiences of everyday life (Robbins 2006) and other socially constructed perceptual dimensions such as values, sense of place, trust, existing discourses, and perceptions of agency (Bickerstaff et al. 2008; Ellis et al. 2007).

In my case study region, support for drilling was widespread, but there was substantial equivocation about the industrialization it was generating and the development pathways implied by its use, all of which was steeped in much ambiguity. In my research, I drill down on social perspectives, experiences, and emerging storylines. I draw inspiration here from literature on the social construction of technology and policy and its emphasis on values, interpretation, ideas, and institutions. Technologies have "interpretive flexibility" (Bijker et al.

(2012). Put simply, a technological artifact will mean different things to different people and different social groups. A nuclear power plant might for some invoke jobs, for another national energy security, and for a third a catastrophic health risk. In the context of proposing a new and imagined technological pathway, because different actors assign different meanings to the technological artifacts, there is no way to know in advance what interpretation will become dominant. Debate and argumentation unfold, new information and social learning shape the expressions of groups, public conflict may arise, and eventually closure of the debate is reached in particular institutional settings (Smith 2007; Hajer 2005; 1995).

This implies questions about the political process, publics, and participation. Issues of equity, power, public participation, and vulnerability lurk in the visioning, defining, and practicing of transitions. (Lawhon and Murphy 2012; Geels and Verhees 2011; Smith and Stirling 2010; Coutard and Rutherford 2010) The formulation of visions about transitions and transition policies involves foundational political questions about which systems to focus on, who gets to focus on them, and what sort of transition pathways are selected (Meadowcroft 2009). “Whose energy transition is it, anyway?” Who gets to decide? (Moss et al 2014). What kind of energy transition and for whom? (Kern and Smith 2008).

Hajer’s interpretive policy analysis (1995; 2005) offers a vocabulary for thinking about the mechanisms of politics here. According to Hajer (1995), discourses are prevailing interpretive schemes consisting of a “specific ensemble of ideas, concepts, and categorisations that are produced, reproduced and transformed in a particular set of practices and through which meaning is given to physical and

social realities” (44). Through argumentation about the meaning of an issue area, “discourse coalitions” form aggregate and coordinated storylines that reduce broader and more complicated rationalities to a language of metaphors and argumentation. Discourse structuration occurs when many people use a set of storylines and ideas to make sense of the world and conceptualize a domain of interest. Discourse institutionalization occurs when the set of practices and ideas constituting the discourse become stabilized into institutional assemblages and policies (Hajer 1995: 60-62). Hajer argues that a dominant discourse is one where both criteria are fulfilled.

The previous paragraphs described the way the articulation of ideas and argumentation can be a central social agent of change in energy systems as described. But they also may be rigidly reproduced as locked-in discourse. Over time, a particular interpretation may gain momentum and become part of “bigger social framings” that can “color societies’ thinking about whole areas of public life” (Scrase and Ockwell 2010). Through a comparison of nuclear policy and state actions in South Korea and US, Jasanoff and Kim (2009) suggest that differing “sociotechnical imaginaries” in the two countries have “underwritten very different responses to a variety of nuclear shocks and challenges, such as Three Mile Island (TMI), Chernobyl, and the spread of the anti-nuclear movement.” Furthermore, the “processes of formulating and implementing nuclear energy policies have simultaneously reinforced particular imaginations of risk and benefit, public good, and nationhood.”

These locked-in imaginaries may be resilient to contextual pressures as regime advocacy actors (Sabatier and Jenkins-Smith 1999) and discourse coalitions (Hajer 2005) reframe imaginaries to support new uses and visions of technology that allow for technological fixes to maintain existing pathways. For example, progressive discourse on low-carbon transitions in recent year has been challenged by new visions of clean coal technologies that industry regime actors have used to frame continuing policy support for coal extraction and use. These have been associated with new constellations of energy and political regimes (Tyfield 2014). In other circumstances, such imaginaries may become brittle and destabilized by new storylines and discourse about technology and society. Bosman et al. (2014) have referred to “discursive regime destabilization” to describe this situation. In one case study drawing on Hajer’s work, Geels and Verhees (2011) trace the way cultural legitimacy for nuclear energy was built in the 1950s and 1960s but then contested by the anti-nuclear movement seeking to institutionalize an environmental frame in national policy. In the context of energy systems, Scrase and Ockwell (2009) elaborate four prevailing “issue areas” of national energy policy discourse: ‘access’, ‘security’, ‘efficiency’ and ‘environment’. At any given time, discourse coalitions may operate to reposition the dominant balance of emphasis.

Locked-in and evolving imaginaries are not exclusively national in scale. Regional socio-technical visions may also weave visions of policy, identity, and the good life, as in the case of the regional “abundance storyline” described in this dissertation and its institutionalization as state policy in Pennsylvania. And indeed, at the community level, national (or regional) imaginaries are likely to be highly



contextualized by transformations of social, economic, physical, and cultural systems and new distributions of benefits and risks. For example, Eaton et al (2013) demonstrate the way that local actors in four northern Michigan communities draw from local conditions of risks and benefits to “frame the national imaginaries woven into local bioenergy proposals.”

Here is an opportunity to circle back to the early discussion on regional economic evolution and better integrate this with the discussion of ideas and politics discussed in this section. The regional shale regime in Northeastern Pennsylvania is a transplantation. Therefore, the proposals and imaginaries of a regional gas system are interpreted against ideas, practices, and identities associated with pre-existing regional economic sectors, such as agriculture and manufacturing, and the dynamics of change guiding these sectors in place.

Into this context, economic models and energy imaginaries are performed in place through discourse to make sense of an ambiguous future. These models can come to shape the practices and policies of actors and have self-fulfilling prophecies (MacKenzie et al 2007). Input-out models imply specific forms of economic behavior and relations within the economy that may not yet be built in the place that is modeled. In some cases, there may be a lot of work necessary to make the region’s systems operate in ways that capture these flows.

Actors may treat the prospect of a new regional economic form and the requirements for new practices with suspicion and wish to bolster those practices that support existing economic relationships. Or they may seek to embrace the new ones. These are interpretive and political questions about evaluating the potential

outcomes of interaction between the two processes and how to manage the “double exposure” of two global processes (Leichenko and O’Brien 2008).

Finally, there is the question of resilience that has been brought up in a few different ways in this chapter. Resilience is a term that has increased in use in fields such as ecology, psychology, engineering, hazards and other areas (Walker and Salt 2012). The term is used loosely in this dissertation to refer to the way that systems have the capacity to re-organize after disruption. Literature in resilience emphasizes that one must define resilience *of what* and resilience *to what*. In my case, there are two primary ways the idea of resilience is brought forward. First there is the resilience of a socio-technical regime to the twin pressures of contextual change and niche development. There also is the idea of community resilience to disruptions associated with energy development. In this way, my larger question about the relations between transition dynamics and change in local regions is also a reflection on the relations between socio-technical regime resilience and regional resilience.

## **2.4. Concluding thoughts on the literature**

The goal of the research presented here is to advance our understanding of the ways that local places are shaped by socio technical energy transitions and the way that local conditions shape the nature of energy transitions. Literature on transitions and geographies of regional development can help here. The regional development literature can sensitize socio-technical research to place particularities. In turn, the socio-technical literature helps us think about contextual

factors that drive change. The cross-cutting approach to discourse analysis put forward by Hajer and others offers a way to sensitize both sets of literature to the role of argumentation and ideas as drivers of change.

The literature I reviewed sets the groundwork for the rest of the dissertation by framing an approach to studying the social and geographic elements of an energy transition, including the places of origin, regional context, drivers of technical change and innovation, uneven expression of development, and the way ideas of the future guide the transformation of practices in the present.

The goal of this dissertation is to draw on the observations in this case study to find ways to bring into dialogue transitions perspectives and economic geography perspectives in ways that can help us better understand moments of energy transition such as that presented by shale development.

Adding to the literature on resource frontiers and industrial geographies, a transitions analysis can help to contextualize regional dynamics and experiences. I situate discussions of the community development experience in a longer trajectory of technological change. Through ideas such as spatial flickering, I link these changes to the patterns experienced by respondents in my study.

To literature on energy shifts and transitions, I offer a case study of a recent and understudied fossil fuel industrial adaptation as an additional empirical case study. This is a timely contribution, given the ongoing dynamism of this energy shift and the centrality it has in current local, regional, and national discourse. The case study also contributes to geographic perspectives on transitions by developing a regional case study and situating regional change in ongoing dynamics at other

scales. This echoes the need expressed by some for more spatially diverse approaches to transitions.

### CHAPTER 3: PLACING REGIONAL EVOLUTIONS OF SHALE

In this chapter, I present an account of the genesis of the shale shift as an adaptive evolution in recent decades of the natural gas system in Texas. I highlight institutional, technological, and industry organizational ‘fixes’ developed to maintain the stability of existing natural gas pathways. I concentrate here on system-wide changes at an interstate and national scale and illustrate the crucial role that southern energy states and resource dynamics in Texas played in this history. The recent history of shale innovation and growth can be seen as an experimental adaptation or upgrading of the industry in Texas that took advantage of established regional knowledge connections and the legacy of institutional and technological evolutions in the national natural gas system that have unfolded since the 1970s. In the second part of this chapter, I describe the commercial risks that were not overcome with new technologies. I describe the emergence of organizational preconditions in the natural gas regime that have enabled operators to imagine new business practices that might overcome the inherent risks of variable well performance.

#### **3.1. The stunted roots of shale gas**

Many of the signature events in early fossil fuel history took place within a few

hundred miles from the present-day shale gas hotspot at the center of this study. And while it is sometimes assumed that shale gas and the controversial technologies of hydraulic fracturing used to recover this gas are new developments, they too have roots in this regional energy landscape. The first commercial natural gas was produced from wells drilled into shale in the 1820s in Western New York. A few months later, gas-fired streetlights glowed along the streets of Fredonia, New York. Shale drilling spread across the shore of Lake Erie through northwestern Pennsylvania and into Ohio and eventually throughout the Appalachian basin. By the 1880s, gas from Devonian shales supplied Louisville, KY (Office of Technology Assessment 1977) and the state started producing it commercially from the 1920s (Avila 1977).

In contrast to its prominent role in the early history of natural gas, by the mid 1970s, gas from shale was a negligible component of the overall natural gas supply landscape in the United States. In absolute terms, it was still a source of production in localized spots in Kentucky, for example (Kuuskraa et al 1996). But over the 20<sup>th</sup> century, shale gas was displaced in relative terms by production in rocks that could produce more gas, more quickly, at less cost.

Most of this gas has been produced from sandstones. In contrast to shale's low permeability, "conventional" sandstones are highly permeable and gas flows readily. Over geological time, gas in these formations migrates upwards until it is sealed in reservoirs or "pools" of relatively limited extent beneath rock of lower permeability, often in arched domes. Because it is concentrated, it may be possible to pump gas from a potentially large volume in the subsurface, if a driller

successfully finds a seal. By the 1970s, natural gas production in the United States was dominated by drilling in the most prolific region of sandstone—an energy belt encompassing the three states of Oklahoma, Louisiana, and Texas. In 1979, these three states accounted for 79% of national production (Allison 1984). Since the 1940s, Texas in particular has been a cornerstone of U.S. gas supply, consistently producing a little more than 30% of the nation’s gas.

### **3.2. The evolution of well technology and the devolution of performance**

Just as the history of shale gas has roots in Pennsylvania, so too are the principles of hydraulic fracturing rooted in the genesis of the oil industry just across the state. In Titusville, Colonel Drake drilled an oil well in 1859 that catalyzed a regional and eventually international petroleum network. A few years later, in November 1866, U.S. Patent No. 59,936 was issued to Civil War Veteran Colonel Edward Roberts, often referred to simply as “exploding torpedo.” This was the precursor of today’s hydraulic fracturing. The patent described combining an explosion at the oil-bearing point of a well with “superincumbent fluid tamping.” Put simply, a well was filled with water, after which gunpowder encased in an iron ‘torpedo’ was submerged in the water and then detonated. The fluid helped to distribute the energy from the explosion laterally, expanding fractures in the rock that increased the initial flow of oil. (Pennsylvania Heritage Magazine 2009).

Within a few years, Roberts’ torpedoes had been developed and deployed in wells around northwestern PA. The technology was so critical to the success of producers in these early years that a cottage industry of underground “shooters”

emerged to challenge Roberts' monopoly on the technique, prompting him to spend hundreds of thousands of dollars in legal and detective fees defending his patent (AOGHS 2013). An offshoot of Roberts' company, the Otto Cupler Torpedo Company, continued to produce nitroglycerin torpedoes in that state up until 1990, a business that ended in turbulent fashion when the nitroglycerine supplier's plant exploded. (The company had been outsourcing nitroglycerine production since 1978, when its own plant had exploded.) (Pees 2013)

Beginning in the 1950s, Robert's exploding torpedo was supplanted by modern techniques for hydraulic fracturing of wells, which ushered in modern forms of well stimulation as a staple technique in tighter sandstone formations. Modern hydraulic fracturing pumps large volumes of water down a well, using the water pressure to fracture the rock. In many places with tighter formations, such as Western Pennsylvania, fracturing in shallow formations has been common since the 1960s. But the techniques evolved significantly in the next decades. Compared to the shallow sandstone fracturing that became common starting in the 1960s in tighter formations such as those in western PA, fracturing techniques evolved in the 1980s and 1990s to take place in rock at greater depth and under greater pressure. Where shallow formations are 1500 feet or less below the surface, deep gas formations, whether sandstone or shale, can be ten times deeper. Furthermore, hydraulic fracturing has evolved to use millions of gallons of water at pressures significantly higher than an exploding torpedo. The water is mixed with sand to help prop open the fractures that form. A variety of chemicals also are added to the fracking fluid to increase various properties that allow greater recovery, such as



breaking surface tension, anti-bacterial agents, and corrosion inhibitors. While some of these chemicals are products used in household and packaged food goods, there has been considerable attention to the lack of transparency about all the additives and the potential for toxic agents to migrate into groundwater.

The importance of hydraulic fracturing and related well stimulation technology has increased in recent decades for those operators under pressure to maintain profitability in mature fields with declining reserves. The situation in Texas illustrates this situation. Beginning in the 1970s, Texas as a staple of gas production has become more volatile. Large low-permeable reservoirs have been more difficult to find or gain access to. Reflecting the condition, by the end of the 1990s, the number of new wells drilled each year statewide had nearly doubled since the 1970s, but the amount of gas produced was nearly half. (Swindell 1999). Across the lifecycle of these new wells, the estimated ultimate recovery (EUR) of gas was a fraction of older wells. In 1971, the average projected recovery was 6.2 billion cubic feet per well (bcf/well). By the end of the 1990s, this had declined to 1.0 bcf/well. (Swindell 1999).

Over the 1980s and 1990s, operators in Texas turned more and more to technological fixes such as improvements in horizontal drilling and massive hydraulic fracturing that can 'coax' gas from declining reservoirs and from "unconventional" gas formations that are deeper and less permeable. From one perspective, the gains from these improvements were striking. Over this period, improvements in horizontal drilling and massive hydraulic fracturing manifested as nearly a tripling of first-month initial production rates in new wells in Texas

(compare 15,601 mcf/month in 1983 to 44,894 mcf/month in 2000) (Swindell 1999). From another perspective, these changes in the upfront profile of wells did not offset longer decline trends; the high initial production did not translate into long-term performance. This is partly because producing gas at such high pressure corresponds also to much higher decline rates, which is a measure of how quickly initial production rates decrease over time. The overall first-year initial decline rates in new wells had increased from around 10% in 1971 to over 50% by 2000.

In sum, the most productive wells were drying up and more marginally-producing highly-worked wells had to be drilled faster and with more work to maintain current rates of production. Because of steady decreases over time in the estimated quantity of gas developed per well, Swindell (1999) judged in 1999 that "volumetric replacement of the state's annual gas production requires the completion of an estimated 6,100 new gas wells compared with only 3,566 new gas wells in 1999 and 4,580 new gas wells in the year 2000" (Swindell 1999).

### **3.3. Industry evolution in Texas - Technical and regional adaptation**

The situation of well performance and production in Texas spilled into arguments about national energy security. By 2003, the Economist magazine declared it "conventional wisdom" that the U.S. was in the midst of a natural gas crisis (Economist 2003). Alan Greenspan remained pessimistic about the future, claiming there was no easy fix for this problem, which potentially could spill over and contribute to an "erosion of the economy." The impressions that production crisis were looming was amplified by ongoing attention to explosive demand. Chapter 4

describes the way a transition coalition successfully boosted natural gas over a generation as a stop-gas fix for environmental and national security anxieties. Explosive demand in the early 2000s in no small measure was an expression of the success of this discourse coalition in framing policy. It had successfully helped press regulations against coal in the clean air act and institutionalized other forms of support for natural gas as a clean energy technology, contributing to a surge in popularity in combined cycle gas turbines among power producers. Reflecting the supply crunch and surging demand, before the end of 2005, the price of natural gas in the U.S. had increased to 12 times the record low in 1995 but production was down 8% from just a few years earlier in 2001. (Smil 2012).

One company central to these ‘crises’ trends was Mitchell Energy. In the late 1990s, the company’s conventional wells in North Texas were drying up, and the company was actively experimenting with different completion technologies. Recalling these experiential efforts, one former geologist at the company recalled, “this was survival, this was need” (Father of Fracking 2013). The company formed a small experimental shale team. Most experts at the time assumed that more cutting edge well stimulation technologies using fluids such as foams and gels would be the way eventually to make shale wells competitive. (Zuckerman 2013). But a group of employees within the company’s shale program, tightly networked into practices within the industry, tried adapting high-volume hydraulic fracturing used nearby by another company in tight sandstone formations (Father of Fracking 2013).

This knowledge spillover is a key moment of adaptive innovation in the present shale shift. But it is worth emphasizing that the innovative moment was

tightly coupled within a regional industry that in many ways was already using the technology. The moment of innovation might better be understood as an adaptive transfer of technology within ongoing trends in the industry.

By adapting the technology of hydraulic fracturing, Mitchell Energy demonstrated that drilling a shale well—despite its low productivity—might under *some* circumstances compete with the shrunken performance of the state's other sandstone wells. This was enough to assemble interest among industry actors and help larger companies to begin concocting business practices and other technological best practices that might be used to scale development and make a “play” at developing shale gas more broadly. After Mitchell energy was purchased by the larger Devon Energy in 2002 for \$3.5 billion, other industry best practices, notably horizontal drilling, increased well performance further in Texas' Barnett shale (Yergin 2011).

In a heroic reading of shale development that has been widespread, Mitchell Energy's founder, George Mitchell, is an industry disruptor who reinvented the natural gas industry, the “father of fracking” (Father of Fracking 2012). But in another sense, the bulk of the technologies he adapted were widely in use in other tight formations, and the incremental adaptation of them from tight sandstones to shale was not a stretch of the imagination. The story overlooks the single biggest hurdle to commercially *scaling* shale now and in the past: It has an inconsistent temperament. The capacity to read this temperament was not changed by Mitchell Energy, and the commercial risks of shale remained. On the eve of expansion from Texas Barnett shale to other plays around the country commercial risk remained

locked to managing this inconsistency just as it has in the past. In the next section, I describe in more detail the commercial risks and the new business practices that were imagined to help manage the considerable risks of shale that still remained.

### **3.4. Scaling a new mode of production and lingering inconsistencies of geology**

Unlike conventional “exploratory plays,” the gas in shale is distributed throughout a formation, which may underlay huge areas of land. In these “resource plays,” a well will hit gas nearly every time. This can give the impression that “finding costs” are low. But the promise of shale gas abundance is undercut by the fact that that shale is not a “simple and consistent” rock and therefore neither is the distribution of its gas. Differences in the permeability and porosity of shale, natural fracturing, and other characteristics that influence recovery rates can vary by a factor of ten across a whole play and a factor of two or three between one well and an adjacent well. (Durham 2010). In fact small-area variation in average initial production rates from one play to another are relatively small compared to substantial variations in performance within individual shale plays (O’Sullivan and Paltsev 2012). Even the best wells tend to pack performance at the front, with high initial production rates and steep decline rates in the months and years after.

Fully overcoming these constraints would require the knowledge and optics to envision geology and forecast production over short microvariations. But in spite of advances in 3d seismic and associated visioning technologies—without which commercially producing shale gas would be impossible at all—the technology for

characterizing micro-variations and translating them into probabilities of well performance “still poses challenges” (Forbes and Wilczynski 2011). Such key factors as the “role of natural microfractures in reservoir production or in assisting artificial fracturing is not well understood” (Speight 2013). In brief, while the risks of not finding gas are low in shale, the risks of losing money are high.

What has changed perhaps as dramatically as the technology is the organization of producing natural gas more generally—the speed and flexibility with which labor, commodity chains and technology can be organized and re-organized in place—and the capacity to imagine “new business practices” around this mobility. These are the subjects of the next two sections. The first section considers a set of historic characteristics of the natural gas regime and some evolutionary changes to the contextual landscape of the natural gas system. These dimensions clarify preconditions that have enabled the natural gas regime to imagine scaling shale production from its adaptive roots in Texas and transplant it elsewhere. The second section considers the way the regime has been characterized by competing business models that imagine different ways of scaling shale production. This experimentation is a reminder that regime practices are unstable and there is high commercial risk associated with scaling.

#### *3.4.1. The character and catalysts of regime practices*

In the days of early enthusiasm for shale gas, many industry regime actors argued that “new business practices” were now able to reduce commercial risk posed by the inconsistency and heterogeneity of the shale subsurface. These actors saw the possibility that standardization, speed, and homogeneous business

practices might create efficiencies that could average variations for net gains. This vision relied on a set of pre-conditions and technical, institutional, and organizational transformations that co-evolved over a generation to engineer the U.S. independent natural gas industry as a mode of production with unprecedented capacity for flexibility, mobility, speed, and scaling of drilling and production. In this section, I consider some of the precursors and conditions before describing the new business practices in more detail. The totality of this analysis describes the current form of the shale mode of production.

*Incremental market deregulation* has transformed the structure of the U.S. gas industry (DeVany and Walls 1994; Juris 1999; Joskow 2012). Since the initial round of re-pricing in the late 1970s that partially liberalized wellhead prices, legislation in the 1980s and early 1990s included efforts to further liberalize wellhead prices, create open access to interstate pipelines and limit long-term contracts, which allowed large users and producers to bypass interstate pipeline companies and exchange directly (Juris 1999).

In the deregulated market, most trading now takes place at a series of regional hubs. Out of market restructuring came liquid spot markets, short-term term contract markets, derivative markets and other mechanisms that define a responsive market with rapid price swings. Differential prices at regional hubs incentivize the development of production technologies and practices that can rapidly take advantage of these spreads with a speed of decision-making that is now fundamental to competition (Joskow 2012). Furthermore, other changes to ‘on the ground’ institutions have increased the capacity for rapid growth, such as faster

permitting for pipelines and related infrastructure. In sum, liberalization increased competition and market responsiveness, thereby placing a new premium on speed, mobility, and scalability as part of the competitive landscape. The new market has created conditions for the flourishing of new technologies and forms of business organization.

*Private property is another important condition.* The United States' unique mineral ownership structure creates flexibility, speed, and competition in mineral contracting. In almost all nations across the world, the state allocates access in the form of concessions to private and state enterprises to conduct exploratory work. Instead, in the United States, the onshore subsurface is governed by a patchwork of resource holders, including federal entities, state entities, and private agents. Because leasing works under real estate laws, mineral access can be acquired and divested quickly and offers rapid scalability. During land rushes, leases can be swapped and change hands multiple times before any extraction takes place. Space can be strategically optimized favoring rapidly acting firms with first-come access to proprietary knowledge about potential prospects. Therefore, private leasing enables operators to critical flexibility to react to rapid and volatile price spreads in restructured markets.

A well-capitalized, highly competitive *system of independent oil and gas operators* willing to take on commercial risk is an active part of the natural gas regime in the United States. While transnational majors—Big Oil—wield enormous influence over the whole commodity chain of production and distribution of fossil fuels, smaller independent natural gas producers in particular have dominated the



shale shift in its early years. These independents are still significantly capitalized companies, but are widely proliferating and have varied sizes. This regime is highly competitive. At the height of interest in Bradford County, more than 20 independents had staked claims to leased land in the county.

*A mature network of drilling infrastructure* unrivaled in the world supports these independents. In the U.S., there are 2000 drilling rigs in operation. For comparison, just two rigs operate in Australia, a country with a similar degree of development and its own shale resources (report). Rigs in the United States are optimized to migrate technology and people in a matter of days and roll in and roll out of massive production campaigns in weeks. Technologies like multi pad drilling and mobile rigs are innovations designed to take advantage of the competitive pressures to make production flexible, rapid, and customizable to the demand from pipelines, refineries, and market hubs and to navigate microvariations in geology. The “biggest drill rig ever” manufactured by Schramm can “walk and talk.” It has “walking portability for fast moves from hole to hole.” It “talks by offering full communication interface connectivity to third party data acquisition providers that utilize the Internet or dedicated satellite communications systems to remote operation centers in multiple locations” (Schramm 2013). 3-D seismic technology and related technology for imaging the microvariations in shale plays is also key. These are technologies that matured in the 1990s, have decreased finding costs enormously within the industry (see Bridge 2005). They are key to managing geological risks in the highly variable shale formations (Geokinetics).

In recent decades, industry changes also have resulted in a robust

*professionalization of contract-driven “midstream” companies*, such as Halliburton and Schlumberger, and subsidiaries, through which support service and labor mobility are choreographed to support independent upstream sector. The mobility of labor has always been a priority, since prospecting creates a constant state of flux that requires movement to new geographies. Increasingly, such labor pools are self-contained and imported. It is estimated that 75% of workers on drilling rigs in Marcellus are brought from out of state (Olsthoorn 2012). The majority is stationed for some months or years in one location, before moving on. The labor organization and infrastructure is designed to accommodate migratory workers, emphasizing such things as work schedules with two weeks on/off, housing in temporary man camps, and 12 hour shifts.

The changing landscape of global competition also drew the attention of *‘big oil’ capital* to shale prospects. While independent operators drove the operational side of the shale boom, oil majors played a significant role in bankrolling these efforts. A range of pressures on the oil and gas regime have amplified uncertainty for oil and gas majors seeking to access new production opportunities around the world. Bridge and Wood (2010) and Anderson (2011) have explored this situation. This reflects in part a diminishing rate of discovery, as fewer major new fields are uncovered. As well, institutional constraints in different countries limit the geographic extent of an E&P company’s potential access. Anderson (2011) describes a few of these constraints. For all these reasons, international oil and gas operators increasingly covet opportunities for easy, quick, and dependable reserve replacement. Joint ventures with oil majors and IOC were central to the early

capitalization of shale. In many cases, a small set of finance actors successfully brokered mega deals for shale development. For example, Ralph Eads, who brokered \$35 billion of such deals, described the way investors eagerly invested in shale assets that had not been proven. According to Aubrey McClendon, former CEO of Chesapeake, one of the largest shale operators and a major presence in the Susquehanna core, the ability to take out large, long-term loans to ride out boom bust cycles was “almost as important an insight as horizontal drilling” (Goodell and Acker 2012).

#### *3.4.2. Experimental business models and the commercial risk*

The previous section described industry landscape changes and characteristics of the natural gas regime that created a certain set of structural conditions to the natural gas regime on the eve of industrial scaling of shale production. In this section, I consider the way these conditions enabled actors to imagine new business practices that might overcome the challenges of drilling in low porosity and heterogeneous formations such as shale.

Inconsistencies in the character of shale rock within a geological formation historically created high commercial risk. In the lead up to Marcellus production, many regime actors argued that the industry was able now to manage these risks. New drilling technology went hand-in-hand with “new business processes capable of handling large numbers of wells.” The “application of factory-like models are now becoming the industry norm to speed up both surface and drilling activities of multi-year development programs” (Forbes and Wilczynski 2011). These ideas were

central to a “manufacturing” model that imagined spreading immediate commercial risk across time and space through large acreage, “basin-centered” leasing and systematic and standardized drilling campaigns. The emphasis was on locking down acreage and moving to production at high intensity, speed, and efficiency to lower costs and capture revenues from heightened gas prices before swings in commodity prices would bring the play below break-even prices. The constraints on the pace of drilling were typically set externally by rig availability, deployment of infrastructure such as gathering capacity, and access to capital. Meyer and Blackford (2012) contrast this strategy with the “traditional approach”:

The traditional approach is to invest considerable time, engineering talent, technology and money to *maximise the initial production rate* from each new well. However, in unconventional basins, success will most often be predicated on maximising field/basin production by *optimising the overall number of wells drilled* while placing a premium on speed, predictability and cost management. In this new world, production volumes are driven by manufacturing wells rather than a more intensive focus on engineering wells.

Looking back, some analysts such as Neal Anderson, global head of consulting at Wood Mackenzie, argue that investors in the years before Marcellus expansion (prior to 2008) were misestimating the risks.

The investment community has been a huge supporter of shale gas. We had equity analysts’ quotes from four or five years ago where they were strong supporters of shale gas. They loved the volume growth. They didn’t really care about the value – were they making money? It was more of a volume play than a value play. It’s only since the start of this year that they’ve sat back and figured out who’s actually making money. So to me that’s going to be the turning point for that correction. (Q&A 2011)

In the early years, a variety of high-risk and controversial financing vehicles were adopted. These included so-called “volumetric production payments” that tied upfront cash payments on projects to the future production of gas. In other words,

in extreme cases, some companies were borrowing against future production in plays that had yet to see much production at all.

The drop in commodity prices accompanying the market downturn in 2008 tested these commercial strategies. Companies that got in early, with low costs on leasing and good hedging, were able to continue production. But many operators were caught with partially completed wells, commitments that extended out in time, and surplus of uneconomic land positions. Some companies such as Schlumberger called attention to the problems of the manufacturing approach to resource plays, calling for a "flexible factory" approach that balanced speed and standardization with more attention and investment in "analysis and customization" in each individual well. The model urged tiered appraisals of conditions and built-in triggers for modifying "design, drilling plans or capital deployment strategy" in response to swings in market, unexpected geological developments, in order to retain the small margin of profit for shale. (Schlumberger 2011). The transition from high-risk 'manufacturing' to more 'flexible' and careful models has coincided with a host of changes in financing. In contrast to earlier joint ventures, some of the recent M&A acquisitions have set up complicated risk mechanisms to deal with heterogeneity across geological space and production rates over time (Crowe 2013).

### **3.5. Summary**

This chapter has offered an account of the re-awakening of shale production at the intersection of technological change and industry organization. The historical account ends right on the doorstep of early production in Pennsylvania. In chapter

5, I bring a geographic perspective to industry operations and strategy as away to begin setting the industry in place in the Susquehanna core of Pennsylvania. I expand on this idea of rapid scaling and standardization of campaigns by more fully exploring the way that mobility and migration of activity also has been used as a strategy to manage commercial risk. This structure of production is central to understanding the unique uncertainties about activity and impacts experienced by communities there.

In their article on unlocking regional lock-in, Martin and Sunley (2006) suggest a typology of trajectories of regional path creation. These are useful pathways for thinking about regional energy transitions. They help to illustrate that a “shale shift” as a regional transition can follow multiple pathways in relation to existing development trajectories. In Texas, the emergence of the shale industry can be seen as an *adaptive* upgrade of the existing industry under pressure to maintain profitability—a knowledge spillover in a tightly linked and mature regional energy assemblage. At this level of analysis, it is useful to point out that despite gains in productivity and efficiency, and all the adaptation of technologies brought to bear on shale in Texas, the USGS estimated that in 2011, the average estimated ultimate recovery (EUR) of a well in the Texas Barnett shale—the site where Mitchell energy’s successes prompted the original round of industry scaling of shale practices—was 1.3 bcf/well (Sandrea 2012). By comparison, conventional production at the time in Texas was 1bcf/well. By this measure, it is clear that shale wells were performing at least on par and slightly better than conventional wells. By contrast, in Texas in 1971, the average EUR was approximately five times the rate of

either average. Wells at that time averaged 6.2 bcf/well. This measure is a reminder that the performance of shale wells is an incremental and small improvement, not transformational.

This point is important as the industry was considering scaling to new shale plays. The tension described in the previous section between the two models of industry scaling for shale production underscores the business uncertainties and commercial differentiation rife within the industry as it expanded beyond the regional niche of Texas Barnett shale. Sandra (2014) argues that the shale gas business has an “equation” that operators have not fully solved, if they ever can. Analysts, operators, policymakers, and the public have not fully grasped this.

In Chapter 5, I explore in more depth what the geographic implications of this are. Where the shale shift in Texas has been a diversification and enhancement of the existing industry in response to immediate declines in profit, the shale shift in Pennsylvania has been a “transplantation” of the industry enabled by new business practices within the regime that enabled rapid mobilization. Uncertainties and efforts to manage commercial risk have translated into patterns of uneven development over various scales of analysis, including small variations from towns to town within the Susquehanna core.

Before returning to that discussion, I turn in the next chapter to once again reach back into the history of shale to consider the politics and policy of natural gas and the way that imagining shale practices in Marcellus destabilized long-standing ideas about the role of natural gas in the broader energy system, and the role of the state in fostering these transitions.

#### CHAPTER 4: (DE)STABILIZING THE TRANSITIONS STORYLINE

Intersecting the resource declines, competitive struggles, and technological innovations described in Chapter 3 is a story of evolving policy discourse, advocacy, and government engagement. In this section, I consider the way an ensemble or constellation of ideas about the natural gas system came to stabilize a discourse coalition around a storyline of state support for natural gas as a transition fuel.

Natural gas historically has roots in an environmental discourse expressing the role of gas in as a technological fix for emblematic burner-tip issues such as acid rain and climate change and a security discourse expressing the role of gas as a fix for energy insecurity, including national independence and energy affordability. In the last generation, increasingly these two concerns have become enrolled in a “transitions” discourse coalition joined around the storyline of natural gas as a metaphoric “bridge” until such time as new technologies can fully realize these goals.

In the second section of this chapter, I consider the way that this discourse coalition has become destabilized by ideas about abundance and local environmental risk associated with the diffusion and transplantation of shale practices from the mature energy plays in Texas to relational resource frontiers such as the Susquehanna core of the Marcellus shale. I consider the way that the



new practices of shale extraction have begun to transform the established political and policy storylines about the role of natural gas in national energy systems. In later chapters, I consider in more detail the regional and community expressions and experiences in Pennsylvania.

I draw here on literature on the role of ideas in energy and the environment. Scrase and Ockwell (2010) suggest that arguments about national energy policy often balance four issue areas or discursive emphases: ‘access’, ‘security’, ‘efficiency’ and ‘environment.’ Hajer (1995) argues that following storylines is an important way to understand the way such discursive emphases are translated into institutional forms through argumentation. Metaphors and other parts of speech operate as translation devices that glue together diverse “discourse coalitions” around a particular interpretation of an issue.

#### **4.1. Constructing the bridge**

In the next two sections of this chapter, I trace some historic links of the energy security and environmental dimensions of the transitions coalition. I link a key moment of evolution in the transitions coalition to the intersection of energy security discourse and the anxieties about energy crisis in the Southern energy producing region in the 1970s. I then trace a history of ideas about natural gas in environmental discourse.

## **4.2. Energy security and energy transitions**

One component of the transitions storyline emphasizes the role of natural gas in transitions to energy security. There is a lengthy recent history of natural gas and energy security but not enough space to explore it here. To emphasize the way regional discursive dynamics can redefine national energy horizons, which is a theme in this chapter, I trace a key moment in the evolution of the energy security component to the Southern regional response to the “energy crisis” of the 1970s. This is the narrative subject of this sub-section.

Between World War II and the 1970s, optimism about the stability of production in the South underpinned a strong role for the state. State and federal policy positioned governments as key mediators of access to mineral markets and the distribution of rents (Waples 2005). Wellhead prices were set by federal regulations and state actors imagined rent capture as part of integrated programs of statewide social and economic development. For example, beginning from the earliest days of the oil and gas industry in Louisiana and the populist politics of Huey Long, the state of Louisiana had deployed severance taxation as a means to build public infrastructure and community services, whether hospitals, sewer lines, or textbooks. By the 1970s, oil and gas provided 40% of the state’s revenue (Burnett 2010).

In the 1970s, declines in major fields in the South and snowballing problems matching regional gas supply and demand called this optimism into question. The energy system increasingly became an object of inquiry and argumentation in an emerging politics of energy transitions and energy security. In natural gas, one of

the key ideas to emerge was the idea of supporting niche technologies and restructuring the market landscape of natural gas in order to re-organize the industrial regime into a leaner, more responsive, more innovative form.

An influential figure at the time was Robert Hefner, the founder of natural gas and oil firm GHK Company and ultimately the chairman of Oil and Gas Men for Carter. As a frequent public commentator and expert for congressional testimony, in the late 1970s Hefner enjoyed unique access to mediating public and political narratives about natural gas. Articulating a metaphor that was central to the emerging security storyline, Hefner referred to natural gas a "bridge" to those 21st century energy technologies that would provide full energy security. In his formulation, those were likely to be nuclear technologies, but there was wide interpretive latitude on this portion, because the emphasis was ultimately on natural gas and not the endpoint of a transition. Hefner stressed the need to strengthen this "bridge" by restructuring natural gas markets with supportive pricing and federal tax support for alternative regime practices such as deep gas production.

A discourse coalition came to successfully argue that such an institutional fix was in order. In no small part, this was empowered by the weight of support offered by high-level actors in Southern energy producing states. Louisiana's Governor Edwards argued that the system of federally regulated pricing was sending cheap natural gas to the northeast, creating shortages in the South, distributing the environmental risks to the South, and subsidizing unregulated manufacturing of finished goods in the north that were then sold to the South at full cost. Actors in

southern energy producing states saw in market deregulation a way to gain independence from Northern interests. A successful populist campaign resulted in bumper stickers across the region that shouted: “let them freeze in the dark.” Governor Edwards threatened to slow down production in an attempt to get northeastern states to increase exploration and production in their regions.

Navigating energy regionalism and the specific issue of federal deregulation of natural gas was a tricky political issue during Carter's 1976 campaign. During the campaign, he ultimately signed a pledge with the Governors of southern energy-producing states to pursue deregulation in office, but he pivoted on the issue after his election (Novak and Evans 1977). Hefner and others pressed for *partial* liberalization that would set in place a tiered pricing system for different types of gas, engineered to incentivize forms of unconventional energy production. With one swipe of the pen on November 9, 1978, President Carter signed the Natural Gas Policy Act (NGPA), which did just that. The new pricing arrangement created different incentives for different classes of production.

As businessmen interested in deep gas production, for Hefner and others, the Act more or less circled Oklahoma's Anadarko basin and declared open for business' deeper, higher pressure unconventional gas formations, for which technology was more expensive and less proven than in conventional shallow formations (Hightower 2014). On *60 minutes* in December 1980, just after initial price controls were reset, Hefner argued that with these efforts, natural gas could get us “well into the next century.” Addressing the Senate Committee on Energy and Natural Resources in 1981, three years after the 1978 NGPA deregulated 'deep gas,' Robert

Hefner argued that the NGPA was "not just working well, it is prompting the largest natural gas drilling boom in the history of the industry" (quoted in Hightower 2014: 2011).

That boom was short-lived, but it did effectively redefine the horizons for a generation of technological experimentation with unconventional deep gas exploration and discourse on market incentives and state support for natural gas innovation. These early efforts established two things. They structured into federal policy a merger of security and environment domains around the "bridge" idea at a key institutional moment. This coalition stabilized throughout the 1980s and 2000s with a variety of successes. The environmental domain is the subject of the next section. These earlier efforts by regime actors also set momentum for further deregulation and began to establish the conditions for speed, mobility, and scaling in the unconventional natural gas industry, which were critical to the "new business practices" of the shale industry in the 2000s. This was addressed in more depth in the previous chapter.

### **4.3. The environmental discourse of natural gas**

Another constituent component of the transitions storyline is its emphasis on a transition away from dirtier forms of energy production. The distillation of this component can be traced to the earliest days of natural gas production. Extending back to the 19<sup>th</sup> century, actors have positioned natural gas as a preferred fuel source to fix above ground, burner-tip environmental issues associated with the

energy system: air pollution, acid rain, and climate change. Competition with coal can be traced directly to the use of the adjective “natural” in natural gas. Burning coal at high heat produces methane, which also is the main product refined from natural gas. Coal gas—often referred to as “town gas” or “manufactured gas”—was the original commercial source of gas used in the first gas lamps in 1785 in London. It was not until 1821 that methane bubbling up from the ground was used commercially. Incidentally cities such as New York, manufactured gas continued to be the predominant source of gas into the middle of the 20<sup>th</sup> century.

The adjective “natural” came about as a way to distinguish this new fuel source from coal-based gas. For the next century, this ‘natural’ dissimilarity from coal was central to environmental health discourse that has consistently positioned natural gas as part of the solution to help clean the energy system of coal and oil. In the aftermath of the demonstration of a natural gas economy the 1880s, “smokeless” activist campaigns in Pittsburgh resulted in the development of 3000 smokeless furnaces (Oakley 1913). In 1926, the president of the American Gas Association argued that burning coal in its raw form is an “economic crime” and that coal smoke must be “outlawed if universal good health is to be enjoyed” (Wall Street Journal 1926). By 1947, the science and economic impact of air pollution had become considerably more developed, and the American Gas Association among other entities was producing science on the quality of life and economic impacts of coal smoke (Miles 1947).

As policy issues evolved in the environmental domain—from localized air pollution, to regional acid rain, to climate change—a storyline about natural gas as

cleaning the energy system continued to be ‘part of the solution’ in a transition away from ‘dirtier’ fuels. For example, natural gas came to be seen as a transitional fix for the emblematic problem of acid rain during the 1980s (e.g. Hajer). Natural gas power production was a key beneficiary of efforts to institutionalize clean air policy with the Clear Air Act. The fit with climate change has similarly positioned natural gas as a transitional fuel. By the 2000s, an ecological modernization discourse had come to structure a discourse coalition that found Worldwatch and Sierra Club speaking in harmony with major gas companies and state actors around the shared goal of shutting down coal and ‘bridging’ this shutdown with natural gas.

Until recently, natural gas escaped the sort of environmental scrutiny and social contestation that have accompanied the production of “dirty and dangerous” oil and coal or the scrutiny on life-cycle infrastructure emissions that have dominated debates about new fuels such as biofuels, where accounting for emissions from indirect land use change became a source of great debate within the environmental policy domain. If as Graham (2010) argues, the goal of infrastructure is “invisibilization,” or to become “part of the unconscious backdrop of everyday life” (Furlong 2011), then the natural gas system was successful for more than a century at producing environmental invisibilities.

#### **4.4. Scaling the regional politics of shale**

Unlike Texas, where shale gas extraction developed as an adaptation of a slow moving crisis of production, regional transition in the northeastern United States

with the Marcellus shale has been what Martin and Sunley (2006) refer to as an industrial “transplantation.” Despite a history of oil and gas production in both New York State and Pennsylvania, the form and geography of the latest round of activity does not overlap the areas in these states where previous cycles of investment concentrated. Nor has the scale of investment in these states been very large in many generations. As a result, rather than an adaptation, the shale industry has been experienced as a resource frontier making sudden contact with social, physical, and economic systems that have little history of adapting to the processes of energy development.

At moments of dislocation such as this, ideas and imaginations of the future may become the dominant terrain through which politics and power expresses itself (Hajer 1995). In this section, I consider a series of imaginations about the future of gas production in the Marcellus shale that have sought to institutionalize particular pathways of development in the region and also contributed to the destabilization of the bridge coalition. (The experiences at the community level are the subject of later chapters.)

The imagination of a juggernaut of production up and down the Mid-Atlantic has been a powerful guide here. In the first section, I describe this imagined juggernaut. In the following sections, I describe two ubiquitous storylines that have emerged to define perspectives on the regional scale of transformation: an abundance storyline and an anti-frack storyline. Just as regional energy dynamics in the south in the 1970s provided the context in which state and regime actors sought to articulate a new role for natural gas as a bridge to the future, so too have regional



energy dynamics associated with shale catalyzed new storylines that destabilize the transitions storyline. The efforts of these coalitions increasingly influences the hard-wiring of the natural gas system not just in the Susquehanna core, but reaches across regions through the power of institutional change in state and federal policy.

#### *4.4.1. Scaling the future: Constructing a Mid-Atlantic juggernaut (2008-2012)*

In this section, I consider an imagined energy future that frames Marcellus shale as a juggernaut of production extending across the Mid-Atlantic and lasting for 100 years. This imagined future was key to representing a scale of impacts that framed state and local policy storylines and institutional action in the early boom years of Marcellus shale production (2008-2012). Central to invoking a juggernaut of production were two spatial representations of the geology of the Marcellus shale. First, the boundaries of commercial shale production were implied as coterminous with the geological extent of the shale formation. Second, the gas within this extent was represented as a volumetric totality within this container.

For example, a presentation from 2009 by the energy company XTO argues that the “sheer size” of the Marcellus shale, extending for 95,000 square mile under the surface, would deliver a “knockout blow” compared to the 5,000 square mile Barnett shale, at the time the most productive shale play (Patterson 2009). In parallel with this depiction, the 95,000 square mile space was often filled—as though a container—with volumetric estimates of gas across the whole formation, divorced from estimates of commercial recoverability. A 2011 passage from a report by “Enterprise Appalachia” marries such an estimate with a political

geographic overlay.

"The Marcellus Shale formations are 400 million years in the making, stretching from western Maryland to New York, Pennsylvania and West Virginia and encompassing the Appalachian region of Ohio along the Ohio River. Experts estimate the Marcellus Shale could contain as much as 489 trillion cubic feet of natural gas, a level that would establish the Marcellus as the largest natural gas resource in North America and the second largest in the world"

Representations of a large and continuous area of gas helped in the early years to signify a scope, distribution, and expectation of impacts. Importantly enough, depicting a juggernaut of future production was a shared frame of reference among transitions, anti-frack, and abundance coalitions. It also has been reinforced publically in popular media, policy analysis, and academic writing. These imagined futures have been widely cited within the anti-frack coalition to denote the scale of cumulative future risk. They also have been particularly powerful as a signifier of the scale of economic benefits. The figure of 489 trillion cubic feet was cited on the first page of a leading early economic impact report issued by Penn State (Considine et al 2009). The author argued in media about the way the scale of abundance translated into prospects for long-term development. "It's an exciting development for East Coast energy. A lot of people from New York to Washington have no idea there's a supergiant gas resource 150 miles west of where they live." He went on to add: "Even under rapid development out to 2020, production would use up only 8% of the reserves in the region. The Marcellus is going to be around for years to come. I view it as a generational resource that will be around well into this century" (Snow 2010).

Representing tight geologies as continuous surfaces predates the shale boom.

Indeed, the material character of such formations lends itself to such depictions. For example, in 1993, Robert Hefner contrasted the situation of oil, which is “geographically, geologically, and physically limited in its occurrence” with the deep formations of nonassociated “tight gas” that “virtually permeates the deeper parts of some basins” (Hefner 1993). The idea of ‘virtual permeability’ invokes a spatial imaginary of continuous abundance that has been central to promoting and marketing a range of ‘tight’ geologies of natural gas. So too was it central to the early depictions of Marcellus shale and to shale gas more generally. (And it should be noted again that this material character was a central component to the organizational logic of the manufacturing model, which imagined optimizing large-area drilling campaigns as a way to manage these inconsistencies).

As a preview of Chapter 5, I would note that the poetic idea of “virtual” permeability contrasts with the more disciplinary description of *geological* permeability that I described in Chapter 3. Where ‘virtual permeability’ represents gas in a space of continuous abundance under much of the mid-Atlantic, geological permeability draws attention to the variations in permeability (among other characteristics) that occur *within* a shale formations. These variations can be dramatically expressed over short subsurface areas as micro-variations. These differences translate into an uneven geography of well performance, an industrial topography of variable commercial risk, and a community experience of flickering densities of uneven development. Though it was a useful way to implicitly or explicitly promote certain ideas about the distribution of impacts, the 489 trillion cubic feet estimate says nothing about variations in commercial prospects. As an

entry point to analysis, focusing on geological permeability offers a way to imagine a far greater number of stages of development expressed in a more complicated geographical form.

#### *4.4.2. Deconstructing the bridge: From burner tip to well head*

As a locus of extractive activity, production in the Susquehanna core of drilling in northeastern Pennsylvania has become an emblematic setting for arguments about the qualitative nature of the utopian and dystopian futures imagined as the effect of this energy juggernaut. One official I interviewed in Bradford County summed up the way the town and surrounding region were becoming laboratories.

I'm starting to feel like I should have one of those period costumes, we have so many people coming down here, from New York state, from New Jersey, all over the place have been down here, and they'll come down in buses and vans, and from all universities, and so there's been all kind of people. Public radio has been here a couple times, Binghamton public radio has had interviews, last week I got to drive around the county with some National Geographic photographers.

Certain towns were becoming particular sites of illustration. In Dimock, on New Year's Day in 2009, a private water well exploded, about an hour from Towanda, in and around which most of my interviews took place. Subsequent investigations discovered elevated levels of methane and contaminants in multiple nearby wells, and attention rapidly descended on Cabot Oil & Gas, which had been hydraulically fracturing shale under the area. Cabot argued that the methane migrated naturally. Many questioned this and pointed more broadly at the variety of additives that were used in the drilling process. Despite EPA investigations and Cabot eventually providing an alternative source of water to the community, the relations of

responsibility and the character of impacts remained heavily contested and murky despite investigation (Gardner 2012).

For advocates trying to draw attention to environmental risks associated with shale development, the situation became an emblem of the inherent risks of fracking technology, with Dimock characterized by one activist whom I interviewed as the “three mile island” of hydraulic fracturing. Well contamination in Dimock figured prominently as a key piece of evidence in a documentary entitled *Gasland*, which traced the filmmaker’s campaign of self-education and public awareness about the risks of fracking. The documentary was released widely in 2010.

Empowered by prominent critical reception and the public activism of its director, the documentary stands as a seminal pathway for the emergence and evolution of an anti-frack discourse and more general public awareness about shale gas.

As part of my research, I conducted a few key informants interviews with fracking risk advocates and observed a number of public events mostly in New York and New Jersey. Through this, I distilled a few strands of the argument. There was common alignment with the need for transparency and disclosure about the chemical additives that are used in fracking fluids. Under this, a top-order distinction can be made between those advocating more research or regulation and those advocating a ban. A core fossil fuel resistance positioned fracking as inherently contaminating and argued for a permanent ban on fracking and an immediate transition from fossil fuels to clean energy. An environmental risk strand sought to draw attention to the cumulative impacts of industrialization and the range of pollution risks from fracturing technologies. This narrative argued that

evidence for environmental safety, economic and community security are not established and demanded further study into a range of impacts, perhaps under the cover of a moratorium on drilling. Such risks included water withdrawals, frack water spills (which include chemicals used in the process), the injection and fracturing process, wastewater spills, and wastewater treatment and disposal. A skeptical steward strand called for carefully tightening regulation, local environmental security, and drew attention to the uneven playing field of local actors, sometimes making claims to fair share distribution of burdens and gaining a better deal from the industry.

In contrast to the “burner tip” issues in the bridge transitions storyline, the anti-frack storyline is a 'wellhead and infrastructure' environmentalism that has developed around grounded issues like water pollution. An “anti-frack” storyline repositions natural gas in the environmental policy domain by introducing a new ‘dirty and dangerous’ storyline to natural gas extraction similar to those that have accompanied coal and oil. It de-emphasizes the emblematic issue of air pollution that historically enrolled natural gas as a low-sulfur solution.

The case of the fracking storyline is almost a reversal of the case study that Hajer used to develop his ideas on ecological modernization. Hajer demonstrated how UK-based discourse coalitions arguing for policy related to the international impact of acid rain first had to challenge institutionally embedded discourse on air pollution framed around the health impacts of more localized urban air pollution. (Hajer 1995). The case of fracking and water discourse is an inversion of this trajectory. It challenges the more established storylines of ecological modernization

that have helped institutionalize supportive natural gas policy. It does so by narrating the localized health and ecological impacts of trying to reach these goals. Actors also complicate assumed notions about natural gas in the transitions storyline.

For example, actors articulating one ‘strand’ of the anti-frack storyline have challenged some basic assumptions of greenhouse gas accounting of natural gas infrastructure, arguing that they that have been understudied. Widely circulated by coalition actors and subsequently picked up in public media was a piece of grey literature estimating “fugitive emissions” of methane from pipelines was becoming a heavily contested document during my fieldwork (Howarth et al. 2011). The transitions coalition struggled to evaluate this new piece of critical evidence. Worldwatch commissioned its own study on the issue and self-consciously recognized that such evidence was “a critical assumption in our common conclusion that natural gas can facilitate a reduction in power sector GHG emission,” and further acknowledged in a review of existing literature that “emissions factors that have been used for life cycle analyses involve greater uncertainty than previously appreciated” (Kitasei 2011). More generally, some of the major national environmental groups remained largely on the sidelines in the early years of the anti-frack arguments as they tried to decide how to respond to a storyline that ran perpendicular to the transitions storyline and potentially even contradicted it.

#### 4.4.3. *Deconstructing the bridge: From transition to the end of scarcity*

Across the Marcellus shale, a regional “abundance” coalition has developed around linking ideas of abundant gas and abundant local benefits. Illustrative of the coalition’s arguments are those of the Marcellus Shale Coalition (nb: it is formally named a “Coalition,” which is not reducible to what I am referring to as a discourse coalition). With 40 energy companies as members, it is the top trade group for the industry within PA (State Impact 2014). It represents a collective voice of oil and gas development in the state and is a premier actor in disseminating information to the general public, reflected in its prominence as a source in state news coverage. In addition to emphasizing the abundance of gas available, it emphasizes the abundance of jobs and economic development associated with growth and communicates the risks of burdening growth through regulation. It attempts to attenuate public perceptions of social and environmental risk by deemphasizing or delegitimizing attempts to institutionalize risk discourse.

The idea of abundance has been used by this coalition to undercut two core logics of the bridge storylines: that natural gas is a transitional fuel and that the federal government has a managerial role in the energy system. At the heart of the idea that natural gas was a transitional fuel was an understanding that natural gas was empirically in long-term decline. For much of the 1980s and 1990s, this fit well with a dominant understanding of well performance declines observed in places like Texas, which occurred in spite of technological innovations. State support and security measures were designed to delay this decline until other efforts could supplant this pathway. For those emphasizing the environmental domain, delaying



“decline” was part of a purposive guiding vision to phase out coal more rapidly than natural gas, with the goal of transitioning to renewable energy as quickly as possible. These two visions were not necessarily compatible but they could be articulated together.

The prospect of a new age of abundance undercuts the proposition that support for natural gas is premised on its transitional role. Many influential analysts have argued that shale gas represents a global paradigm shift and a realizing of national energy security in the United States (Yergin 2011). In concert, the conservative think tank the American Enterprise Institute (AEI) applauds: “natural gas now is the future.” (Entine 2011). Emphasizing how this new imaginary breaks the transitions coalition, the AEI editorial points out that this is, “[m]uch to the chagrin of energy activists.” And accentuating the metaphoric dimensions of this argument, it argues, “No longer is natural gas a bridge to the alternative energy future.”

More substantively, the idea of abundance also undercuts a central institutional orientation of the storyline around the role of the state. A core of the idea is that national and regional energy insecurity requires a bridge that at least in part was supported by the federal government. The bridge metaphor helped clarify the state’s role as a manager of energy transitions by suggesting an integrated way to change behaviors through different forms of intervention, whether supporting unconventional energy technologies, re-structuring markets, or regulating air pollution. Efforts to break this narrative connection are reflected in the way

discursive disruptors paint heroic portrayals of George Mitchell as the “father of fracking” or the founder of a “shale revolution” (Entine 2011).

A core of the “transitions” coalition has rallied around a defense of the federal government’s role in bridging energy futures, partly by expanding origin stories emphasizing the role of federal involvement in shale development. The Breakthrough Institute has sought to dispel the “myth that the shale gas boom was brought about through private sector innovation alone,” dissecting mechanisms of federal support over the past decades (Flagel 2014). One focus beginning in the 1970s was state support through R&D, taxes, and market change to expand gas exploration and production in deeper and tighter formations in the United States. For example, the Eastern Gas Shales Project (EGSP) was designed to help understand shales and develop technology for accessing them (Harper 2008). These and other geological and well technology advances demonstrate the roots of government agency in the shale shift, a fact noted by Mitchell Energy and those widely credited as “industry disruptors.”

In his 2012 State of the Union, President Obama drew on research from the Breakthrough Institute to make the case that “government support is critical in helping businesses get new energy ideas off the ground” (Breakthrough Staff 2012). This is part of a broader re-articulation by the Obama administration of the transitions storyline and efforts to rebuild the discourse coalition. An influential report on shale gas from the MIT Energy Initiative, headed by Obama’s future Secretary Of Energy, Ernest Moniz, recommended federal support for natural gas “as a ‘bridge’ until better options are available” (Lin 2013). The way the Obama

administration has supported the idea of natural gas as a pathway to national energy security and a future of environmental sustainability and climate security (White House 2009). Obama, recognizing that pairing these ideas can potentially build coalition support, pivoted to the country's "terrific natural gas resources" when asked at a press conference to put forward points of potential compromise following his "shellacking" in the 2010 midterms (Pipeline and Gas Journal 2010).

#### *4.4.4. Scalar politics of shale and state institutions*

The abundance and anti-frack coalitions have pursued a politics of scale to construct institutional credibility and legitimacy around competing roles for the state (Smith and Ferguson 2013). The abundance coalition has sought to centralize shale regulations from federal or local control to the state level. The anti-frack coalition has sought to broaden and deepen regulation more opportunistically, with particular emphasis on regulatory mechanisms that can tighten state oversight and expand federal management through agencies such as the EPA (Davis and Hoffer 2012).

The institutional outcome at stake is on display in the contrasting policy approaches in New York State and Pennsylvania. In New York State, a moratorium on fracking was established in 2008 guided by a precautionary principle of 'why rush?'. Many New York towns have banned fracking and upper level courts have supported their home rule powers to do so. The state has conducted environmental and health studies, drafting preparing multiple environmental impact statements

and two sets of regulations prepared. The Department of Public Health was also engaged to develop a review, currently ongoing (Sadasivam 2014).

No such moratorium was established in Pennsylvania, setting the stage for the boom in 2009. Policy discourse in Pennsylvania has been dominated by questions about capturing benefits and the appropriate actions to offer resilience to local risks. In the next section, I set the stage for discussions in later chapters by exploring more fully how these discursive efforts were ‘flavoring’ the policy context at the state level in Pennsylvania.

#### **4.5. Representing the flight of the juggernaut**

Arguments of the abundance coalition in state policy were framed at the intersection of two powerful geographic visions. On one hand was the vision of abundance in a juggernaut of production presented earlier in this chapter. On the other was a vision of this juggernaut migrating away and shutting down in the state. These powerful geographic visions framed the policy storylines structuring state institutions but also influenced the policy storylines structuring local institutional responses.

In media, the author of the most influential statewide economic impact estimate in the early years, gave expression to a geographic vision of industry volatility: “It’s a very different world in 2010. Gas companies can move their chips to other parts of the table...If too many taxes are imposed, drilling moves elsewhere. We’ve seen this in the United States: Drilling is down in the Rocky Mountains, it’s

falling in parts of Texas, and it's growing in the Marcellus" (Snow 2010). The "different world" he is referencing may have been 1984. Expressing a common sentiment at that time about taxation and industry movement, in 1984, Lowe (1984) pointed out, "imposition of a severance tax on production of coal or oil and gas is less likely to result in a movement of business activity from the state than an increase in the general corporate or individual income taxes, in part because businessmen cannot take the resources with them."

A severance tax is levied on the removal of a resource. The distinction between the two quotes above is that in the 1970s and 1980s, the relative geographic fixity of natural resources was seen as capturing the resource industry in place, a feature that made statewide severance taxes attractive. In the world portrayed by Considine in 2010, the opposite was true. This storyline about the fear of flight was a seminal point of argument against the severance tax. Inverting the argument of the 1980s, Pennsylvania Governor Corbett has argued that industry mobility is a defining condition of gas production: "I can tell you, I heard throughout the last four months, 'well, they're not going anywhere because the gas is there.' Quite frankly, that's what allows them to go anywhere. The gas can't go anywhere. It's there. It's been there for thousands of years. It's going to be there whenever the price gets better" (Detrow 2011).

This difference in emphasis between the fixed character of a resource and the mobility of the industry underpins a very different style or mode of governing access to the industry and organizing the state's approach to rent. The idea of fixidity implicitly underpinned the energy development policies of southern states

in the 1970s and 1980s. A state severance tax pegged to the extraction of a resource was seen as a way to promote social and economic development. Stemming from resource booms in the 1980s, at that time there was a proliferation of such tax efforts across a range of resources (Lowe 1984). Indeed, such was the consensus support for levying and raising severance taxes that debate at the time focused solidly on whether or not state-level resource tax wars might break out as states competed to set the highest tax rates. The outcome of these efforts is unambiguous today. 31 states have extraction taxes on oil and gas, and six states receive between 10.5 percent and 74.3 percent of total state tax revenue from severance taxes (Pless 2012).

Pennsylvania stayed institutionally silent on this issue at the time and remains the largest natural gas producing state with no severance tax (Pless 2012). There have been ongoing debates since the early 2010s in the state over whether and how to set such a tax. In contrast to the situation in those states with existing severance taxes, the highest severance tax rates suggested by mainstream advocates in Pennsylvania has been 5-10%. The mobility of the gas industry has been a dominant frame for discussion on all sides.

These changes are in line more broadly with what has been called “roll-back neoliberalism,” a policy direction that emphasizes how states, regions, localities and individuals are in competition for growth and development and that policy decisions must first and foremost consider how decisions can foster an appropriate institutional business climate that ensures competitiveness. As in many manufacturing sectors, such as the garment industry, for example, the possibilities

of industrial mobility have changed the way regime and government actors understand the potential spatial patterns of the industry and the institutional conditions in which firms make locational decisions.

In contrast to a severance tax, the abundance coalition has advocated an “impact fee” with an effective tax rate of 2 percent. (Fontaine 2014). Where a severance tax is a long-term mechanism for generating revenue pegged to rates of production, an impact fee is pegged to the number of wells drilled and the price of gas. The coalition has argued that this is a novel way to address immediate impacts in a flexible and cost-effective manner.

Rather than the “fair share” approach often articulated in severance tax storylines and an emphasis on statewide development, the impact fee is a resilience action designed to help compensate localities for those legible and institutionally clear disturbances immediately associated with drilling, such as road disrepair. As a matter of policy, it is not designed to assist with less certain disturbances or offer broader hedging against future downstream effects associated more with industrialization than drilling, such as the build-out of pipelines, compressor stations, and other associated infrastructure, which is projected to increase in the coming few years (Post-Gazette 2013). Indeed, even as production expanded from around 1 Tcf in 2011 to 2T cf in 2012, the revenue generated from the impact fee actually decreased from \$204 million to \$199 million because not as many wells were being drilled. In Bradford County, in the same year that one local booster lamented “there goes the economy” because drilling was in a downswing, gas production in the county nearly doubled. But the impact fee fell from \$8.4 million in

the county in 2012 to \$7.3 million, largely because fewer wells were drilled (Loewenstein 2013).

In sum, the energy security discourse arising in the 1970s and 1980s suggested that the state could have a strong role in accessing the energy system, both as a transition agent in the energy system and as the organizer of energy rents to promote broad-based social and economic development within a state. In contrast, the Considine report imagined a volatile world in which the benefits of energy development are fleeting and contingent on finding the "right" way for the state to indirectly access them. The argument was that a severance tax was simply an incentive for the industry to out-migrate (Detrow 2011).

Apprehension about industry flight has been imagined as a statewide exodus. For example, Pennsylvania House Majority Leader Turzai has argued of severance tax percentages that "Ten percent, I think it would shut (the industry) down" (Fontaine 2014). Key to this representation is an implicit idea that production is balancing on the edge of breaking even across the state and exodus might be triggered by taxation. Such a binary response would be unlikely; a chilling effect would not simply be spread evenly. The most lucrative areas at the core would remain lucrative, but such taxes might have effects at the margins (Levi 2011). There were such wide variations in commercial risk and commercial reward in the heterogeneous landscape of shale, that mobility was much more complicated than an off and on switch at the state scale. In the next chapter, I examine the "flickering" zones in marginally producing areas. It was in the uncertain marginal flickering zones that the expressions of the fear of flight had disproportionate meaning.



#### 4.6. Summary

Local, national and regional energy imaginaries weave together at particular moments and may affect the hard-wiring of energy infrastructure over long periods in ways that interconnect energy regions. Perceived local and regional crisis in the 1970s Southern energy-producing region helped emboldened a transitions coalition to propel a new national imaginary of federal action in the energy markets. This eventually institutionalized the market preconditions that enabled over time the scaling and diffusion of shale experimentation from its niche development in Texas' Barnett shale to other regions.

The transplantation of these practices has emboldened a new arena of politics. Significant to these politics in the early years was an *imagined* regional energy space, the Marcellus shale. I described the way actors constructed a space of great abundance and overwhelming impacts, both beneficial and risky. Representations of shale as a container of gas under large areas of the surface helped frame a dominant representation of the space of development that was accepted in both storylines. In this space, the future impacts were imagined as widely dispersed and abundant, which helped propel these arguments into regional and national public consciousness.

This geographic vision was enrolled in the argument of two discourse coalitions—one a dystopian vision of environmental risk and the other a utopian vision of economic benefits. Bosman (2014) introduces the idea of discourse regime destabilization to describe the way that niche discourses may create disruption of locked-in sociotechnical imaginaries. Increasingly, the niche storylines of anti-frack

and abundance are chipping away at institutionalized discourse of the transition coalition. Importantly, it is images of *regional* change dynamics that have seeded these storylines, which are deployed as institutional arguments at multiple scales and may influence the landscape context for other energy regions.

Here is a good place to step back and consider where we are in this dissertation. This chapter acts as a pivot in this dissertation. First, the case of the severance tax illustrates the way that the abundance storyline diminishes the role of the state amid fear that the juggernaut of production might be fleeting. Through this illustration it describes a key moment of institutionalization of the abundance storyline, and is therefore a seminal moment in ‘breaking’ the bridge coalition, tying a theme from earlier in this chapter. This chapter has described a pivotal and consequential policy position taken by the state with respect to defining its relationships and responsibilities for local resilience and development. In chapter 6, I describe an “influence by inches” storyline that was the dominant idea about the role of actors in local government. The pro-business policy approach established in state government is one contextual factor that drove the apparent dominance of this storyline at the local level and its emphasis on restrained coping. This contrasts with the situation of state intervention in energy development in the 1980s.

The chapter also sets the stage for the extended discussion of industry mobility in the next chapter (chapter 5). In the current chapter, I traced the push for liberalization to one of the earliest successes of the transitions coalition. As described in chapter 3, the natural gas industry has become more mobile and capital more footloose since the 1980s, in part stemming from liberalization. The vagaries

of producing gas in a volatile deregulated commodity market have created conditions for organizing an industry that is rapid, easily scalable, and highly flexible. In the last few decades, technology and new business processes have evolved in response to these incentives. Illustrative of this was the “manufacturing” model set in motion in the early years of shale development.

This mobility was invoked in absolute terms by the abundance coalition to create apprehension about the fear of flight created by taxation. But I argue that it obscured more spatially explicit ways of describing the unevenness of commercial and geological risk, such as the microvariations, break-even zones, and industrial flickering. These variations drive an uneven distribution of benefits. In chapter 5, I put these characterizations up front by demonstrating that the practices of the industry and the experience of development was differentiated and muddled by wide variations in the distribution of commercial risk within Pennsylvania, within the Northeastern zone of drilling, and within the Northeastern Susquehanna core. In contrast to juggernaut boom and bust dynamics, the spatial decisions that operators make to navigate fine spatial distinctions of commercial risk describe bewildering patterns of mobility that have been central to the development experience of local actors.

## CHAPTER 5: AMBIGUITY, FLICKERING AND UNEVEN DEVELOPMENT

The anti-frack and abundance storylines articulate contrasting forecasts about the future outcomes of shale gas (dystopian environmental ruination versus utopian regional development). But they tend to hold in common the framing of resource wealth as abundant and industrial activity as prolific and widely scaled in time and space. This scale is a key part of the justification for the need for action. In this section, I implicitly decompose this frame by narrowing in on the business practices and commercial risks that have defined the spatial practices of the industrial regime. The *absolute* abundance framed by discourse about volumetric gas-in-place is undercut by the relative permeability of shale and the way this material property differently distributes commercial access to gas. Where gas may be economically producible in one place, quite nearby it may not. By honing in on these variations within an energy region, the situation of risks and benefits begins to have a geographic dimension that looks different than discourse that scales development regionally or statewide. But this is not the central aim of this chapter.

The more central aim to this chapter connected to the research questions is to begin to set the shale experiment in place by describing the way shale production as a set of spatial practices of commercial risk management create patterns of spatially uneven development and ambiguity. The chapter proceeds as follows: First, I situate

recent energy development in the Northeastern part of the state in a history of natural gas and fossil fuel development in the state more generally, describing the earlier boom in the 1980s as a precursor. Then I describe the recent trajectory of shale development in geographic terms, including the ways that different areas within this region were rapidly coming into and out of focus as spaces of production. To make sense of recent patterns and the way they transfer different degrees of uncertainty to places, I develop the idea of a spatial flickering of activity. In brief, gas operators manage the commercial risks and ambiguities of production by cyclically migrating drilling campaigns within and between shale plays. Three factors guide this activity: the costs of producing gas, the productivity of well(s), and the market price of gas. Because each of these are dynamic factors linked to ambiguous and uncertain contextual factors such as commodity markets and geological porosity, gas operators are continually challenged to spatially optimize drilling activity in regions where they can best profit and avoid risk.

For those communities experiencing such movement, the boom-bust cycle of the industry expresses itself in uneven patterns of activity that vary both regionally but also over small areas. Where one county may experience a classic boom and long-term bust, others may experience a rapid cycling of boom and re-boom. Over time, certain areas are likely to feel this volatility with greater amplitude than others. The local geography of this activity is only recently becoming observable and distinguishing certain areas with more structured coherence to production than others.

This chapter draws on literature in energy development and political economy

(Freudenberg 1992; Harvey 2001) to make connections between the research questions about the re-organization of the industry in an energy shift, the spatial distribution of commercial risk, and ambiguity about the redistribution of community risks and benefits. The organization of the industry to spatially manage commercial risk creates patterns of activity that define the scale, scope, and magnitude of development-related disturbances experienced by local communities over time. Rapid spatial flickering is a defining characteristic of the community risk landscape.

### **5.1. Pre-contact in the Susquehanna core**

Compared to the declines in Texas wells that drove national policy discourse on the eve of shale adaptations in that state, gas production in Pennsylvania on the eve of shale production took place in a relatively small, localized system that was systemically mature and stable without the rapid treadmilling in Texas. It was not the focus of any national policy attention or much innovation. Geographically, the industry had made very few advances into northeastern Pennsylvania, so most of the population there was wholly unfamiliar with modern energy extraction. The Northeastern part of the state therefore was only peripherally touched by the long historic arc of gas production in the state, described in the next paragraphs.

Early forays into sandstone fossil fuel production under the counties surrounding Pittsburgh helped define a regionally integrated powershed powering the city's manufacturing industry in the 1800s, an economy central to the industrial

development of the United States. This regional gas economy expanded and contracted over the years with a peak in production in the early 20<sup>th</sup> century (Waples 2005). The historical fossil fuels landscapes of western Pennsylvania have remained a relatively stable base of the local economy throughout the 20<sup>th</sup> century even as the locus of national production moved South. For example, Peoples Natural Gas, which provides service to 360,000 homes and businesses across SW Pennsylvania (PNG) estimates that 70% of their gas comes from small suppliers producing conventional gas from shallow formations within their service territory (Yerace 2012).

Most of these sandstone wells were drilled (vertically) at shallow depths and are considered marginally producing "stripper wells," tending to produce less than 90,000 cubic feet of gas per day. But to give some idea of their omnipresence, in the decades prior to Marcellus drilling, Pennsylvania was surpassed only by Texas and West Virginia in the total number of wells in a state, despite being 15<sup>th</sup> in total production (EIA 2012). By comparison to the drilling in shale, there are approximately ten times more shallow wells in PA as there are drilled shale wells from this latest shale boom.

Prior to the shale boom, more than 90 percent of the state's gas development was occurring in low permeability tight sands. (Litvak 2014). Since the 1960s, nearly all sandstone wells in Pennsylvania have been artificially stimulated (fracked) though not with massive high-volume fracking and horizontal drilling in deep high-pressure formations (Weigle 2010; Harper 2008).

Almost all production in the Pennsylvania was classified for supportive

pricing when wellhead prices were partially deregulated in the 1970s. In response, in the few years following, small and medium exploration and production companies dropped more than 10,000 wells in northwestern PA. Operators also steadily extended speculative activities into less explored areas of the state. During the 1980s, oil and gas leases were signed in approximately two-thirds of the counties in the state, including all over the northeastern portion that includes my case study area. But by mid 1980s, when prices dropped and full liberalization changed the pricing incentives, such wildcatting in Northeastern PA was largely finished.

In some sporadic cases during the boom, exploration near to the current zones of heavy drilling in the 'Susquehanna core' transformed small clusters of communities as the oil and gas industry moved about. The experience at the time in these communities foreshadowed the experience of shale drilling. For example, the North Central Oil Cos sunk \$3 million to acquire 10,000 acres in Bucks County (Jaffe and Gemperlein 1985). At the time, the state was widely reported to have some of the most lax state oversight of drilling. Argued the head of a local watershed association: "We see it as a threat to this sylvan rural area - the reason we live here." With the help of North Central Oil, Nockamixon Township in Bucks County sought to fill the institutional void in state oil and gas regulations by writing a 36-page drilling ordinance. The Oil and Gas Act of 1985 superseded the ordinance. The precedent set in this law for limitations on local control continue into the present shale boom.

Perhaps the starkest contrast to the modern shale boom is the pessimism of the wildcatting discourse: the vice president of the North Central Oil frankly



assessed limited prospects for success: “obviously bigger than a bread basket or we wouldn't be up there...But looking at it realistically, it will probably be a dry hole.” This transparency is a reminder of how different the discourse of shale as a low-risk resource play is than the high geological risk of an exploratory play.

Following the boom and bust in the 1980s, oil and gas prospecting in the northeastern part of the state has waned and waxed in tandem with volatile energy prices, settling into a meandering, fluctuating cycle of low-level leasing and occasional exploratory activity as different geological formations were considered, land leased, and tests set up. But no scaled drilling ever took shape.

This pattern of extension, recession, and stability heightened and then lowered anticipation among residents, creating a long-term ambivalence about the prospects for fossil fuel development. Among those I interviewed, the community's history of energy peripherality was a frequent mediator of perceptions of the industry and early assumptions about how it operated. Many landowners described to me in detail this long legacy of peripheral interaction on their lands with oil and gas exploration, recollecting generational stories about grandparents, parents, friends, neighbors who had leased with nothing to come of it. They painted impressions of oil and gas activity as slow, stable, predictable, low impact, and low yield. Many landowners referred back to these assumptions to describe their decision-making.

Every once and a while, they come around, you sign for a few dollars an acre, and then they go away. Nothing happens. All of us, my neighbors, we thought it was like it always has been, like for the last 50 years. They don't do anything on the land. You don't ask for much and they don't ask for much.

Others described an assumption that the leasing was more about stipulations for government subsidies than exploration for viable production. Among those who actually had experienced drilling, one landowner had approached this cyclical process with something nearing apathy.

[T]hey drilled on my grandfather's land years ago. The drilled back in the mid seventies or eighties. Only then, everything was vertical. That was probably about a quarter mile from me. That property for the most part is still in the family. Actually, the land now, my husband--well it's been in my family for more than a hundred years. So I grew up on that. They've been actually signing leases forever, you know, at five dollars an acre and so on and so forth. And they came around this last time and I was like, meh, it's like if they really want it that bad they'll be back...

For these landowners, memories of the region's previous experience with extraction exerted a strong influence on their behavior.

## **5.2. Pre-boom (2003-2008)**

In 2003, Range Resources began drilling Marcellus wells a few hundred miles away in the southwestern part of the state. Strong early results prompted the company to drill more wells and refine its technique for fracturing. The company began producing gas in the southwest in 2005, which can reasonably be considered the moment Marcellus shale 'went public.' It provided steam to significant efforts by a few dominant operators to lease land in the Endless Mountains and other areas with potential shale reserves, an effort conducted largely under the radar, but one that positioned companies such as Chesapeake Energy with a strong foothold in the region prior to 2008.

There were two threshold moments in 2008. The first was the sharp rise in gas prices beginning in the summer of 2007. By the summer of 2008 the monthly average price at the Henry Hub had doubled, reaching a peak not seen since 2005 in the wake of Hurricane Katrina (EIA 2014). The second was the publication and wide distribution in 2008 of a report from a prominent Penn State geologist estimating total gas in place across the entire Marcellus extent (Engelder 2009). The geologist described (albeit hyperbolically) the influence of his work: When he and a colleague “pointed out that the Marcellus would become one of the world’s top super giant gas fields, according to volumetric calculations...The press got wind of this news and set off a land rush in the Appalachian Basin” (Silver 2011). It may be more accurate to say that this report publically affirmed and described a process heretofore ‘underground’.

In conjunction with these threshold moments, this period corresponded with heightened engagement in the Northeast part of the state characterized by land speculators, inflation in mineral leases, the expansion of industry players from a much smaller core, and the earliest efforts at drilling. One landowner summed up those early days,

The first guys that came through, they really didn't have anything to do with the gas company. They knew that the gas company was coming in and so they come in and buy it up and then they sold our lease to the...rights for a hell of a lot more than we got.

Most land is privately owned in the region (92% in Bradford County). A regional land and mineral market has flourished as operators work to secure contiguous sets of prospective acreage. Mineral speculators and gas operators secure and swap

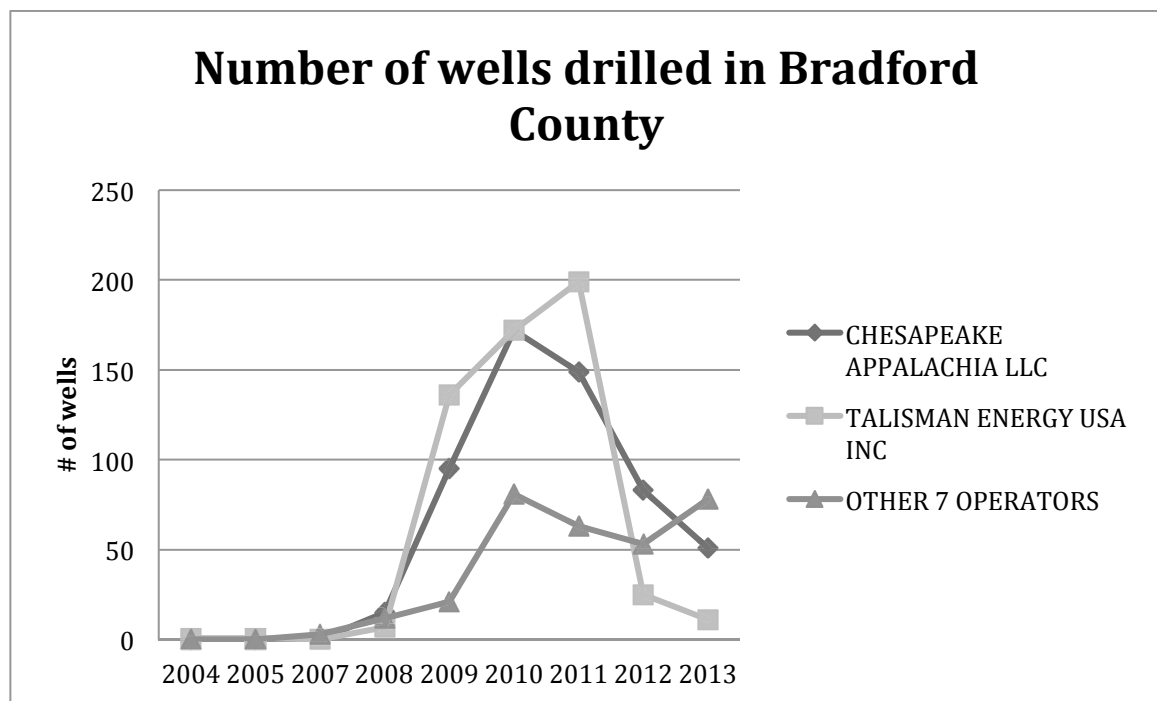
access rights to consolidate the best mineral and land position. The two most active drillers in the area are Chesapeake Oil and Gas, based out of Oklahoma, and Talisman, a Canadian independent. Both were first comers in the area. Talisman initially found success in adjacent areas of New York prospecting for oil in Trenton Black River. In 2004, years before the land rush, it purchased 475,000 acres in Appalachia, including the northern tier of Pennsylvania for \$65 million. Chesapeake was new to the area and considered Marcellus acquisitions part of a larger “land campaign” that it was engaged in across dry shale plays in the United States. Much of its acreage also was acquired before the main land rush.

### **5.3. Boom development (2008-2011)**

A boom period of exploration and production followed. Operators were imagining a range of models to manage uncertainty in this period. The manufacturing model suggested one approach to this heterogeneity was to pursue efficiencies such as economies of scale in leasing and drilling and also to cut costs at the leasing stage by quietly amassing acreage. The driller sets down wells strategically to lock-down leases without fretting about customizing well design for the operational context. Chesapeake’s efforts exemplify this strategy in Bradford County, where a quiet under the radar leasing campaign enabled it to scale quickly. This is seen in the considerable uptick in drilling in Figure 2. A more cautious approach put forward as the “flexible factory” imagined more selectively ‘picking’ spots to drill and engineering customized and flexible processes that could retreat

and advance in response to volatile conditions. Some operators were rolling out drilling more cautiously.

At the apex of drilling in 2011, a total of 816 wells had been drilled in Bradford County. Of these, a mere 14 were drilled in 2008. Two years later, 386 were drilled in one year, and 303 were drilled in the first nine months of 2011 alone. At the time, Bradford County was arguably the “sweetest spot” for gas production in the country. In a state that was sometimes touted as a bellwether of shale transitions, there was no county with more concentrated drilling activity. One town official referred to the industry as “20 or so” “major players” in the county. According to permitting records, only nine such “players” were actually drilling. Talisman and Chesapeake were trendsetters. Their activity accounts for approximately three quarters of wells drilled (Figure 2).



*Figure 2. Number of wells by operator in Bradford County*

#### **5.4. Development or post-development? (2012- ?)**

Regional energy development has often been depicted as a pre-boom, boom, and post-development phases. In the previous two sections, I described a trajectory of pre-boom and boom that tracks moderately well with this conceptual model. In this section and the remainder of the chapter, I begin to show how the explanatory power of this model as a representation of the situation in Northeastern Pennsylvania weakens as complexity increases 2012. How might one characterize the situation in the subsequent years and what does this character demonstrate about the risks inherent to shale production? In the remainder of this chapter, I introduce a spatial dimension to the analysis. In this section, I situate the 'post-boom' period in national context and in a regional powershed context. In the subsequent section, I describe more fully the spatial variation of commercial risk within the northeastern shale sweet spot that increasingly manifests as rapid *recycling* of pre-boom, boom, and bust trajectories in the same region, with different towns at various stages within this cycle.

##### *5.4.1. Regional migration: Hydrocarbon portfolios and commodity markets*

Around six months from my initial fieldwork, the major drillers suddenly cut back their activity by two thirds over a few months (Figure 2). Chesapeake announced in January 2012 that it would decrease active drill rigs in the region from 75 to 24 (Falcheck 2012). Other independents joined the shift and the total rig count

in the county dropped by half at the end of 2011 into 2012 and has remained flat since then (EIA 2013).

Since drilling rigs are highly mobile and flexible, at any given time an operator may rapidly re-direct a rig activity to a new location or to drill for a different fossil fuel, whether oil, “dry gas” containing methane, or “wet gas” containing natural gas liquids. Operators try to organize the rate and place of leasing and drilling to take advantage of premium prices in one or more of these commodity markets, and there is substantial regional movement of drilling rigs as operators seek to maximize locational advantages.

At their peak, prices at Henry Hub reached above \$12/MMBtu in 2008. By late 2009 and into 2010, they had reached a low peak below \$4/MMBtu. Decreasing natural gas prices widened a relative price spread between natural gas and oil. This prompted gas companies to refocus away from areas that produce methane-concentrated “dry” gas to those areas that produce either oil or “wet” gas containing more condensates that peg closer in price with oil. Where a few years ago, upwards of 90 percent of rigs were drilling for dry gas, in 2013 three quarters of the rigs in operation were oil-directed (Clayton 2013).

The national geography of shale production has shifted accordingly. Rigs have shifted from areas with dry gas such as Arkansas and northern Louisiana to those with wet hydrocarbons in places such as N Dakota and Texas’ District 8 in the Permian basin. In Northeastern Pennsylvania, the gas from shale is particularly dry. There has been a significant draw down of rig activity in this area as rigs reorient to

areas in Southwestern part of the state and Ohio, where Marcellus shale is “wetter” and to those areas elsewhere in the country with oil and oil shale.

#### 5.4.2. *Powershed production: Capturing premium prices in demand hubs*

In spite of the out-migration of drilling, gas production in the county continues to grow as operators bring online all the wells that they drilled during earlier drilling. As of 2012, a limited drilled wells in Bradford County were producing, which reflects the significant upfront investment of capital associated with the manufacturing model, which drilled to lock down prime acreage and book reserves even before gathering capacity existed.

In the first part of 2012, the county surrendered 26% of all gas produced in Pennsylvania (Examiner 2012) compared to 21% in neighboring Susquehanna and 11% in its neighbor Lycoming. By the middle of 2011, production from these Northeast counties nearly surpassed the combined production from all other Marcellus production and all other plays in the Northeastern US (EIA 2011). To put this production in national perspective, the play surpassed all other shale plays in daily output in 2012 (Strauss 2013). The EIA estimated that in the month of December 2013, gas from Marcellus shale alone would produce 18% of the nation’s supply (EIA 2013). To give a further sense of scale, the gas produced in the Susquehanna core was more than 2 trillion cubic feet (TCF) per year in 2013. (Institute PA 2014). This is roughly equivalent to the 2.2TCF that is transported from Russia through the Ukraine. Control of that amount of gas has been widely



cited as an underlying factor in the proxy war that Russia is engaged in (Helman 2014).

In addition to the “core” productivity of wells, location is an important element in the Susquehanna core. The region is central within the established natural gas transport infrastructure and proximal to major premium-priced demand centers. To draw on Magee’s (2006) term, the NE PA shale “powershed” currently mobilizes dry gas production for Pennsylvania and Northeast markets. While northeastern Pennsylvania never itself was productive for gas, it was within the ‘fly zone’ for pipeline expansions between western PA’s older gas network, storage fields, and demand centers in the Northeast. Therefore shale drillers have easy local access to the Tennessee pipeline, which passes through Bradford County, and the Millenium pipeline in counties just north. In the near term, a *scarcity* of takeaway capacity has been a factor constraining wells from going on line, but potential over the medium range to cost effectively build into the existing dense network to nearby premium demand centers is part of the reason that Marcellus is sometimes referred to as the most economic of all the shale plays.

Imagined powersheds include major build outs to constrained Northeastern markets and also reversing the pipeline flow to send surplus to the Southeast, Midwest, and potentially for liquid natural gas (LNG) export (Rittenbaugh 2014). Efforts to put these imaginaries into practice in the near term include a variety of expansions of gathering and high-volume pipeline expansions aimed at New York and New Jersey (EIA 2013). Expansions targeting New England are more slowly rolling out, with service planned at the earliest for 2016. The geography of this new

capacity is reflected in dramatic price differentials at New York's Transco Zone 6 Hub and New England's Algonquin City gate. In the recent past, the differential has registered as an average lower price month-over-month in New York as well as relative price stability across peak winter demand in New York compared to New England. (EIA 2013). Capturing this premium is a significant long-term goal for producers. Despite the boom in shale, national gas reserves are at an 11-year low as of 2014. As the winter heating season builds, there are concerns about localized price spikes in places such as Maine, where there have been "unprecedented" efforts by the Public Utility Commission to raise public funds for pipeline expansions (Fishell 2014).

### **5.5. Geography of flickering: The spatial expression of the cost-price squeeze**

The idea that a "cost-price squeeze" creates "flickering" in mining regions was developed by Freudenberg to describe the experience of those places with central mines. In these situations, production costs and productivity are relatively systematized and forecasted but what varies is the price in the commodity market. When a mining company can "break even" in the market, it ramps up activity, but when revenues shortfalls are projected because of low commodity prices, activity is slowed. The "flickering" of activity that capriciously goes 'on' and 'off' heightens uncertainty about the stability of investments in the region and in such a way increases commercial risk in downstream industries and the regional economy.

The situation with shale gas production is a bit more complicated. Unlike mining in a centralized location, not only do gas commodity prices vary over time,

but also revenue and costs both vary spatially. Productivity varies widely by microvariations and technologies of access. Costs include “leasing of acreage; drilling and completion; operation and maintenance; and payment of royalties and taxes” (MIT 2011). Like in a mine, an operator makes decisions about *when* to produce. But different to this, an operator also plans over short and long periods *where* to drill. The cost-price squeeze therefore is expressed not only in temporal terms but also spatial terms. Flickering is in large part an expression of industry operators locating and (re)locating production as much as it is simply expanding and curtailing it.

A fundamental distinction is the zonal variation within a shale play. Wood McKenzie estimated a spatial component to commercial variations in Marcellus extent, categorizing nine “sub-plays” associated with break even prices ranging from \$2.68/mcf in the northeast “Susquehanna core” to over \$8/mcf in some of the less established areas in central and northwest Pennsylvania (Wood McKenzie 2013). A break even price can be estimated as the Henry Hub benchmark gas price required for an operator to profit on a well (MIT 2011).

In the next section, I consider the different uncertainties that accompany the experience of communities in these different zones. I make the heuristic distinction between zones that are core, non-core of core, and non-core. Uncertainties in the non-core are fairly binary. These are areas that come to have high break even prices as a geological prospect is incrementally delineated over time. These areas are associated with diminished potential for strong well performance and are unlikely to see any production unless an extended period of elevated market prices resets

the baseline. Similarly, in the “sweetest” core areas, the higher performance of wells will tend toward high enough returns that the impact of commodity market fluctuations may be blunted.

It is in the non-core of the core that the industry’s mobility and rapidity create situations of especially deep uncertainty and rapidly changing prospects. Changing conditions may at one moment put an area ‘in play’ and in the next take it ‘out of play’. The cumulative territorial strategies of operators tends to create blurred but distinguishable zones of such uncertainty within which a break-even line advances, recedes, and or rapidly combusts into activity in response to contextual changes such as commodity market price or changes in the business climate.

Where an address resides within these break even tiers conditions vary different experiences of ‘winning and losing,’ uncertain time horizons in relation to disturbances. All this creates different spatial and temporal expressions of structured coherence (Harvey 2001), structured incoherence and general unstructuring in places.

#### *5.5.1. The structured coherence of flickering in the core of the core*

In Bradford County, the core of the core, the divergence between production and rig counts establishes a divergence between an industry that seems to be booming and a community that for many has seen a dimming down of these effects. “There goes the economy,” commented one disenchanted booster (Falchek 2012).

But over the long-term, a “slowed-down” industry would still prize the consistently higher well performance in Bradford County. Certain “sweet spots” of

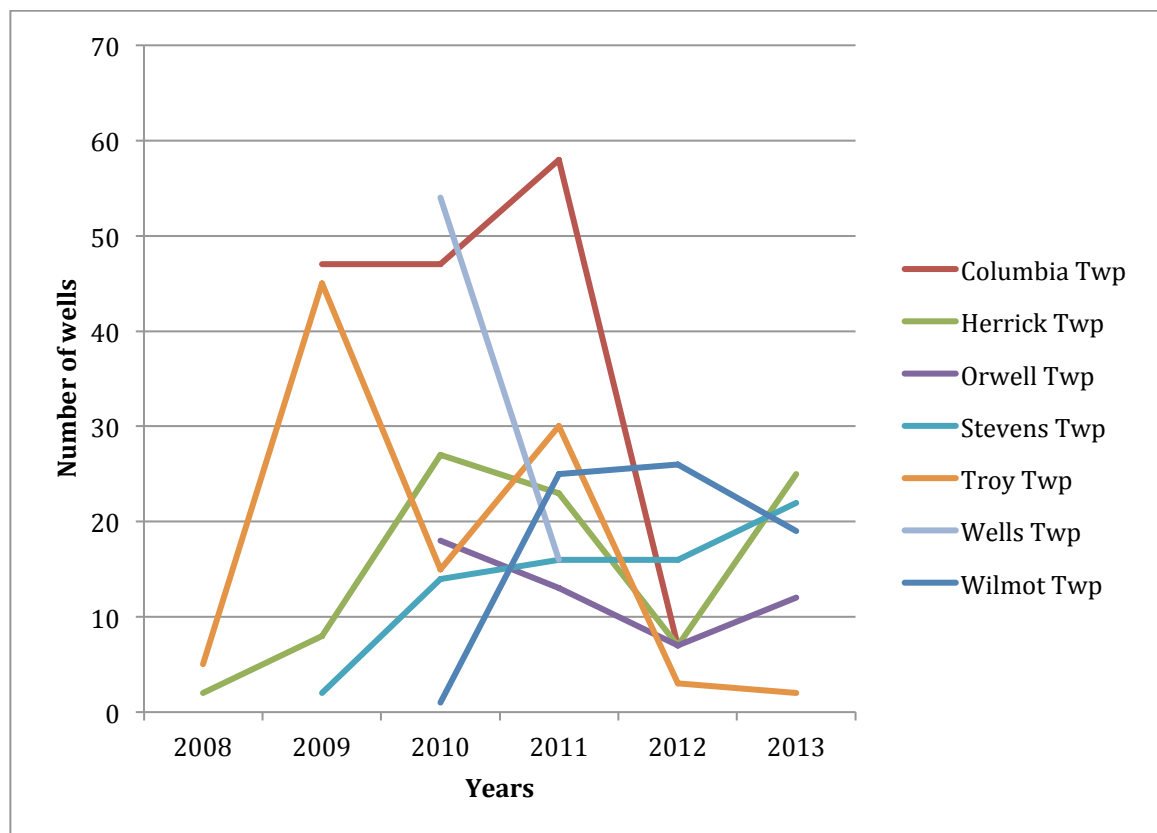
production such as the Susquehanna core may be less likely to feel extreme swings in commodity prices, meaning the amplitude of flickering may be reduced. Most of Bradford County landowners will likely continue to benefit in relative terms from royalties and bonuses even amid short-term price changes, and there is likely to be consistent drilling over time. As a production zone, activity in the core of the core may create periods of structured coherence to the production trends. The experience of drilling in the core during a period of flickering is likely to reflect this relative stability. In 2013, after the downturn, one landowner in the core argued:

We know there's been a decrease. Will it bounce back to how it was? Maybe, maybe not. Personally I think all it will take is a cold winter or some new pipelines and then they'll be right back at it in the same way as before. I think it's on the margin right now, but you know.

But in spite of the general downturn across the Susquehanna core, patterns at the town level tend to be complicated. For example, while the dominant trend experienced in Bradford County has been a significant downturn in drilling, there are a few select townships that have seen an increase in drilling. Indeed, mapping the trajectories of drilling at the township level over the last several years demonstrates the degree of local-area heterogeneity in the timing of drilling. (Figure 3). All this local-area heterogeneity distinguishes very different experiences related to the timing and magnitude of disturbances in a small area.

These variable patterns at the local level are unlikely to change. Operators thus far have concentrated much of their drilling around locking down preferred acreage. Wells are distributed across the acreage to legally hold them for production. As operators return to infill drill on this acreage, towns will again see uneven re-booming of activity. This process of densification and de-densification of

activity is amplified by the hard-wired “treadmilling” that tends to accompany shale production—as described earlier, the tendency of rapid declines in shale wells tends toward particularly rapid re-working of proven acreage through re-stimulation of existing wells (re-fracking wells) and infill processes. The need to continuously revisit and re-drill creates a particular frenzy and scale to production activity.



*Figure 3. Different trajectories of drilling in select towns in Bradford County*

#### *5.5.2. The incoherence of the non core of the core*

The eagerness of risk tolerant operators during periods of commodity price spikes to acquire shale assets in zones with relatively high break even zones is paralleled during price downtrends by their eagerness to divest of such acreage

even at the cost of potentially junking purchased leases. Production activity tends to have spatial edges to such high-risk marginal production. On the margins of commercially producible acreage--the 'non-core of the core'--operators balance higher commercial risks, and there is a high degree of uncertainty about whether drilling will or will not take place and when. Outcomes can range from spotty efforts to produce marginal land to "junked" energy landscapes as operators let the leases on mineral rights expire. There may be considerable mineral market activity in the form of divestiture and consolidation.

Illustrative of this situation is Chesapeake's divestiture of 162,000 acres of "non core of the core" acreage on the margins of the Susquehanna core, which it executed around the same time as reducing drilling in 2012 (Zeits 2013). For those communities in this area, the sale of Chesapeake leases to Southwestern crystallized a new paradigm of uncertainty. The Scranton Times Tribune laid out this terrain of uncertainty. The "boom is passing Luzerne and Lackawanna counties by, at least for now - but that might not be a permanent situation." These areas soon might get a "second look" (Skrapits 2014). Trying to guess the current boundaries of the migrating drilling line was something of a cottage industry in media.

The leases on much of the acreage that Chesapeake sold were set to expire without hold-for-production drilling, meaning these lease would be 'junked.' Were commodity prices to double, these places might be reconsidered by operators but with new lease negotiations. In other words, the production cycle would start all over again. The experience in these places is a structured *incoherence* of production. These are zones where more risk tolerant operators are active. The uncertainties of

future activity and the distribution of risks and benefits is amplified. Here changes in commodity price, new knowledge about well productivity, or a host of changes to costs will change the profile of drilling in more binary flickering.

The experience of some mineral owners I spoke with reflected these sorts of uncertainties. Many mineral owners who signed the earliest round of leases described a dizzying cycle as land companies and gas operators swapped and consolidated leasing rights. One reflected on this experience.

I leased mine out four years ago. My lease runs out next year, but I'm one of the idiots signed one that they can renew it if they want to. But they got to pay me the same original price. But my lease has changed hands four times.

Other perceptions of this experience hinted at the sort of bitterness latent amid such uncertainty:

There's a lot of these people signed for a set amount of years, like most of them signed for five years. And then, I'm not saying they doing it for that reason, but it seems like every time somebody's lease is just about ready to run out, why they start working on it. That way they got you, you can't go to somebody else, because they're working on your property

In certain regions with marginal well performance, there is higher probability that operations will trend toward hyper-rapid treadmilling as operators speed up infill production to meet forecasts and obligations. This is the amplification in place of existing trends in the industry: one part of the “frenzied” pace of migration in shale plays is that keeping up high shale production rates requires constant new drilling, because these wells have high initial production rates and steep decline rates.

Tracking drilling rig movement over time reveals patterns that show complex cycling around the country as rigs migrate from new plays back to infill in older locations (Wogan 2014). Because this acreage is less productive in the non core of



the core, when an operator does try to make it work, lower initial production and higher decline rates on wells may tend toward a localized hyper-treadmill effect, as an operator is forced to re-frack existing wells and infill drill more rapidly on this acreage to make it work over the long term. This increases the exposure for landowners and local communities.

By 2013, these unstable pathways of growth and decline had come to define a perspective that was not present in my initial interviews in 2011. It narrowed around a deeper cynicism about the industry's operations: "They've been drilling too much and now they're paying for it," said one landowner. "Some people are saying the gas just isn't there in the same way they said, and half of them are going out of business." Referring to his earlier suspicions that drilling was largely to fulfill 'hold for production' terms in leases, one landowner confirmed his mind: "They've been drilling to keep the leases because they don't want to give it to anyone else...but some of these wells are losing gas so quickly."

For many respondents I interviewed, the logic of the spatial and temporal patterns described throughout this chapter was elusive. One town official commented in exasperation: "But now the gas company is moving so fast... I sometimes wonder if they know what they're going to do. They're moving here, moving there. They tell people they're going to put a well here and a well there."

What is increasingly clear in shale production in the United States is that there is a rapid cyclical itinerancy to production that complicates a temporal reading of the community experience of energy development. Gas operators are not booming and busting places as much as they are 'grazing' from different plays.

Within shale regions, different growth and decline cycles of drilling from one town to another create different experiences of production over time as the sweetness of territory changes in response to contextual condition like commodity prices.

I introduced the idea of spatial-temporal “flickering” to help make sense of the spatial patterns and how they translate to community risks. In contrast to models of ‘cyclonic’ development in which industries boom into resource towns and just as quickly busted out, the recent shale patterns have held to an uneven and rapid flickering of boom and bust happening sometimes simultaneously within regions.

“Spatial flickering” is both central to the distribution of shale boomtown effects and long term uncertainties and risks. One respondent in Bradford County described drilling rigs as “itinerant factories,” a term that aptly captures the way the geographic patterning of industrial activity translates into economic effects in communities. “Itinerant factories” may open, close, move away and then return over rapid time scales, cyclically structuring and re-structuring the sets of local benefits and risks that accompany production.

## **5.6. Transparency and the absence of information about future activity**

In the Susquehanna core, there was an inability to “see” the spatial movement and forecast local-area activity. As described more fully in this section, a lack of industry transparency and a lack of information were obscuring any descriptions of the real time manifestations and future outcomes associated with the commercial risk management strategies. Earlier I described the varieties of ways to think about

spatial variation in a shale play: as address to address microvariations, as a range of break even zones from core versus non core, or as wet versus dry properties. Public information was limited on each of these variations. On geological microvariations from address to address, there was no public data and the privacy of proprietary data was coveted highly. Also, it is worth emphasizing again, that issues of transparency aside, lacking also was industry knowledge about characterizing these variations and their interaction with well performance. There was significant uncertainty along these dimensions within the industry and considerable experimentation and failure.

On zonal variations, public geological data also did not exist. On the eve of Marcellus production, the “temporal-spatial variations” in the geological character of the Marcellus formation as a whole was not mapped in any public sense (Harper 2008). Reflecting this void of public information, in a data resource book designed as a primer of the county’s resources, Bradford County planners reproduced a map of the entire Marcellus extent based on federal research on shale thickness and depth conducted in the 1970s as part of the Eastern Shale Gas Project. Not incidentally, macro-scaled variations such as the differences between wet and dry *were* widely discussed. Respondents understood that these variations created very different market conditions in the Susquehanna core than in the southwest.

Apart from geological data, well performance data can be a key metric for seeing current patterns of activity and forecasting future activity. It can demonstrate where high performing wells are and estimate where there are commercially worrisome decline rates. Well performance data is routinely collected in oil and gas

regions. In Pennsylvania, however, data on shale well performance was unavailable or unhelpful. In the early years there were no reporting requirements and as late as 2010, data was still proprietary for five years, although this changed with the passing of SB297, requiring oil and gas companies to disclose production data twice a year (Engelder 2009). Proxy data from other shale plays in the country was not helpful. Shale in general was such a new situation that extrapolating from well performance to a new formation was an unreliable metric.

In the absence of more fine-grained data on where and when future activity would concentrate, respondents in my sample were inclined to emphasize current and future activity as governed by more macro-scaled system dynamics over longer time periods. At these scales, perspectives tended to emphasize a binary of long-term abundance across the Marcellus as a whole and the risks of statewide catastrophic bust. This framing echoed representations that dominated state-level policy discussion and at the time were mechanically reproduced by media and programmed into the premise of storylines for all discourse coalitions. Whether transitions, abundance, or anti-frack—the different discourse coalitions made similar assumptions about widespread abundance and commercial achievement over the full extent of the multi-state Marcellus region. None emphasized that there was likely to be significant concentrations of activity and large areas of uneconomical production.

Visions of abundance and long-term growth were ubiquitous among respondents I interviewed. The ubiquity was all the more striking because it was just months before a major downturn. In 2011, one Bradford County official

expressed: "Drilling has picked up, but we're really at the beginning of this thing. It's at a very early stage here locally." Another landowner said, "this'll be with us for, who knows, 10, 20, 30, 40 years." One industry booster argued, "it's gonna happen," implying that the present rate of 300 wells per year was just the beginning. The perspective was reinforced in the local papers. Drilling may last more than 50 years, an article explained. Representatives of the Oil and Gas Association of Pennsylvania made similar claims in their presentations to locally authorities, such as the Bradford County Citizens Advisory Committee in March 2009 (Daily Review 2009). Some respondents framed Bradford County as now part of a globally integrated gas delivery system that was feeding increased demand in other parts of the globe (even as basic infrastructure to pipe and compress gas for near-range transmission to interstate pipelines was not yet existent).

At the other end of the binary, visions of abundance were tempered by widespread perception that the near-term prospects for a continued boom were contingent on a threshold price of gas and global supply and demand dynamics. Five of those I interviewed made an attempt to guess that day's gas price, assuming that there was a tipping point that might push out the industry as a whole. One framed the local prospects in the context of a global system of supply.

[Natural gas] is a global commodity, and a cubic foot that comes out of the Marcellus versus a cubic foot that comes of the Barnett versus a cubic foot that comes out of the North Sea, is still a cubic foot of gas, and the supply of natural gas is what's going to determine the price of natural gas. I know that in the back of mind. Nat gas was down to \$3.87 this morning I think. It broke through \$4 yesterday.

Like the framing of long-term boom, this also echoed the dominant framings of temporal and spatial scale put forward by actors concentrating on the state's role in

taxation and local compensation. It did not realistically consider finer gradations. The implications of this re-appear in the next chapter, where I describe a form of local decision-making that bracketed off any other trajectory of development than the current growth period.

### **5.7. Summary**

The opening of this chapter explored the limited historical experience in the region with energy extraction. I transitioned from this to a discussion of the pre-boom and boom development periods, before describing in detail the various coherences and incoherencies that have become more apparent in the aftermath of the initial boom period. Knowledge gaps associated with pre-contact and with uncertainties about the future have been defining conditions of the experience of community actors in the Susquehanna core in the early years of shale development. Actors in the region lacked previous experience with the industry and lacked the information to see how the industry was operating.

To reiterate, shale gas is not easy to produce because of its inconsistent temperament. Each well has its own characteristics that differentiate production economics from “address to address,” from sub-play to sub-play, and across regions. High performing wells tend to concentrate over small areas in the subsurface. Break-even prices vary significantly from zone to zone and even within these zones there is great variation. Changes in commodity prices move the line of viable production dramatically. Furthermore, shale wells tend to inherit many of the same characteristics as recent conventional wells: Large initial rates of production are

difficult to predict and there are generally high decline rates. Shale drilling must be undertaken at rapid rates to maintain stable growth trajectories.

There is no doubt that the industry is commercially lucrative for operators in the right circumstances. In some cases, shale wells can be explosively profitable. Cabot estimates some of its recent wells in the core may have estimated ultimate recovery of 20 bcf/well. But by another measure, among the largest shale players, there have been write-downs in recent years of nearly \$35 billion (Sandrea 2014). Some of the more successful operators have learned to manage the micro-variations in commodity markets and shale geology through new business practices. The most successful companies have secured large-acreage access to the “sweet spots” within this differentiation, optimizing well performance, and rapidly cycling drilling operations within these geographies to match fluctuations in a range of conditions. Others operators are trying to make it work in less optimal conditions. Still others are divesting acreage and writing down assts. Sometimes each of these is going on in one zone of production. The recent extreme volatility of commodity markets means that the expansion and receding is only increasing in speed and extent, more rapidly creating differentiated geographies of risk with their own rhythms of flickering activity.

To take stock of prominent theme that is arising over the course of this dissertation, it is worth synthesizing a few sections from other chapters. As I described in this chapter, the inconsistencies of shale rock condition a spatial form of commercial risk to producing shale gas. Industry practices try to manage this risk in part through rapid and responsive drilling migration (a practice which at least in

part developed in the wake of liberalization and the new increments in the marketplace that required flexibility and responsiveness as a condition of competitive success). As I described in chapter 4, these migratory strategies also have come to define the horizons of state governance in Pennsylvania. The mobility of the industry is a key argument about the ‘flight risk’ of gas operators. Discourse about a fear of capital flight has been key political terrain for arguments about not levying a state severance tax on the industry. In this way, the materiality of shale gas, the organization of the shale mode of production (around mobility), and the political possibilities of energy development in Pennsylvania are related and co-constituted.

At the same time, this binary scaling of boom and bust simplifies the complex spatial patterns and uneven development that is taking place in Pennsylvania, whereby the risk of capital flight is not evenly distributed, and certain zones become areas of concentrated uncertainty about future activities.

All this creates a complicated landscape for communities experiencing energy development. In the next chapter, I fully ‘land’ in the Susquehanna core by exploring in greater detail the perspectives and narrated experiences of actors involved in navigating these trends. The remainder of this dissertation includes a series of empirical chapters that consider perspectives, experiences, and emerging storylines that are circulating through different actor groups in the Susquehanna core: public sector actors, landowners, resident community members, and business owners, among others.



## CHAPTER 6: INFLUENCE BY INCHES: A PUBLIC RESPONSE

This chapter is a pivot point in the study presented here. This and subsequent chapters dwell less on the industry evolution, its spatial stamp, or regional expression, and more on the experience of community actors in the Susquehanna core working to establish understanding and practices related to new contact with the industry. This brief section introduces the next two chapters.

In Appendix 1, I catalog a list of matters of concern identified by respondents. Each matter of concern might be considered to be associated with different ideas about responsibility for these concerns. The question here is what are the “relations of responsibility for risk” (Bickerstaff et al. 2008) that are imagined and for which different actor groups? Depending on the nature of the disturbance pathway imagined and the established institutional authorities, such an agent might be an individual or the state or a social network or grouping. Methodologically this calls for identifying key actors groups and the storylines and institutions that enroll them. Two local actor groups with particular responsibility for governing disturbance and risk were local government officials (Chapter 6) and landowners (Chapter 7). These actor groups were invoked as authorities with established relations of responsibility. The empirical chapters are designed around storylines that organized the practices of these groups and the experiences of individual's

learning and practicing these roles.

In contrast to Texas, the transplanting of a new development trajectory meant that those actors central to local decision-making had to learn about their roles. Landowners did not understand the institution that they were called on to perform. Local officials were 'awestruck,' as one put it. The demands on practices, institutions, and existing services--all this was new. The fact that there was so little previous energy development is good ground for examining how exactly local and regional actors come to develop a sense of their roles.

### **6.1. Government actors**

The remainder of this chapter is dedicated to public sector actors. I begin this way because this actor group was central to interpreting, managing, and distributing information. Therefore, describing their perspectives and practices helps to introduce a range of disturbances that were being talked about and helps to set the stage for the following chapters. This placement is inconvenient from another angle. Chapter 8 explores in depth the rural underpinnings of the region, which helps to descriptively situate a 'place' understanding of the region that might usefully be explored more upfront.

Public officials in the Susquehanna core became active players only after much of the private negotiation of access to minerals and land had been done. Because industry activities were not transparent and because there was little legacy of such preparation, officials were caught off guard. Many public officials described

early road disrepair issues as their first indication that anything was taking place. In other words leasing had been occurring for years before local public-sector actors became engaged in the secondary effects of industrialization. In this chapter, I consider that engagement. The question posed in this chapter is “How did local public managers imagine public responsibilities for steering the trajectory of gas development, their own roles, and the challenges of management?” I argue that in Bradford County, which is the emphasis of the case, a storyline of “influence by inches” was becoming a strong guiding vision for institutional responses in local government, most notably in the assembling of a series of task forces.

I distinguish a few features of the “influence by inches” storyline: coping, learning, and restraint. First, the storyline emphasized immediate and tangible sets of problems. Second it focused on learning and information management. Third, it took a restrained and nonaggressive stance toward dominant actor groups. One local official summed up this style: “We look for opportunities to change things from within, to influence the industry in inches.” Optimism that small actions could offer resilience was conditioned by apprehension that larger efforts might cut them out of equation. “It doesn’t do any good to throw rocks from outside, because then you have no communication.” I argue that its emphasis on information, learning, and incremental coping actions reflects ambiguities about the character of development and constraints on public engagement, described in the subsections of this chapter.

## 6.2. A near horizon

The majority of my interviews were conducted on the eve of the post-boom incoherence that I described in the last chapter. This offers the occasion to re-read the way respondents conjured future activity in 2011 in light of new patterns that increasingly characterize the experience as of 2013.

As the literature on boomtowns has suggested, lacking information about future activity is a key impediment to proactive local response. If the change processes themselves are obscured, then so also are obscured the places and timing of manifestations of change and the distribution of risks and benefits. Increasingly, cycles of boom and re-boom and spatial flickering seem to be a big part of the future scenarios of development in shale regions. But as the previous chapter described, public capacity to see and forecast these fine-grained dynamics was hampered by a variety of factors, including propriety information, uncertainties in the market landscape, and lingering ability on the part of operators to characterize microvariations.

Instead, respondents tended to invoke future stages of development as a linear curve of boom or bust evenly distributed in space over large areas, often conceptually considered as a statewide dimension. Bust was widely acknowledged, and there was a lively discourse about what constituted *the* indicator price of an industry bust, but the implications of this were not well articulated, either in terms of how the industry might actually respond to price declines (and create new temporal and spatial patterns of exposure in communities) or what it might mean

for communities. Nor was bust imagined as a thing that might be a temporary flickering, that the future might constitute cycles of short-term boom and bust.

The implication of the “juggernaut” framing reveals itself in the types of concerns expressed on the ground. As the aggregate data in Appendix 1 attests, actors overwhelmingly framed concerns as linearly expanding increases in present outcomes. Officials concentrated on coping actions to address immediate needs, which they anticipated would increase. While bust was acknowledged in abstract terms, the only aftereffects of a bust were described in crude terms as a return to ‘normal.’ There was no dominant policy imaginary about preparing for more dystopian futures associated with a near-term bust or about anticipating spatial and temporal variability as an inherent function of shale energy exposure. The influence by inches storyline reflected this immediacy by emphasizing tangible coping actions, the subject of the next section.

### **6.3. Prioritizing tangible disturbance pathways**

Within the core of production in Bradford County, communities were experiencing the immediacy of energy development in different ways. During my fieldwork, the shifting drilling activity was producing a heterogeneous range of activity with effects felt along social, economic, physical, cultural, and psychological dimensions, among others. Associated with the processes of industrialization respondents identified hundreds of discrete pathways of disturbance and change. (See the catalogue in Appendix 1). Effects often were experienced not as one or a

handful of specified issues but at the intersection of dozens. One county official reflected on the challenge of simply conceptually seeing and understanding all the systemic interactions:

We keep seeing these little ripple impacts all over the county, just so many different things, we could spend just 8 hours talking about the socioeconomic impacts that we see diffusing through the whole system: housing, all the other businesses, people who have money versus people who don't have money, traffic...

There was a sense expressed by many that the sum was not the aggregate of the parts. The particular “wickedness” to understanding and forecasting impacts was that these pathways intersected and amplified each other at particular moments. Certain places, individuals, groups, or agencies might find themselves at the nexus of multiple concurrent processes.

For example, ring towns on the periphery of Towanda, characterized by a mixture of commercial, industrial, and residential activity, were mini epicenters of industrialization and on the front line of managing a sustained clustering of land use activities related to such things as warehousing, transportation, material, and temporary housing. “That's where I think people are doing things,” one ring town supervisor described. “I think a lot of the problems that we have seen with planning and some of these things have been more in the areas that are partially developed.” Accompanying these changes, these areas saw concentrated challenges to their public capacity, social conflict, institutional confusion, and skirting of local rules.

But where warehousing or truck depots clustered in ring towns, commercial activity concentrated within larger towns like Towanda, while drilling clustered in more rural areas. Therefore, at any given time in the core, one township might be

experiencing new population growth, another was experiencing drilling, a third was struggling with indirect consequences of industrialization, and a fourth was experiencing a commercial boom.

Local officials and agencies were struggling to conceptualize and practice a response to the preponderance of effects. An ensemble of ideas that one official characterized as “influence by inches” was dominating the way that public sector actors were imagining their roles and what could be done. The storyline was a way to prioritize responses amid a set of constraints on their capacity. In part, the storyline was characterized by a ‘rapid response’ vision that guided officials toward the most immediate and most tangible issues. In the next two sections, I expand on this idea by contrasting the problem of road disrepair with the problem of informal camper settlement. These different problems illustrate two ‘types’ of disturbance pathways with distinct sets of uncertainties and clarity of responsible authority. Legible pathways such as road disrepair were the dominant focus of governance decision-making.

#### *6.3.1. The policy problems of ‘normal’ development*

In the range of impacts associated with shale production, some disturbances mimicked policy problems that could be imagined under a variety of development scenarios involving other industries, some familiar to the area. These were classic policy problems with stable and comfortable roles for public management and little room for interpretation. There was clarity to observing disturbances, consensus about the need for action, and line of sight on the range of potential responsibilities. While the manifestations of these problems were sensitive to uncertainties in the

magnitude and rate of future drilling activity, the nature of the disturbances themselves was "legible," involving calculable change to existing infrastructure and services.

An illustration is the issue of traffic-related road disrepair. Many cited road issues as their first awareness of the impacts of shale development. It was the sort of process that easily could be tabulated, and there were existing indicators and monitoring in place to track the change. There was general consensus about the need for resilience action to decrease local sensitivity. One businessperson put forward assumptions that this would be resolved.

There is road construction going on. That happens. I don't think people are upset about the fact that the roads get damaged, as long as they get repaired. I think most people recognize that this what's going to happen. The roads go bad, they get fixed. But that happens all the time.

It "happens all the time" because institutional practices exist for managing such matters at the local level and the state level. Therefore it was an uncomplicated impact to comprehend, to interpret, argue about, and practice solutions for. This is not to say people agreed on how to deal with the situation, but there were tangible and pre-existing planning and technical actions with associated costs that easily could be forecasted. From these forecasts, it was clear by most accounts that townships zones of intensified drilling needed external support. At the time, many townships were pressuring drilling companies to make improvements: "If you just close down a piece of road, the companies might be there the next day to help out. They need that road. The minute you restrict how they get to their sites, they'll move on it."



Because of the clarity of this disturbance pathway, road disrepair also was one of the few areas where respondents imagined the potential for long-term systemic consequences of the boom. One official expressed concerns about long-term fiscal solvency, particularly where dirt roads were being upgraded to paved.

But where does this leave us when they're gone? The new roads buckle, the condition gets worse, they look great now, but when they leave, what condition will they be in? When they're no longer here to take on all the work.

The roads issue was part of a suite of tangible concerns stemming from increased use of public services and goods. Many of the largest burdens were felt on public workers themselves and the new labor and time burdens. In ring towns particularly, where industrial activity tended to concentrate, the demands on time and labor were formative. Said one township official:

I'm getting tenfold time what it was before the gas industry hit...We've been trying to take care of it, but we are just getting swamped with it. It's almost to the point where we need a full-time man. For example, the day you called me, including your call, I had six calls, from engineering firms, different things pertaining to land developments and gas company...five years ago I would get one call maybe every three weeks.

Though the scale of these demands was unique, these were largely policy and managerial problems that were not unique to Marcellus development. Issues such as increased road traffic or demands on public services might be associated with a range of other types of industrial development. With clear problems with a narrow range of solutions and qualified responsible parties, the imagined options for improving the situation tended to accumulate around established ways of doing things, such as forms of state compensation and re-budgeting.

As far as the township goes, the gas companies, they created a lot of expense for the townships and the townships are absorbing this. We're really not getting, to

my knowledge, a whole lot of compensation. You've got us fellows running the roads on \$3 gas which a lot of us, X is absorbing it himself, and I do some. I turn some in, but the local stuff I absorb, as do the other township officers. And that kind of gets to be, that can get a little old. As I said, on \$3 gas.

The personal burden embedded in these new demands also offered moral clarity about the need for some sort of action. For many local officials, the road issue and personal burdens had become evidence that the state needed to step in to backstop resilience action. At the time, no Impact Fee funds had been distributed to towns. Absent an impact or severance fee, the prevailing options for towns to access revenue from shale development were limited. (Herr 2011; Kelsey et al. 2011). It was issues such as these that drove local opinions about state involvement in local management. As a segue from describing the state of roads, one town pivoted to a complaint about the state:

Each time they get a tax on this gas coming out, he isn't talking about the townships. Our townships need the money worse than the state does, I think, because you take most of your townships and by the county you're basically poor townships. We don't get that much out of the state. You can only go to the well so many times as far as taxes concerned.

In contrast to these clearly delineated problem areas, another set of issue areas was more murky on the role for local state actors and was associated with deeper insecurities and anxieties about the nature and future of development. I turn to these in the next section.

### *6.3.2. Hidden disturbances and Institutional voids*

Another set of effects associated primarily with new populations and migrating labor presented challenges that were not part of the normally imagined

suite of impacts associated with other types of development. These posed a particular challenge to local managers because they were difficult to see through normal means and difficult to formulate solutions involving public sector action. The drivers of disturbance and indicators of disturbance were less observable and measureable and there was less clarity on what sort of public responses were possible and appropriate.

From the standpoint of governing, a central difficulty was seeing and estimating intermediary drivers such as population in-migration and understanding what these populations were doing. In some shale boomtowns in recent years, such as Williston, North Dakota, population has reportedly doubled. This puts Williston on par with the situation in some of the original boomtown literature. Sweetwater County, WY, one of the first boomtown regions studied, had 18,391 residents in 1970 prior to the energy boom at that time. By the time population growth tapered off in the early 1980s, the population had more than doubled to 36,860. (Jacquet 2009) In such situations, the pace and scale of boomtown population growth overwhelms service and businesses.

Compared to rural boomtowns in the literature on energy impacts, the region of the Susquehanna core has a higher population density, more infrastructure, and strong service sector. For this reason, local communities had some capacity to meet new demand for business services from new workers through expansions in hotels, restaurant, retail, etc. Where local capacity did not exist, the larger region housed cities such as Williamsport that could absorb temporary relocations for many more itinerant gas workers. The need to import support businesses and populations was

therefore less than in other energy boomtowns and regions.

At the same time, there was anecdotal evidence that something more complicated was going on. For example, spillover populations in mobile homes were dotting the hillsides as in-migrants informally set up temporary campers on private lands in around Towanda. Because they were not enrolled in any permitting process, there was no record of their presence. One county official was alarmed about potential emerging sanitation issues accompanying sewage disposal at these sites. Noting that to date the county had only been involved in this issue in a limited way, her apprehension was the unrevealed impacts she believed were 'hidden behind the hedgerows.'

[But] now as the leaves fall out there, you drive around the county, there's going to be campers [behind] hedge rows all over, and as they're pointed out to us, somebody calls in--neighbors police each other--so as these things come about, this has to be addressed.

In addition to difficulty tabulating the problem, some problems such as this also fell into an institutional void—there were no clear line of sight on who should be responsible for action, what that action would be, and who should pay. The official expressed frustration about the lack of such clarity:

How do you tax them? They're living here, they're staying here, but they're not staying at a hotel, you're not collecting that revenue, you're not collecting revenue for the tourists, which is part of the tax for hotels. The property owners are saying yeah yeah, you can stay there a while, but we have winter.

Clarity on the issue was further muddled by a lack of any capacity to enforce solutions amid questions about the oversight authority of the local government. Said one town official, "We do have the ordinances in place to control this a little bit, but

the problem, is there's a lot of people now that the money is here, they don't want to conform to the ordinance."

The scale of such problems was only further muddled by population data that was unable to suggest the dynamics of population change. In 2010 the head of the Bradford planning department estimated 5000 people had arrived in the county in the previous few years, using that as an illustration of the scale and scope of new demands on the community. But on that front, the existence of a population driver was not born out in 2010 census data. In fact it was way off. The census was unable to detect *any* gas-related population increases in the county. Compared to 2000, the population in Bradford County decreased by .2% from 62,761 in 2000 to 62,622 in 2010 (Loewenstein 2011).

Some combination of factors are at play here: It is likely that certain trends were simply not captured by the data. The 'shadow population' of gas labor is a moving presence, and the numbers do not capture those workers who are rapidly migrating in and out, those who might record their out-of-state residences, or others who are commuting in by day from other counties. Also, some population growth is masked by longer-wave demographic declines unrelated to the gas industry.

Whatever the reasons, these sorts of uncertainties about population growth and behavior were muddling the intelligibility of public planning and governance responses. And because there were so many other more tangible manifestations of change, muddled issues such as the campers tended to be put on the back burner not because they were of less priority, but because they were more confusing.

Advocating and designing resilience actions for disturbances that are "hidden

behind the hedgerows” and falling between the cracks in normal ways of doing things presented a very different challenge than making arguments to justify increase resources for ‘normal’ disturbances of development.

Importantly, these also were the types of effects that increasingly were creating some of the most alarm and conflict within the residential community. The intangibility, illegibility, and lack of clarity on who and how to assign public responsibility was amplifying apprehensions. There was an integrated fog of uncertainty: The future activity of the industry was unknown, so it was unclear whether the manifestation might be growing, shifting, or declining, and at what rate. Campers were “hidden behind the hedgerow,” meaning the problem was physically hidden. It also was metaphorically hidden behind the hedgerows since public accounting of the informal practices was not systematically taking place. This integrated uncertainty was at the heart of the collective anxiety that accompanied expressions of this type of impact.

And because the role for public response was unclear, those who were unhappy with the situation tended to concentrate their discontent inwardly on community actors who were hosting these campers. For example, this and related industrial siting decisions by local property owners was a strong undertone of the rural disruption storyline and its emphasis on the breakdown of civic institutions (described in chapter 8). To reiterate, this contrasts with those legible issues such as road disrepair, which helped to textualize storylines and institutional argumentation around state policy such as the severance tax.

#### **6.4. From Awe to Learning -The birth of a boomtown planning vision**

Another characteristic of the influence by inches storyline was an articulation of the role for public sector actors in facilitating information and learning. This aspect of the storyline had become institutionalized in the most proactive cooperative planning effort in Bradford County, which was a series of task forces that government actors had launched. The Natural Gas Advisory Committee was established in the spring of 2008. At that point, only a handful of the hundreds of wells had been drilled. The group started out informally and eventually formalized into a core with subcommittees that met at least quarterly. Members included three county commissioners, township officials, state police, the county sheriff, banking and economic development representatives, and county conservation, in total about 25 or 30 people. The committee pursued three goals: “To develop relationships with the industry and our community. To encourage a diverse forum from which to learn about this developing industry. To develop opportunities for public education and understanding.”

In chapter 5, I traced how the region historically was peripheral to energy extraction. This inexperience offers one part of an explanation for the focus of the task force on a mission of information, learning, and relationship building.

The distillation of the principles and roots of social learning practices embodied in this mission can be traced in part back to efforts put forward at an early stage by Penn State Cooperative Extension. The extension service acted as a clearinghouse for information and also offered hands-on engagement at the county level. It offered access to dozens of publications about gas drilling matters, had set

up webinars, updates, and through its agents established a virtual and community presence. Early webinars cited by officials included webinars such as “What communities can consider when determining municipal impacts” (Penn State 2009). The information described a range of responsibilities for local governments, options for response, and set out what authority local governments did and did not have. Webinars described who were the major public players and regulatory agencies. They explained relevant oil and gas law and limitations under existing laws.

These webinars helped establish a shared way of ‘thinking like a boomtown’ and construct an agenda for agency collaboration, new committees, and public actions. Almost all officials I spoke to referenced the influence of the extension service. Officials tied the birth of their planning practices to early information sessions and webinars that “focused us on where do we really need to be going” at a time that they were stunned into inaction by the “utter awe” of the drilling activity. Said one official,

You know to sit here and say so and so's restaurant is doing good. This is not what it's about. I think because it's the newness, like anything, and you're all sitting in a room, it's like if you've never seen a drilling rig before, you're thinking, did you see how high that is, did you this?

Through these conversations, local officials began to assemble broader goals of communication and social learning as the principles for public response to shale development. One member of the task force argued that the task force could provide critical community service by being a gatekeeper on information.

There's so much bad information out there. I have filing drawers filled with clippings, newspaper articles, reports, data, analyses, and regulations—from all around the country. We [the task force] are the place that people can turn



to for the unvarnished truth. We cut out all that stuff. I think we have the reputation for that.

A planning subcommittee had a similar public educational and information focus, described by one planner as the desire to “educate ourselves for the public and for the municipalities.” She described meeting once a month to “orient ourselves on that path so that as supervisors, municipal planning commissions, and so on, had questions, we were prepared to answer the questions.”

The committee had participated in a few proactive learning activities, including site visits to the Barnett shale in Texas, followed by public presentations. Some of the members were reaching out for advice to networks in energy fields in Colorado, Wyoming, and into Canada. Members of the committee described self-education and public information as a dominant objective. As one member put it, “We are focusing lately on just educating ourselves. We’re talking to anyone we can, all over the world. This is all so new.”

Some of the issue focus areas that the committee sought to learn about and communicate included monitoring local gas activity, safety and emergency management, traffic and road maintenance, and methane in the water. The committee also was scoping a range of coordinating activities that it could help with, including issues around 911 readdressing, mapping of gas impact data, mediating land use conflicts, housing shortages, increased need for law enforcement, social services, courts and corrections.

## 6.5. Regulatory politics and institutional fragility

In the previous section, I described two categories of problem that were presenting themselves and described the way problems characterized with greater legibility and tangibility tended to be prioritized by local actors simply because they were less complicated and mimicked more familiar policy problems. Questions of jurisdiction and legal authority over certain problem spaces are also important here. Expressing a common caveat, one county official listed a long series of concerns related to gas development before abruptly concluding, “we could talk about all this, but it is not necessarily in our jurisdiction.” The issue of limited local jurisdiction is central to understanding the adoption of the “influence by inches” storyline. In a variety of ways, residents, landowners, industry, and the state were putting pressure to modify or pull back certain local public functions. This was cooling ambitions of public managers to argue openly for certain actions that might indirectly exacerbate these forces. The mission of the task force was a politically neutral effort in this respect. As one official put it “It doesn’t do any good to throw rocks from outside, because then you have no communication.”

### 6.5.1. *Rescaling authorities*

The idea that communication might be severed was not an abstract fear. The relationship-building component of the citizen’s advisory committee was connected in its mission to staffing arrangements at gas companies. For example, Chesapeake, the most active driller in Pennsylvania and a dominant producer in Bradford

County, originally had set up field offices in Bradford County with a small department of six or eight community and landowner relations staff, who effectively were the mouth and ear of the company to the community and the advisory committee. The model threatened to collapse as the industry transitioned out of the drilling stage in 2012. After cutting back on drilling and restructuring at the corporate level, the company laid off and closed down the whole department (Cusick 2013). This effectively centralized communication and shut down local community relations. The company still continued to produce large quantities of gas though, and increasingly there were community concerns about royalties and other issues, as described earlier.

Some officials expressed discontent that circumstances such as these created an uneven playing field but stopped short of arguing for any leveling:

The oil and gas companies seem to have a different set of rules. It can seem unfair if you focus in on that part. But you can't go down that road. You keep your head above water and deal with what's coming right at you. If we could step back in time, I'd do it. We'd do things differently. But we just keep talking with them [the industry] and keep working to keep away the problems.

A related apprehension expressed by local officials was that what little standing counties might have in local relationships with the gas regime was in jeopardy of being centralized to the state. Finding leverage to 'talk' to the industry was not straightforward. For example, a member of the County Conservation District described the decision to rescale authority over soil permitting from the county to the state. He described it as a "a concession to the industry to give them fast turnaround so that they can pump these out as fast as possible."

So [the industry] saw in some counties they weren't getting there things turned around, whether that's conservation district capacity, whether it was how rigorous they were looking at that application, or whether they were getting lousy permit applications, that cry went to Harrisburg and at the governor's level he decided that he was going to consolidate all of that and run it through the department.

A direct effect of the centralization of permitting was that it removed a source of local oversight of one part of the drilling operation. The local delegation of permitting was useful as way to “try to get them to do what they’re doing in as sounds a method as possible.” But the conservation officer also described the permitting delegation in more general terms as a platform for “relationships that we were starting to build.” Without the delegation, those relationships had disappeared. He described the way that the permitting process had enabled interactions that indirectly facilitated the flow of other information about activities and decisions that the industry was making. The task force, he argued, was a mechanism to try to rebuild those relationships. But without the jurisdictional component, it was harder to bring players to the table.

One of the more far-reaching pressures on local authority was the effort to expand exemptions of the gas industry from local zoning. Since the Oil and Gas Act of 1984, the industry has been exempted from local regulations on operations, but townships have been able to regulate the location of gas wells through the land development process. These restrictions were new to officials in Bradford County, and key again here was Penn State in offering guidance on how to be in compliance.

One of the biggest things I think I learned right away was whether you are for or against the industry; you can't just adopt the ordinances to change things that change with the industry. You have to already have had zoning in place and address those issues prior to them coming. You can't now back door well

I want to put decibels on noise, which--that affects them. Those things saying you can't pick and choose where they're going to drill.

Efforts to amplify and attenuate these exemptions were working through the courts during my fieldwork. Ultimately, Act 13 signed into law in 2012, set a uniform set of zoning restrictions across the state, requiring that “drilling, waste pits and pipelines be allowed in every zoning district, including residential districts, as long as certain buffers are observed.” This compelled many towns to make large scale updates to their ordinances to bring them into compliance, which was set as a condition for receiving impact fees associated with the Act (Loewenstein 2013).

#### 6.5.2. *Little government*

Amplifying this downward pressure on local public decision-making was pressure from within the community that some officials described as a culture of rural civic-mindedness, which exerted strong guidance on local government. One county manager described a prevailing rural worldview that promoted skepticism about government relations of responsibility for planning, managing or regulating. By way of explaining how his hands were tied to address some of the social conflicts that he was seeing related to industrialization, another township official put it frankly: “We don't have zoning. You see, this area is not zoned. And probably not in our lifetime ever will be, because rural people...zoning is kind of a bad word to rural people.”

Of 51 municipalities in Bradford County, only 13 had town zoning at the time of the gas boom. When the idea of uniform countywide zoning re-surfaced in the

2011 election of County commissioners, only one of five candidates supported it. The incumbent, who went on to win re-election, argued that: "The cost (of having county-wide zoning) is extremely prohibitive, and we'd probably actually have to raise taxes to do it" (Loewenstein 2011b). No townships in Bradford County were among the seven townships in the state that sued to have Act 13 overturned (Herr 2011).

Another official compared the situation in Bradford County to that of adjacent Lycoming County, where all 52 municipalities have a zoning framework, including 17 that are under the umbrella of a county planning administration. Lycoming was the only county in northeast Pennsylvania to proactively develop an amendment to the county zoning ordinance in anticipation of the expansion of the gas industry (Wheeland 2011). The official argued that the zoning framework offered Lycoming a measure of resilience missing in Bradford County, which she referenced to a "mentality" in Bradford linked to its rural demographics and history.

Lycoming County is close enough strategically to us, and Lycoming I believe has had the population structure that there's a--and this I wouldn't want repeated this way--there's a mentality you've got to break through [i.e. a mentality in Bradford compared to Lycoming]. Lycoming has been faced with a lot of different issues, so I think they've been a little more aggressive. Bradford County's population hasn't changed since the Civil War. It's in the 60,000 range. A majority of us have lived here all our lives and we can trace our roots back to Wales Ireland and Germany type back. We've been here.

The effects of gas development and associated new demands for information, services and oversight offered a graspable opportunity among some county and town officials to debate this state of affairs and advance justification for a more robust form of governance and regionally-coordinated planning.

We haven't had the influence of southern PA until the last 20-something years—just a different way of thinking. So, you've got to break through that barrier, because the days of somebody saying to me 'that will never happen' is never going to be said to me again. I can't accept that. Or when you explain why there's regulations and rules, and they'll say 'well, that'll never happen, why do I have to do that?' Well, that's not an acceptable term to me. Not anymore, not after what we've seen happen in the last two years.

In brief, some officials voiced impatience with limits on public authority for planning. They described a set of core values about civic governance and 'little government' that they felt was constraining the social base for launching resilience actions. Such limits were amplified by other efforts of regime and state actors to change the local authority available to town and county actors.

## **6.6. Avoiding politics and judgment**

In contrast to these latent ambitions, public officials tended to avoid expressing political statement about the energy transition or make judgments on the preponderance of risk or benefits. Officials frequently side-stepped transition politics or principled evaluation of change. This was expressed by some as ambivalence about the attention that Bradford County was receiving as the empirical focus for arguments about regional and national energy transitions. Local actors were aware that the attention paid to the area by regional and national actors was mixed up in a politics 'beyond here', with Towanda valued as an empirical case study for the contentious transitions politics described in the earlier section. But in Bradford County, many respondents kept this risk politics at arms-length and expressed ambivalence about the contours of storylines from both the anti-frack coalition and abundance coalition. One county official analyzed the 'spin'.

I mean, everybody's spinning. You know you have people who are really opposed to it spinning negatively, and the pros are spinning positively, and it's like people want to come down and see first hand what some of those impacts are, drive around and see what the rigs look like and some of the landscape impacts and the impact of other things. A lot of ecologists, they're coming down just to get a feel for, you know I guess it's kind of a boomtown type of impact, it's almost like a gold rush type of thing, where companies are coming from all over the place, and so it's go, go, go, it's kind of like the circus is in town.

Some respondents more explicitly repudiated the premise of the polarities put forward by the two regional coalitions and argued that it was counterproductive to take a stand in such a way. Recalling a trip that he and others in the county had made to a town in the Barnett shale, one county development worker recalled the advice that a county commissioner in Texas gave to "a lady that seemed to be sort of anti-everything natural gas drilling wise." The commissioner said "Ma'am, if you don't at least make an attempt to embrace this on some level, you're just going to spend the rest of your life being mad." The development worker used this anecdote to argue that "it's not like you can, you know, take a real strong stand for or against or crawl in a hole and ignore it, you just sort of gotta roll with the punches a little bit and [make sure to] embrace what you can, try to change what you have opportunities to change as well."

This sentiment was part of a broader disengagement from any hard line on whether the distribution of effects related to development were good or bad.

Officials expressed exasperation about the challenge of trying to find a 'balance' of opinion on the risks and benefits. One county official expressed:

I guess it's better, right here at least, if you look out at all these farms and all this land. What do you say to a farmer who has new equipment and buildings, tractors? They aren't in debt. I don't know. If I were living in town and no royalties were coming in, and I was stuck behind the trucks all day,



maybe I'd feel different. I just keep expecting to wake up with all of it gone some day.

One county commissioner sidestepped the politics of risks and benefits, arguing: "as a commissioner, you can't sit in judgment one way or another." He described a restrained role for himself brokering information about legible, tangible, and immediate issue areas. "You have to refer people to the right place. If they have a water issue, get them to DEP. If it's a road issue, have them contact PennDOT. If it's a problem with a royalty check, see an attorney."

Prioritizing tangible and legible impacts was a characteristic of the "influence by inches" approach, explored earlier. There was limited imagination of response to problems with an intersecting nature or amplified feedbacks. Nor was there significant attention to more intractable public problems like emerging outcome inequality associated with development or concerns about the distribution of citizen participation in development.

### **6.7. Influence by more-than-inches – An illustration of producing spatial data**

In this section, I offer an extended illustration that brings together some of the pieces presented in previous sections of this chapter. I present the case of stymied efforts to launch a database and mapping tool for leased parcels in the county. It was a particularly forward-thinking initiative that was mentioned as a vital initiative by members of the task force. In contrast to many of the public activities that were reactively addressing immediate needs, this effort had the strategic and visionary goal of building transparency about the activities central to patterns of drilling and

industrialization. I demonstrate the challenges to setting this in motion amid a preponderance of public demands, institutional lock-in, and an uneven playing field. The illustration highlights some of the constraints on efforts to practice resilience by more than inches.

As described elsewhere, there was significant ambiguity about the local and regional patterning of future industrial activity and acknowledged need to find ways to bring more clarity. One of the goals highlighted by members of the task force was trying to better map indicators of this activity. At the time, the county planning agency was spatially patterning the industry using well permitting data. While permitting data is useful, it tends to be the last step before drilling, so as forecasting tool, it is limited. Information on leasing would potentially be much more useful. For example, the timing on lease expiration was a key driver of drilling migration. Consolidating acreage was another. Getting a handle on the gradations that went into these strategies would offer information to landowners interested in negotiating lease terms. One official put it this way: “They have a group of unleased parcels and different property owners in this group. And they wanted to know around these parcels where the concentrations of the companies were.”

The agency also envisioned broader public uses for this data set, including overlaying a variety of spatial data layers to make patterns of relationships between gas development and other factors more explicit. In such ways, it would offer some better information on the patterns of future activity and the agents involved in those patterns, information useful for managing future disturbances and designing proactive measures to increase community resilience. The product was imagined

both to "reach in" to empower landowners in their negotiations, and to reach out to other counties such as Tioga as a regional project.

The challenges facing the department in trying to assemble this data speaks to the "uneven playing field" that one respondent referred to. The idea of developing a leasing database arose from the insight that this was data that the industry had already widely collected and was selling internally as a valued base for strategizing. Planners in the county agency described the genesis of their desire to create the leasing database.

We were watching a Penn State webinar on natural gas...but the gentleman from Penn State that was doing the presentation, had a portion of his PowerPoint dedicated to a section of our county with all color-coded parcels and they were leased parcels. And I said to [my colleague], why don't we have that. And we started looking into it, and what we were looking at on the presentation was proprietary information from Geokinetics...who's a company that does the geologic 3D testing around our area, pretty much.

The data was created in part from public records in the county. Representatives from firms such as Geokinetics are able to absorb fees and labor costs even if transcribing by hand to translate public data into proprietary data sets. County personnel did not have time to cull the information from hard copies of the leases at the Recorder's office. And despite the involvement of a number of officials in multi-agency discussions, a jurisdictional and resourcing divide between the recorder's office and the mapping agents had thus far hampered coordination and prevented the county from reproducing this dataset. Digital forms of data would require software and licensing fees that could be absorbed nowhere. As one worker described it: "We're a county department, but yet we have to buy the software to access another county department, which is sort of silly." Officials described a time

consuming administrative process of applying to the “Records Retention Committee” in the other department, something in process at the time. This is a good example of how so much of the uncertainty about the rate and magnitude of exposure was generated from the proprietary control over information. Gas operators exerted this controlled access in order to keep their strategies under wraps from competitors. The speed and access of their activities was outmatching communities by miles.

The flexibility and speed of response in these agencies, and their capacity to concentrate on innovative projects such as this, also was hampered by the preponderance of multiple intersecting pathways with feedbacks and amplifications that created multiple forms of pressure at particular nodes and places. Ironically, the Bradford County planning department’s activities were significantly strained by the industry’s high-volume demands for spatial data from their office. Respondents described the way that land men started coming in droves in the past three years to request map information on tax parcels.

Just the central parcel with the bounded by parcels, that’s all they’re looking for, eight and half by eleven, and every one of them is the same. Every company wants exactly the same thing, but it was a huge drain when they were e-mailing us a list of thirty maps that they need, and then their ten other buddies are e-mailing another list.

Respondents described the way they set in place new protocols to manage the flow of requests, including charging the front office personnel with processing parts of the requests and setting up an account system for users to work off a balance. One official noted how 75% of her work day at times was taken up by such requests.

Another respondent described how these requests came to dominate the hourly affairs of the office

How about something as simple as putting a sign up on the front door saying, lunch time. No, seriously, people had no problem coming in at lunch, and of course we were trying to be as user friendly as possible with people, come to the point where, wait a minute, people are losing their lunch hour, we need to just stop it.

Meeting data service needs of this sort was an added burden on local departments operating on a thin margin and illustrates another angle at which pressure on their capacity was being tested. It shows how the preponderance of specified pathways was amplifying governments' ability to both deliver regular services and burdened their time on creating new products.

## **6.8. Summary**

The illustration presented in the previous paragraphs speaks to the mismatch between the speed of the industry and its ability to manage commercial risks in comparison to the community's ability to manage disturbances. Industry actors in practice were more equipped than local agencies to mine and produce information. Industry regime actors were able to access information rapidly, while public actors struggled to cut the red tape creating internal checks on rapid actions. Service demands from the industry were supercharging everyday labor demands in ways that overtaxed public resources. The case of the planning initiative extends to similar types of problems elsewhere. Among public actors, there was a sense that the preponderance and intersection of pressures in particular places and groups

and individuals was creating concentrations of change that was preventing public sector actors from operating at the speed and capacity of the industry.

As described, actors in varying degrees were forced to make choices about what disturbances to prioritize. In Bradford County, where I concentrated the empirical analysis, an ‘influence by inches’ storyline selected information and learning as the appropriate response and emphasized immediate and legible problems with tangible solutions. Literature in resilience often makes the distinction between actions to build specified resilience and those designed to build general resilience. Where the former describes disturbance pathways that can be reduced to questions of ‘resilience of what to what,’ general resilience describes building capacity within a system such that it can withstand a variety of disturbances (Walker and Salt 2012). By this distinction, one might characterize the influence by inches story as limited to specified resilience actions that could be legibly reduced. But while certain valued pathways of disturbance might be easily specified (like road disrepair), others were more muddled and less reducible. Though they were equally ranked as high importance among public officials, these were being sidelined as local actors struggled to launch resilience practices to address more tangible problems.

In large measure, this was a function of local capacity that set constraints on the types of actions that were available to local governments and agencies. Compared to some nearby counties, Bradford County was equipped with a unique staffing capacity to set in motion planning efforts. Explained one planner, “it’s a unique set-up that we have here, with a GIS person in the planning department. Those are

separate departments [in other counties].” Describing the way some counties had not saved county data that the Bradford department was now using to visualize activities, he remarked, “I mean we did that right from day 1,” but in other counties, “they threw them away. They're dying right now, they're trying to play catch up and they can't.” Respondents involved with the planning department described a gradient of operational and knowledge capacity across the region, with Bradford County in the middle. Adjacent Lycoming County had a planning staff large enough that it could dedicate resources to proactive countywide planning and consider new ordinances to manage shale development. In adjacent Tioga, a rural county, there was one planner to whom Bradford County officials were offering support services.

From a different direction, capacity was also constrained in terms of the authority of local public sector actors, a subject of discussion through this chapter. To situate this in earlier arguments in this dissertation, the “influence by inches” storyline and practices emphasizing immediate localized resilience actions were in line with the impacts framing of the state and its engineering and infrastructure vision emphasizing bouncing back from immediate disturbances such as road disrepair. Apprehensions fostered by state discourse focused on the fear of capital flight and encouraged localities to think in this manner. This set the stage for local responses. Unlike in the 1970s, the mobility of the industry and roll-back discourse did not encourage public involvement in support of re-hardwiring the energy system or further accessing rents. Indeed, it more than encouraged disengagement by institutionally conditioning community receipt of impact fee funds on community compliance with the state’s overruling of local zoning.

## CHAPTER 7: STEWARDING INDUSTRIAL LANDS: LEASING, LANDOWNERS, AND VULNERABILITY

This chapter is related to the previous one in that they both consider actor groups identified by respondents as important for managing risk, in this chapter landowners as actors. The focus of this chapter is on the lease as a contract that empowered landowners to make decisions about the physical environment. The leasing contract that land and mineral owners sign with industry operators is a fundamental institutional control of shale gas production and mediator of the mobility described in the previous chapters. It governs how the surface and subsurface are used in the process of drilling. An actor group of relatively small private leaseholders is therefore a gatekeeper to a host of system transformations, including physical and landscape transformation and economic transformations. So too are their practices central to the way environmental risks express themselves. This situation contrasts with the public concession of mineral rights in most of the world or the situation in many boomtowns in the United States where public land and minerals have played a significant role. In these situations, local decision-making about boom activity is related predominantly to the industrialization that accompanies development and not tied to the experience of mineral rights owners and the process of negotiating mineral access.



In this chapter, I draw on interview with landowners and other actors expressing perspectives on the experience and institutions of leasing. The questions posed here are what roles and responsibilities for risk were imagined for mineral and landowners, the state, and industry actors through the institutions of private property? What different experiences did landowners have with the leasing process?

I describe a dominant stewardship discourse that framed interpretations of environmental risk through property institutions. I also describe the experience of landowners themselves as they successfully and unsuccessfully navigated the leasing process and did or did not live up to this stewardship ideal. I highlight three things about the reproduction of the property institution in the context of managing risks that accompany the transformation of the physical landscape: 1) it centralized a key area of decision-making to a small group of landowners, 2) it perpetuated a way of thinking about the management of environmental risk that was a dominant risk discourse but was admittedly limited in its scope of management, 3) it differentiated the experience among particular landowners in ways that were creating new lines of economic and environmental vulnerability that spilled over to wider community effects.

### **7.1. The landowner voice**

Through their role in defining access, land use, and investment, private landowners in the Susquehanna core are principal gatekeepers on the community

flow of risks and benefits. How is this gatekeeping function distributed within the landowning class and community? Reflective of patterns in the Susquehanna core of drilling more generally, in Bradford County more than 90% of land is privately owned. 60.3% is owned by people in county (Kelsey et al 2012). The distribution of acreage is skewed toward relatively few larger landowners. For example, in Bradford County, 50% of locally owned land is owned by a minority 7.2% of landowners, each of whom own more than 100 acres. In contrast, 38.6% of county resident landowners own less than 0.6% of the land. These issues of structured agency and divided decision-making are starker for the one-quarter of county residents who are renters (Kelsey et al 2012).

For gas operators, the use of private leasing offers a flexibility and ease of rapid access that has been critical to navigating the costs of shale development amid widely fluctuating commodity prices. The money that rents this access and is circulated into communities via signing bonuses and royalties can be tremendous. It is useful to briefly review what we know about how these benefits were distributed among landowners and flowing into the community. According to one estimate, gas drilling in Bradford County alone had generated \$160 million dollars in bonus and royalties by September of 2012 (Detrow 2012). This is a significant change in economic patterns in a county with only 25,321 households and median household income of \$40,543 (2010 census:).

The economic experience of landowners varied enormously. The range in bonus receipts ranged from as low as \$5/acre to upwards of \$5700/acre. Anecdotal evidence suggested that a significant amount of acreage in the county had been

leased at rates on the lower end, and many of these mineral rights owners tended to concentrate in neighborhoods that were all signed up along similar time frames. The group receiving royalties actually was quite small. Of the 1,856 wells that had been drilled by 2012, only 512 were in production and therefore producing royalties. (Loewenstein 2012). This reflected the strategies of many companies to drill in order to lock down prime access by activating “hold by production” clauses in leases (Loewenstein 2012).

Landowners are gatekeepers on the flow of mineral money into the community. The local character of indirect and induced economic benefits associated with such payments has much to do with whether dollars are quickly reinvested locally, sunk into personal savings, or flow to agents outside a community. These pathways were difficult to distinguish for local respondents at the time of my initial fieldwork. Some subsequent research suggests a few trends. Kelsey et al. (2011) surveyed 42 mineral owners in Bradford and Tioga counties about the use of bonus and royalty dollars. Of the combined \$2.3 million received, mineral owners overwhelmingly invested and saved this money (55%). Motor vehicles (9%), real estate (5%), and farming (4%) were also significant uses of these dollars.

## **7.2. Stewardship discourse as an environmental risk management framework**

Private landownership is foundational to the rural character of the region and implicit to dominant social and economic institutions, worldviews, and ways of life. A majority of landowners, town officials, and business people in my sample articulated a perspective on ‘responsible private land stewardship’ as an ideal set of rationales and practices about managing environmental disturbances. It located risk management in practices of civic land stewardship, empowered lease negotiations, and adaptive learning between landowners and industry actors enjoined in cooperative enterprise within a competitive industry. The subject of this discourse of responsibility was on ‘empowered’ landowners who actively pushed for controls in leases and indirectly shifted the learning behavior of the industry.

In this section I identify three categories of environmental risks and associated resilience approaches articulated by this ‘stewardship’ perspective: (a) normal known disturbances with established best practices that landowners should secure into leases in order to keep in check the occasional “big bad wolf” behavior of operators, as one landowner described them; (b) unknown risks with responsibilities around industry learning and new practices; and (c) unknowable risks that were not considered matters of concern within the stewardship paradigm and for which there was little discussion of relations of responsibility and controlling authority. I describe each of these three here.

First were those risks seen as inherent to industrial resource production—risks that were easily assignable and that firms should know how to manage with

best practices, such as disposing of cuttings, storing chemicals, lining waste pits. It was incumbent on the landowners to write them into the lease terms to secure natural protections. One landowner I spoke to had set one of his highest priorities as the restriction of burying any tailings on the property and was letting this principle guide many of his decisions about his choice of a gas company. It was at this stage of development that landowners had the capacity to empower themselves collectively (through landowners groups, for example) and control the outcomes of development for themselves and those in the community around them. For example some landowners chose to block surface access completely:

They can go underground, but they're not going to touch my property. And there are a number of people. Which is why we didn't sign on. It's special use, they cannot go on it, even though it's 20 acres. They can put a pipeline across, but that's the only thing that we'd even consider.

A second category of risks was identified as those known risks that the industry as a whole was uncertain how to manage in the new drilling environments of Pennsylvania. Deploying new technologies that worked in other geological formations did not work the same way in Pennsylvania's subsurface. For example, well casings adapted to a distant working environment (i.e. Texas, Oklahoma) would need to be tried and tested in order to adapt them to local conditions.

Landowners and officials expressed a set of graduated expectations for developing best practices and adaptive management of these risks, including a tolerance for experimental failure. For these respondents, an iterative process of learning was helping to set in place increasing land security, as the 'place factors' were better understood. One landowner described this as an evolutionary process, with the area as a sort of classroom that was "giving the industry a lot of lessons" on

how to drill responsibly. He gave the example of so-called “produced water,” which is the flow back fluid that is returned to the surface from the fracking process.

Recalling seeing a drilling rig back in 2008, he described it as “kind of what I remember as a child when I saw a local gas well.” Produced water was “shot out from the rig area into this pond, and then it would settle down, they would cart the stuff off at that point.” He contrasted that with the learning that had taken place in recent years based on perceptions of risk about how such ponds were leaking or overflowing, arguing, “so now they have the capability of keeping everything in what I would call a close-loop system. Anything that's going to leave the site is going to leave--any liquid, or material from underground--is going to leave either in a pipe or in a truck.”

This perspective hinged on a high degree of trust in the industry’s ability and willingness to confront failures, communicate them, and confront them. It left room for some failures to be the outcome of expected malfeasance and mismanagement of “bad apple” firms, and proposed leasing institutions and industry policing as the solution. Contrasting the approaches of different companies, one landowner spoke of Cabot’s problems in Dimock and the process of evolutionary learning in the industry about the need for thicker casings.

And sometimes it doesn't work and they learn all the time, and that kind of stuff... in Dimock, Cabot fought its learning curve I think. Rather than embracing it and learning from the mistakes and owning up to them and fixing them, they said, well, we'll just keep on drilling and, the heck with you, we don't have to do anything. So we won't.

One official contextualized that an uneven landscape of corporate responsibility with good and bad apples was an inherent factor of industrial resource production:

There are twenty five different companies that have at least one well in Bradford county, and so that's a lot of companies, and you'll see new companies, because people are just saying this thing is just getting started. So as they start to really get a full head of steam, you'll probably start to see all sorts of other subcontractors and others drilling wells, so you're going to have varying levels and degrees of responsibility, like any industry, whether farming, or logging.

A third set of environmental risks are unknown, non-point sources of pollution where responsibilities are difficult if not impossible to assign legally to individual operators or landowners and potentially represent risks inherent to the technology more generally. Such risks have been a centerpiece of anti-frack storylines. A large quantity of public debate has sought to address issues around migration of chemicals into aquifers and groundwater, for example. One landowner expounded an expression of faith to address his acknowledged avoidance of managing these risks.

But there are people who are saying we should wait until it's safe. I don't think you're ever going to know that it's safe, and I don't think it ever will be safe, but you learn from your mistakes. Mistakes are going to happen. You clean up your mistakes, and you keep your fingers crossed that there's no long-term permanent damage.

Among those I interviewed, only one respondent directly mentioned the role of the state in the context of these sorts of risks. He called attention to the relative clout that actors in New York City have to change the institutional logic about fracking in upstate watersheds, and argued bitterly that there was an institutional void in the Susquehanna core: "Here we don't have New York City but, as far as I'm concerned, if they drill and pollute my well and destroy the value of my property, I'm just as important as New York City."

He went on to argue that there was not enough industry transparency about what additives are used in fracking fluids, lamenting that

the state has not the power to make them tell us. So God knows what they're putting in the ground. Now they're saying that the way they drill, that there can't be any pollution, can't be any water contamination. But we've already had it. So you can have it.

To reiterate, the stewardship discourse repositions discussion of managing technological and environmental risks from a debate about what role the state should play to a consideration of the way that private landowners in contract with firms could steward the local environment and manage technological risks.

Cumulative problems are not central to the stewardship discourse and its basis in the “parcelization” of resource management. This contrasted with much of the anti-frack discourse, which framed collective responsibilities for cumulative risk that conjoined smaller and larger watersheds across the region. Instead, the stewardship perspective implicitly advocates a trickle up approach to cumulative and community risk management that requires a high degree of trust in both landowners and industry actors to negotiate in good faith for protective contract language and learn from the failures in practice.

To appropriately meet the ideal of this perspective, landowners needed to be informed and empowered to advocate for appropriate protections. Furthermore, industry actors had to in good faith learn from mistakes. In the next section, I question how empowered landowners were and the degree to which good stewardship was being practiced. In contrast to the stewardship ideal, I find a wide range of practices. By way of broader discussion, the stewardship perspective framed responsibilities for environmental protection around a tangible, assignable,



and certain set of ecological and social relationships. By their own acknowledgement, actors articulating this perspective bracketed off certain classes of risk that were less assignable.

### **7.3. Institutional cascades and growing inequality**

The idealism about risk management expressed in the stewardship discourse looks different as one narrows in on the different experiences and types of leases that landowners signed. In this section, I describe these variations in experience. In brief, some landowners were better than others at navigating the leasing process. That some were more successful than others was deepening inequality in outcome among landowners, particularly related to the distribution of risk and vulnerability as industrial expansion introduced dynamic and evolving pressures. While many of the leases in Bradford County might be considered “robust” leases, many were weak. Robust leases protected landowners from unanticipated long-term evolutionary changes in conditions. In contrast, weak leases exposed landowners and communities to risk associated with changes in the contextual conditions or ‘squeezing’ by industry actors.

#### *7.3.1. Leasing conventions and uneven leasing*

A subset of landowners hastily signed leases when leasing was still under the radar in the pre-development phase. One landowner described the situation of her neighbors: “The majority of them signed on earlier than I did. Most of them signed the five dollars an acre thing because that's what they've always done. “ The “five dollar an acre thing” was a turn of phrase used by a few respondents to refer to the

rounds of leasing that started in the early to mid 2000s, well before any drilling had picked up in the area. Reflecting a culture of disengaged leasing stemming from the region's peripherality to energy extraction, these landowners signed with little legal advice and very little protection. Said one landowner "Landmen have been coming around in the area for generations. They've been \$5 or \$25 dollar an acre, that type thing, 12.5%, standard Texas leases. People would always sign them, get the money, they'd go away and that would be the end of it. Well, this time, it wasn't. So people got this little bit of money, and then they got a well in their backyard."

In contrast to these landowners, a different subset of landowners remained cautious during the early stages of development and chose to wait, acting amid the first wave of inflated lease offers as the land rush began to pick up speed. About the coming gas rush, one landowner recalled thinking in 2008:

I knew it was coming. Nobody knew when and what. All the commotion was going on about the leasing. I got \$65 an acre. They paid up to \$5000, \$5750 an acre. So the leases - some of us got in early when we had heard nothing. You know, you didn't hear anything, it was like found money, you know?

Some landowners described informal learning through personal and familial networks, often relatives with experience of oil and gas elsewhere. These were comments like "I've got a brother who works in the gas industry" who first said to wait but eventually said, "what they're giving, you might as well take it." One landowner described reaching out to friends in Texas to compensate for the fact that there was little legal competence in the area to deal with leasing and mineral rights issues.

I do know some lawyers down in Texas, which I had dealt with a while back, because of other things that had happened and you know, and I had this friend of mine, and I had him look at it, and he told me what things I needed

changed on it and stuff. Then I had ones from here looking at it, saying now these are the state laws and this is things you want to look at also. It sounded like they did it on a whim. Well, I'm the first one.

A third group of landowners engaged in more extensive networking and social learning. A key entry point was the existing agricultural resource networks. On rural private property, agricultural institutions and networks have historically had a strong influence on decisions related to use of land and resources. The local farm bureau and Penn State Cooperative Extension in particular provided a critical structuring forum in which actors were educated about land, mineral rights, and leasing, ultimately giving shape to successful strategies of negotiation between landowners, land men from gas companies, and the industry more generally once it rotated into production mode.

The Farm Bureau has historically been a 'first responder' on rural land development issues. In the very early days of shale activity, leaders in county Farm Bureaus were some of the first to provide early warning and awareness about landowners' exposure to the risks of leasing, particularly in the form of taking expert counsel. One landowner who went on to play prominent leadership role at a landowners group traced his first awareness to the arguments of a Farm Bureau president at one of these meetings.

He just said, talk to your neighbors. The landmen are gonna come out there, and they're gonna say that they've signed everyone up around here, and you're the last one who hasn't signed. Don't believe them. Landmen are used car salesman. Don't believe a word they're saying.

As the mineral market shifted into the second stage of the land rush, Penn State's Cooperative extension became one of the key knowledge brokers for landowners. Historically, the dominant focus of extension efforts was assisting farmers on

increasing the productivity of their farms. With changes in the agricultural sector, the activities of the Cooperative extension have similarly shifted over time, and agents widely adapted to this new land disturbance. Landowners described a range of presentations from the county agent about gas drilling impacts, leasing options, and more generally setting expectations about the industry's activities.

### *7.3.2. The power of access: Landowners and landowner's groups*

Perhaps above all else, patient landowners were able to build connections to burgeoning landowners groups, which were a pioneering form of collective lease bargaining that proliferated among coalitions of landowners (Liss 2011). For landowners, 'blocking access' allowed landowners to pool their numbers to cost effectively and efficiently investigate, learn about, and negotiate the leasing process. Landowners groups are often touted as vehicles for securing high bonus and royalty returns, but they also helped landowners become informed, connected, legally protected, and productive in securing a range of other benefits including environmental and surface protections.

Landowners involved in such groups described an organizational development process that gives a good indication of the motivation, time, skills, and expertise needed to negotiate at such a level. One member described a "core group" of around twenty landowners who rallied around a leader who "did yeoman's work" and was "just putting thousands of hours." The group grew to nearly a thousand through a grass roots campaign that involved posting fliers and advocating at group meetings. It eventually represented about 35,000 acres in New York and Northeast

PA, including 7000 in Bradford County, ultimately agreeing to \$5,500 an acre in late 2009.

In a research phase, landowners described chains of engagement that distributed pertinent information from institutions such as Penn State Cooperative Extension and interactive learning with other groups in the area and around the country. Information from the encounters included template and sample leases, insider information on the tactics of particular gas companies, and due diligence research about industry best practices that could inform the lease. Larger landowner groups engaged in comprehensive industry research and marketing. In one group, a member was assigned to investigate companies to weed out those flipping acreage. The group also marketed the block: One landowner described, “calling Texas. Calling Oklahoma. And then those guys would come up and visit. You know, when you're talking about 30,000 acres, they were interested.”

These information and awareness efforts empowered a collective learning process that helped smooth the asymmetry in information and knowledge that invariably favors access of gas companies. This includes information on the uncertainties and risks of drilling and on the process of negotiation itself. Gas companies have access to subsurface visualization technologies and expertise on resource valuation, with long track records of successful negotiation conditioned on these information asymmetries.

### 7.3.3. *Unfolding disturbances - Inequities in leasing terms*

Those landowners who were not involved in information networks within the farm system or members of landowners groups did not have the same access to information, lacked leverage in negotiations, and struggled to secure relations of communication with representatives of the gas companies. Those who signed “weak” leases faced an unfolding set of vulnerabilities as the evolving industry exposed them to new stresses over time. Increasingly they were managing high land and surface risks and underpayment on royalties. In this section, I consider these two examples.

First I turn to surface access. Unlike other areas of the state, where a “split estate” situation is a common outcome of generations of investment in mineral rights, in northeastern Pennsylvania, mineral owners are generally also surface owners. This is another outcome of the region’s limited mineral and energy extractive history. As a result, landowners frequently negotiate a surface agreement for use of the land in addition to a subsurface agreement related to minerals. These surface agreements dictate how the industry will operate. Differences here distinguish a range of experiences among landowners and the cascading environmental risks of the industry. Many of the earliest leases were particularly weak in this regard. One landowner argued that this encouraged a culture of mismanagement among operators in these areas of early leasing.

They [the gas company] were just not doing the work themselves to see what they had to do. You know, they were actively drilling in the area, in the Dimock area, and they had these old leases where they could do whatever the hell they wanted to with the properties, and they were saying, well, we're going to just keep doing it that way.

One of the key powers offered by landowner groups has been a measure of clarity, standardization, and leverage to avoid these situations. One landowner described the way securing “environmental” or “surface friendly” terms was built into the marketing and negotiation of his landowners group. He described the way one gas operator insisted on burying all cuttings on site. The group started making phone calls to investigate and found it was “a bunch of crock,” so cut off negotiations.

But many less informed landowners signed a mineral lease first. Because the subsurface is legally prioritized, once a lease is signed, a landowner’s leverage for surface protections is reduced. One landowner described being sent a boilerplate surface lease and pushing back against the pressure by the gas company to sign it immediately, which she had done on the mineral lease. “Well, to be quite blunt, I figure I got screwed once, I didn’t want to get screwed again.” She described a frustrating, time-consuming, and activist battle to negotiate this lease, which illustrates the particular temperament and resourcefulness required of those landowners “going it alone” in these unequal conditions.

[The lease they sent] was left wide open. It had nothing about what if they destroy my water. I wanted my land restored as much to the natural state as possible when they were done. Talking with the guys from Chesapeake, they’re like, they’ll do it, they’ll do it. It’s like no, if you’re going to do it, you’re going to put it in writing. Don’t sit there and tell me you’re going to do it, and not put it in writing.

In addition to surface risk, the disparity between robust leases and vulnerable leases was increasingly distinguishing economic livelihood outcomes among different landowners. Evidence of a growing wedge can be seen in the situation of royalty payments and distribution, which emerged in 2013 as a flashpoint within the community.

At the time, certain companies in Bradford County had been taking a more aggressive approach to including post-production costs in royalty calculations. (Scheyder 2013) The Guaranteed Minimum Royalty Act passed in 1979 guarantees royalty payments of 12.5% but made no specific rulings on the deductions of post-production costs, which is the cost to get the gas to market. Where convention had confined such costs to deductions of 5% to 10% from royalty checks in the state, starting in 2013 Chesapeake increased that to 60 percent or more. Residents in Bradford County reported that recent royalty payments were ranging from 1.47 percent to 3.11 percent (Loewenstein 2013b).

The question of how to calculate post-production and what is reasonable opposed to underpayment puts a spotlight on the feebleness of leasing as an institution for managing land on relatively small private property. Federal and state governments have available to them mechanisms for controlling the terms of access, monitoring compliance, standardizing deductions, and generally combatting underpayment (Lustgarten 2013). There are few such protective mechanisms for private landowners, though, who enter into agreements without regulatory oversight and must pay to audit or challenge energy companies out of their own pockets. Where royalty payments are not so specified, simply determining how the postproduction calculations were done could require filing lawsuits. (Lustgarten 2013).

Once again emphasizing the power of landowners groups, such stipulations were often made explicit in terms negotiated by many of these groups. Therefore, those who are most affected by the squeeze on royalties tend also to be those who



signed for lower bonuses and have had less control over managing surface risks and outcomes. These tend to be smaller landowners who signed on at some of the earliest rounds of leasing.

#### **7.4. Summary**

Property institutions position private landowners and the private leasing process as defining agents in the transformation of the physical landscape, the character of regional gas development, and the community distribution of environmental risks. In broader context, the legal arrangements set in a community's aggregate of leases defines the nature of regional development through what could be a lengthy period of production even after a boom of drilling and industrialization. Leases are private contracts, leaving limited room for public planning in land use decisions. They are negotiated by an elite group of landed decision-makers who are located at a critical nexus of community interactions with the industry.

Within this private 'mode' of managing resources are established ways to think about how to manage risks in relation to resource access and use. Landowning discourse allows one to plug in a host of imagined risks and output an interpretation of governing authority over these risks along three dimensions: either central, influenced, or outside of the scope of a mineral and land contract.

But the discourse of an institution does not necessarily fit how it is used in practice. In practice, the experiences of leasing were vastly different, reflecting the personal and social positions of each landowner. Actors must decide how to

“activate” institutional logics and imagine how the rules fit the disturbance flow and what their role is in that institution, e.g. can I use the existing rules, conventions, practices, legal rules or organizational authority of an office as the basis for resilience action? How would I do that? What information or learning do I need? What actions are possible? On this, there were a variety of experiences among landowners. As an institutional response to risk, leasing was increasingly not "closing the valve" on the environmental and economic risks for those landowners with vulnerable leases.

Because physical and economic system transformations spill over from private lands as both adjacency and cumulative effects, the decisions of landowners are also collective and community decisions. Because their one-off decisions on signing a lease wield large influence over future outcomes, the initial baseline of information and education among landowners and their empowerment in the process of negotiating a lease is a key determinant defining the long-term governance of the region. Not only will differences in leases distinguish varying outcomes among landowners, but it gives shape to how spillover effects will be characterized across whole communities. The spatial and temporal patterning of social, economic, and environmental risk that is experienced by a community is mediated by the aggregate of decisions made by these landowners. Reflecting a widely shared sense of regret about how ignorance of the industry and leasing in the early years had encouraged bad and unprotected leases to flourish, one county official in Bradford County opined that he wished they could “turn back the clock” to that phase to encourage landowners to negotiate knowing what they now know.

Outcomes associated with unmanaged environmental risks on land or growing economic livelihood inequality are collective problems.

## CHAPTER 8: LINKAGES VERSUS LOCALITY: A POLITICS OF REGIONAL CHANGE

A dominant question among many respondents was whether pre-existing trajectories of development were or were not compatible with new pathways of gas-lead development. Echoing a common expression used by respondents to contextualize gas development, one business owner explained, “We’re a rural town. A lot of people have hit hard times.” In this chapter I consider two ways that this idea of rurality and decline was drawn into contrasting arguments about gas development. These contrasting storylines of change were central to an emerging politics about development and disturbance in the Susquehanna core.

The two sections of this chapter take slightly different tacks, but join back together in the conclusion. In the first section, I contrast a storyline and practices on building local economic “linkages” with the experience of business owners and job entrants, who experienced these linkages as more or less risky and coupled. Echoing the situation in the landowner chapter, I argue that the divergence in experience among business owners has long-term implications for the capacity of the community to maintain the identity of its local economy and not take on the collective impact of many businesses struggling with debt. In the second section, I introduce a social perspective on rural sense of place that was dominant in the community. I explore how a storyline of rural “locality”

While both storylines imagined the flow of money as a disturbance to locked-in development pathways associated with rural economic life, they diverged in how they valued and prioritized the outcomes. Where one emphasized the way the circulation of money offered a way to build more flexibility and diversity into this entrenched system, the other was focused on efforts to adapt and preserve elements of a rural 'way of life.' The two storylines indicate a tension between strategies imagining resilience as "adaptation" versus "adaptability" (Pike et al 2010).

### **8.1. "Linkages"**

As described previously, a discourse coalition emphasizing the state scaling of economic activity emphasized the circulation of money as a positive disturbance capable of shifting state-scaled economic trajectories. It emphasized specialized jobs and business in the industry and money circulating to landowners for gas rights. It also described a broader range of community economic actors as passive beneficiaries to trickle-down circulation of investments. It was an evocative vision. The idea that the circulation of money was a flow of regional economic multipliers had come to inhabit a powerful explanatory story about the community economic experience. The idea helped to describe the equitable effects of development. One business owner conceptually described an input-output model:

What happens, is that rest of us are enjoying the increase and volume of business in the area. So that mini marts are hiring a lot more people, the gasoline suppliers, more drivers are being hired. A number of new-to-the-area businesses have moved in that supply the industry, and they're looking for local people to--they'll bring in some of their own people, but they'll bring in local people too. So the job market now is tighter, which is generally a good thing.

At the time of my initial fieldwork in 2010-2011, shale development was an anecdotal disturbance. For those looking for quantitative reduction as a way to ground-truth claims of how money was circulating, there were few options. The bulk of modeling was generated by the abundance coalition. For example, a coarse-grained statewide economic impact study had been conducted within a year of drilling starting and deployed relatively quickly. Its forecasts gained wide influence, but was not tailored spatially or empirically grounded in the experience of the region (Considine 2009). It eventually came under widespread criticism for its anti-tax advocacy. Penn State withdrew its institutional support for the report. But in the early years there was little polarity offering criticism of the modeling or efforts with more circumspect baseline assumptions. In one of a few cautionary reviews of the evidence for economic gains, at the time Christopherson and Rightor (2011) argue that the "assertion that shale gas drilling will have positive consequences for both New York and Pennsylvania's economies is based on limited evidence."

A second order of research rolled out a few years later and included descriptions of the finer gradations of impacts at the community-level and livelihood-level, including public opinion community polling, the circulation patterns of royalties, including leakage, the local business effects of development. By the time these finer-grained social economic impact analyses were distributed publically—drawing attention to different distributions of benefits and risks—most major gas producers already significantly had curtailed drilling and begun to move elsewhere. This is a reminder of how differently the operation cycles are for the E&P companies versus the grounded impact science. Here I draw on some of that

research, which has now been published, to help situate the experience of those at the time.

During the boom phase, county unemployment rates generated by the Pennsylvania Department of Labor and Industry were one of the few sources of existing data that localities could use to capture a potential measure of localized employment effects. In its August 2010 quarterly report, the Bradford County advisory committee drew from this data to contextualize the effects of shale development. From March 2009 to March 2010, employment rose from 23,000 to 30,400, the highest increase of any county in the state. Unemployment rates over the same period reflected the situation, declining from 10% to 7.4% in Bradford County. Lacking any context for these numbers, the committee simply noted that it “assumes that the majority” of that change is due to Marcellus Shale development.

#### *8.1.1. Business linkages, commercial risks, and community resilience*

Boosters imagined building system adaptability by opening up local businesses to new linkages with the industry and to more strongly open the local economic networks to the industry’s potential investments. As one member of the local development coalition described it, building opportunities for companies that “have an interest in trying to tweak their business model ever so slightly” should be a high priority. A variety of local businesses were equipped to potentially engage the industry in such a way. These included companies that deliver bulk fuel products delivering diesel fuel to well pads; excavating firms providing clearing for pipeline or well site development; or engineering firms expanding activity relating to permitting processes. The local development authority had recently helped stage a

business-to-business exhibition presenting 250 businesses and attended by five thousand people. The exhibition created a forum for local businesses to network with natural gas companies, an initiative that one development worker described as “highly successful.”

Literature in resource development suggests that such linkages over the long-term may not be so clearly beneficial. By misunderstanding, misestimating, or disregarding the risks involved, businesses may overextend their business model, over build, and get caught with associated liabilities that in the worst case are transferred as ‘ghost town’ infrastructure to communities in a post-boom landscape. In this section, I draw on the experience of a range of businesses and gauge their collective experience in the context of ideas on community economic resilience on the one hand and on the other hand dependency and over-adaptation. I suggest instead, that these early years are reflective of a general flickering of activity as certain business owners breathed new air with the industry, some took on high risk, and others chose to avoid dependency. In aggregate, the evidence for a community-wide experience is mixed by these differences in individual experience.

A survey conducted by Penn State of 619 business owners in Bradford County offers a snapshot from the time of my research of how business owners reported changes in their business activities, such as increases in sales and worker turnover. There was wide variation. The businesses most affected by shale development are those who can build direct linkages with the industry operators or who provide indirect services to the industry, mainly via serving the population of labor. The best short-term growth was in those businesses indirectly capturing



gains through serving the livelihood needs of mobile labor. Eighty percent of hotels and campgrounds reported changes in their business activities and one hundred percent reported higher sales. (Ward and Kelsey 2012). These figures give some indication of the diversity of exposure to money that business owners were experiencing, and the range of decisions about risk and investment.

Communitywide, there were many businesses with inherent flexibility in their business model and capacity to meet new demand, which decreased the likelihood of rapid overadaptation as in boomtowns of the past. But what also is clear is that a subset of business owners were taking on far more risk, creating an uneven landscape of vulnerability among businessowners who were confronting an uncertain future of exposure to the industry. Furthermore, while royalty payments continue to flow to landowners throughout the productive years of a well (ideally decades), money circulating to businesses is coupled closely to the rate of drilling activity, which is hard-wired into a system of cyclical migration that can change within short periods of time. As a result, short-term gains are difficult to leverage into longer-term gains. Here I illustrate these themes through examples of businesses with low exposure and those with high exposure to risk.

One subset of owners was comfortably able to absorb significant new demand for services without new investment or much “tweaking” at all, in effect avoiding becoming deeply “entangled” or dependent on the industry. A local barber described new business as a simple opportunity with little risk. “It’s gotten better. We get some new people, gas workers, and maybe they tell their friends. I haven’t done much about it. I sometimes have a bit of a line here, but I can fit everyone.” An

accountant similarly described an add-on opportunity. Many of his clients prior to the gas rush were landowners, and his firm was able to absorb their new business as they signed mineral leases. When asked about marketing or other necessary investments, he only described sitting on panel discussions related to leasing issues, talking about “what kind of money to expect and what to do trying to keep Uncle Sam out of your pocket, type of stuff. Because of all that, we've gotten some new clients in.”

In contrast to these experiences of low risk, another subset of business owners was living and experiencing something different than the storyline presented. Particularly those business owners providing livelihood needs to workers, such as food and accommodation sectors were straddled with estimating more complicated business decisions with high risks associated with the uncertainties of a rapidly expanding, itinerant industry they knew little about and that sometimes required significant labor and capital investments just to gain access to. Describing the general landscape among businesses of this type, one business owner said, “there's plenty to be made, but it's also a risk, and it's hard.” He described the anxieties of a friend with a sanitation services business, explaining “he's nervous as hell, because every time he turns around he's got to buy more units. He's got to make the investment. If it were to walk away, he'd be in some trouble.”

Some businesses were well positioned financially and organizationally to manage these risks. For others, the decision to take on business risks was situated within a matrix of multiple livelihood stresses, reflecting the thin operating margins of many households and businesses in a county where median incomes hovered

around \$40,000. Some business owners described the limits of what they would invest or how they would engage with the industry. One owner offering accommodation expressed this as an inherent dislike about any sort of rigid or large contract with a drilling company, preferring to keep them at arm's length and deal instead with the indirect business from workers.. Describing her difficulty getting financing for a renovations to her business, she argued:

Chesapeake would probably pay for it. Because to them \$13, \$15,000 is nothing if I'm going to give 16 people a place to stay... I should [look into that]. I don't know where exactly to go or what exactly to do. But I'm not the type that does that kind of thing. But maybe I should I don't know. But not really, because if business is good I can make that back fast enough. I just sooner do it on my own. I've never taken anything from anybody.

The situation of one campground owner illustrates how these intersecting considerations conditioned her interactions with gas development.

Not last winter but the winter before I was so poor. I was 4 months behind on my mortgage. I owed the oil company \$1500. I was behind on everything. I had no money coming in. It was the year before my social security kicked in. I was poorer than a church mouse.

A few pipeline workers camped over the summer in 2008, convincing her that they would be there for quite a while. Describing the way this kept building over the next year, she said, "I kept saying if you build it they'll come...I was playing catch up. Basically I couldn't have played catch up if it wasn't for—I wouldn't be ok if they weren't here." Looking back on 2010, she described her perceptions at the time of the competitive pressure to act.

I thought if I didn't stay open [in the] winter I would have the reputation of not being open all year. I knew it was real important to do that. So I did it. By the grace of god. And I was a wreck.

To “stay open” she re-oriented from seasonal camping to permanent hook-up sites by investing in two-years worth of capital upgrades, including putting water lines below the freeze line and a new septic system. Assuming that the gas workers were long-term rentals, she estimated recouping over five years. Behind her planning was noticeable uneasiness about the variability of the business she was catering to and her ignorance of its cycles:

I guess the non-union people make more money but they jump around a lot. I guess in the case of last year they must have had a very important job that had to be done. So they called them in. A bunch of people came in from Texas and they stayed about two months. And then they were gone. And I haven't seen them any kind like that this year. [O]nce they left it was kind of quiet along that front line...So I don't know what 's going to happen.

In sum, the range of exposure across the business sector created wide variation in the risk profiles. For some business owners, engagement with shale development asked them to take on significant risk, while for others it was a low risk investment, and for others more like windfall profit. The implications of this differentiation in risk was that certain businesses were much more vulnerable in the context of a boom and bust or “flickering” industry.

#### *8.1.2. Itinerant jobs and labor disengagement*

Compared to other industries, oil and gas production is capital-intensive rather than labor intensive. Nevertheless, there is vital employment in drilling and drill servicing, and in other midstream industrial activities, such as laying pipeline and compression infrastructure. Industry jobs were perhaps the most widely imagined benefit of shale development. For those imagining jobs in the industry, the tradeoffs and risks to entry were quickly evident. Inherent to shale production is a built-in

labor force that is adapted to the mobility and speed of gas development. Because the rapid swarming and geographic circulation of labor is so important, engaging with the industry often demands flexibility, mobility and degrees of rootlessness as a condition of career success. Existing linkages within the industry also challenge new entrants. Wilber (2012) details the difficulty of some local unions to get contracts, despite their generally good fit (103).

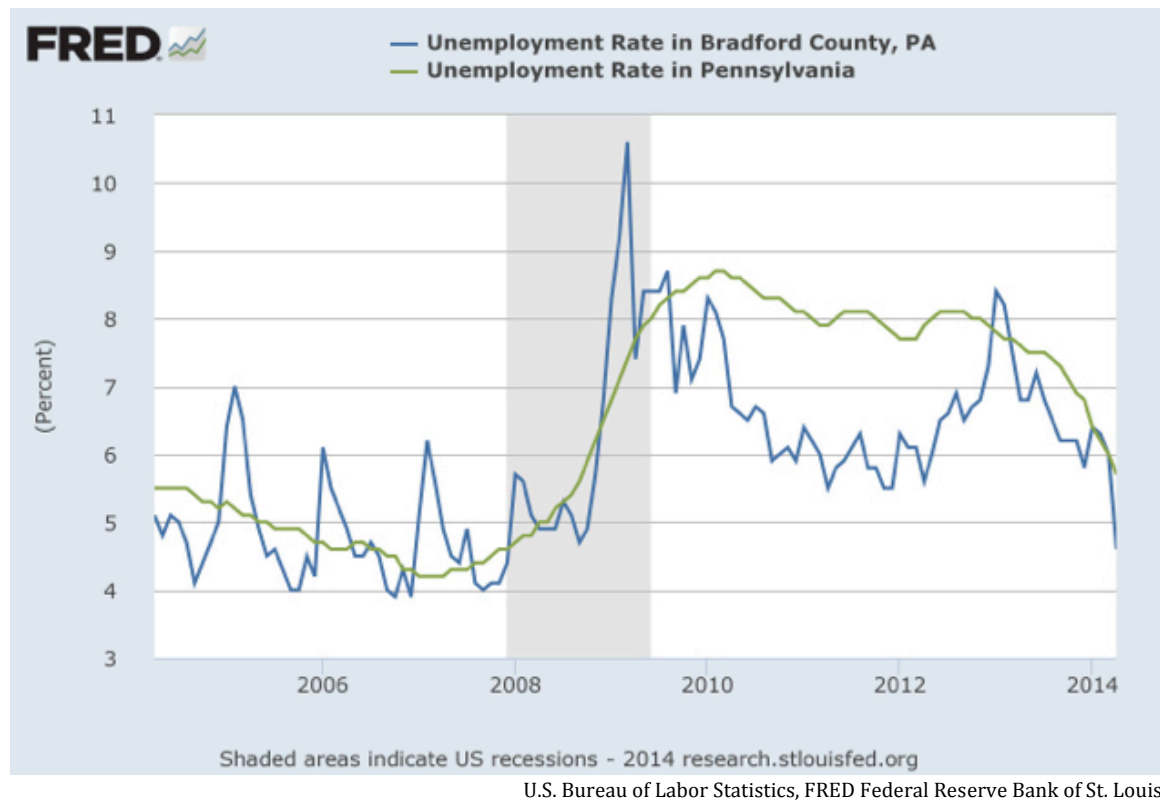
Among those I interviewed, a familiar pattern of temporary and part-time work became apparent in the stories of those entering this mobile labor pool. One resident in Towanda contrasted her husband's difficulties finding purchase in the pool of pipeline labor with his work in the housing industry, which had provided 35 years of stability before he was let go in the economic downturn of 2008.

The pipelines will be here for like three months and then on to another county. Actually my husband worked for a pipeline company from April to middle of August, then the work for this county was done. So he went to another company that's still working here. So in one year, he's switched jobs.

After one such switch, he decided to no longer seek employment in the industry. This psychological response is similar to the conditions described in literature on flickering economic activity in mining regions, where local businesses are hesitant to engage because the nature of investment stability is unclear.

The situation with indirect service jobs in businesses serving boomtown populations is a bit different. These jobs were readily available and accessible. But they were equally dependent on the short-term cycles of drilling. Some business owners I spoke to in 2011, by 2013 had cut back the hours of some employees. On balance, the evidence suggests that the gains in decreasing unemployment in Bradford County were short-term improvements but long-term uncertainties

remain (Figure 4). During the initial boom in drilling, unemployment dipped below the statewide average. This has not held as the drilling has shifted. After drilling was curtailed in 2012, for a time unemployment spiked above the state average before settling into a trend mirroring statewide declines.



*Figure 4. Unemployment rates in Pennsylvania*

Increasingly there is evidence that immediate gains in Bradford were substantial, as measured by short-term employment growth (Kelsey et al. 2011). But estimates of drilling and implied job growth that forecast decades of employment gains have been deeply complicated by the increasingly apparent organizational capacity of the industry to efficiently and rapidly flicker into and out of places with dramatic sensitivity to fluctuations in commodity markets.

In addition to this cautionary word on the temporal aspects of job gains, it is clear in hindsight that the claims of spatial homogeneity in drilling implied by estimates of gas-in-place and invoking a statewide picture of job growth have proven to widely misrepresent the inherent variation in gas production, which has concentrated in two major hotspots in the state (one in the northeast, the other in the southwest). In contrast to the idea that economic effects could overlay a resource that spatially overlaps approximately two-thirds of the state, the majority of drilling has concentrated in only a handful of counties. The job gains related to this have concentrated in these general areas and bypass the majority of counties overlaying the Marcellus shale. In areas peripheral to these cores, the “flickering” of economic activity has been heightened.

## **8.2. “Locality” - Rural decline, industrial creation, and pastoral disruption**

Efforts to build adaptability through new gas linkages—as described in the earlier sections of this chapter—was a vision of regional growth that contrasted with a vision of rural preservation and the *adaptation* of the existing rural economy and way of life in ways that would maintain its identity. Here I present that vision by first drawing more broadly on perspectives of the Susquehanna core not as a space of energy production but as a lived place with ways of life that pre-dated the recent production efforts. “Place” is not only about the structural characteristics that differentiate “hardware,” such as demographics and resource profiles, but also the character of “software”: identities, values, and place attachment. Drawing on interviews from the region, this section presents a few themes about place,

perceptions of place, and attachments to place that surfaced throughout interviews and were woven into perceptions about risks and resilience. In particular, some residents identified with a rural development pathway and way of life that were perceived as brittle by ongoing pressures on agriculture economies and threatened still further by the transplantation of a regional gas economy.

### *8.2.1. Situating the regional rural economy*

Northeastern Pennsylvania historically was an agricultural and foresting core and peripheral to energy extraction. The landscape and social characteristics of this resource regime were a defining aspect of the region's social and economic form and of a rural pastoral identity and way of life that many respondents identified with strongly. This was reflected in a data resource book that Bradford County officials compiled for the industry when they first learned of the intentions of the gas industry to begin drilling in the region (Bradford County 2010). It was generated and vetted in a council process and can reasonably stand in as a consensus among leadership in the county around a dominant local identity of place. In the opening three paragraphs, it cites the rural character of the county three times and highlights the region's historically dominant industrial base in forestry and mining. It describes the county as a leader in agricultural production. Measured by total receipt, the county is the 4<sup>th</sup> most productive in the state and the 49<sup>th</sup> most productive county in the United States. With 50% of the county forested, the value of agriculture is matched by the value of standing timber. All of this speaks to a



powerful legacy of resource use in the county and its ongoing footprint economically.

What is not mentioned is the division of labor in natural resource production. While the rural character of Bradford County remains intact, the contribution of agriculture to the labor structure of the county is relatively small. The county might be better characterized as a service, manufacturing and retail county. The majority of people in the county are employed in one of three sectors: services such as educational, health care and social assistance (25.4%), manufacturing (21%), and retail trade (11%).

In recent years, the share of labor in manufacturing has been trending downward. Echoing patterns across rust-belt landscapes in the Northeast, the sector has been shedding workers for the last decade, in this case by a few percentage points each year. The trend of declining employment in manufacturing has dramatically steepened. Employment declined by nearly 11% in 2008-2009 and by 6.5% in 2010-2011. (BEA 2013). Though agriculture employs approximately a sixth of the workers as manufacturing, employment in the sector has been in similar trend of decline.

### *8.2.2. Valuing place - Narratives of maladaptation, underdevelopment, and locality*

The agricultural economy and identification with a rural way of life intersect in complicated ways—an identifier of landscape aesthetics, a cultural pattern of social life, a source of livelihood, and as a regional economic base. In Bradford County prior to the boom, there was existing apprehension about the decline of a

rural pastoralism, economies, and associated way of life under pressures of long-term restructuring of rural resource economies. This apprehension was rooted in strong place attachment to a shared rural history and way of life. This perspective of place featured prominently in perspectives on environmental, social, and economic risk.

Economic and labor conditions in Bradford County are squeezed by intersecting pressures on two livelihood transitions, one in agriculture and the other in manufacturing. The legacy and decline of these industries is a powerful identifier among residents, who often describe the Endless Mountains area in shorthand as an economically depressed farming region bookended by these twin declines. The erosion of agricultural livelihoods echoes trends that have analyzed from many different angles, but generally encompass factors such as technological change, the rise in energy costs, global competition, and industry consolidation (Brown and Swanson 2003). In tandem with these industrial changes, respondents in Bradford County described a number of trends that geographers have elaborated as the globalization of rural regions, including multi-functional uses of agricultural lands, uneven demand for real estate, with migration drawn to the amenity appeal of rural landscapes as consumptive lifestyles (McCarthy 2007).

Some residents identified in-migration as the most important generational transformation in the area. This migration has taken two forms. In past decades the region has been the destination for an urban-rural migration of retirees from nearby places such as New Jersey who have gravitated toward the affordable real estate and standard of living. One resident described this migration of “Flatlanders” as a sort of

lifeline for the community. When the national recession hit the area in 2008, the regions was hit hard precisely because

we didn't have the influence of people from southeast PA, New Jersey. They have historically retired here, because it's cheaper to live here. Where their 401(k)s and all that tanked, we had no activity. So we were scrambling to stay alive for close to a year.

Another resident similarly positioned the regional effects of migration and the transformation of some parts to bedroom communities. Locating Towanda at the intersection of four regional centers, he described the historic pull of industrial development and jobs in these centers over the last generation. The cluster of high tech firms in Binghamton has been a particularly large center of employment for residents in the eastern part of the Endless Mountains, such as Susquehanna County.

The ascendance of this industrial cluster and associated in-migration coincided historically with a significant contraction of agricultural production. One landowner in the Eastern part of the region swept his hands over the hills, recalling the situation in Binghamton's heyday a few decades ago: "A lot of the farmers in some of these parts...were working at IBM night shift and then doing their farm work and trying to sleep sometime."

Elaborating on how these trends have affected parts of the rural region, he recollected: "The whole area used to be farmland, there was an active farm across the lake, and there were 20-30 dairy herds in the area. There may only be one milker now. I know there's one...There may be three."

Other respondents echoed such declining trends in smallholder farming associated particularly with the centralization of agriculture and the difficulties of

making small-scale agriculture work economically. These trends have been especially pronounced in ring regions around towns such as Towanda.

Identifying the social dimensions of peripherality was another common reference point among respondents. One person described Towanda as a town that was “neither here nor there,” explaining this idea by pointing out that it was equally far from the four major urban centers in the broader region: Binghamton, Williamsport, Scranton, and Elmira. In a similar othering of the place, one resident referred time and again to the geography and local politics and governance as simply “weird.” Another respondent described the dynamism of the circulation of gas workers as counterpoint to the static way of life that most were accustomed to.

But these people, they all are new. mostly Louisiana and Texas their boss was Cajun, he was a really nice guy, Chris. He was Cajun guy. But it is very interesting. Aside from the pipeline people, I live in this little town where nothing happens but I meet such interesting people.

Some residents elaborated on peripheralization with reference to longstanding class and ethnic divisions in the area, particularly stereotypes about “South Towanda Pools,” a derogatory label for a group of old families in the area that are routinely stigmatized with claims of incest, poverty, enclave tendencies, and more general ‘otherness’ (see Lasco (1987) for overview of this community division). For some, the very existence of this stereotyped, stigmatized, and mythologized group was used as a way to illustrate a way of thinking and way of life that marked the area as unique, backwards, or often in the context of their discussion with me, as vastly different than New York and uniquely underprepared for change associated with gas development. These class distinctions are reinforced by the distinction frequently made between lifelong residents of the area and the

“flatlanders” who have arrived in recent years. Two respondents referred to these class dynamics as part of their explanation of why it was difficult to gain consensus about how to manage a public response to gas developments.

Finally, in addition to perspectives on social marginalization and descriptions of the place as the volatile crossroads of agricultural and manufacturing transformations, respondents also identified in a variety of ways with a different type of economy—one with internal, cyclical dynamics and a rural way of life. The prominence of these observations is likely related in part to my foreignness as an interviewer. Invariably, interviews would turn to comments and questions about life in New York City, my trip up to the area, my impression of the landscape, or experience in the community. This lingering divide prompted many to offer sweeping and didactic contextual observations about the non-urban aspects of the region, the “old economy,” and their personal experiences of it.

Central to this vision was identification of the rural pastoral, which I consider as a landscape ideal, cultural way of life, and source of amenity benefits. Respondents described the rural pastoral in multiple intersecting ways. Some called to mind an orderly, quiet, and neighborly rural social-economic contract. Others spoke of a rural landscape as a moral “working” landscape of resource-based rural land uses, such as agriculture and forestry. In counterpoint, still others referred to the amenity appeal of the landscape as a chosen residential lifestyle. To give some sense of the importance of rurality for the residents in many towns, a survey of residents conducted in 2004 by Asylum Township asked what residents liked most about living in the township, and about 90% “liked it because it was rural, was a

quiet, uncluttered way of living.” In a list of potential transformations in the community, those associated with industrialization, particularly at the time agricultural industrialization, were seen as least welcome.

### *8.2.3. Rural pastoral and gas industrialization*

In this section, I build on the place descriptions and values that respondents expressed. These values and worldviews were a frame used by many respondents to give meaning to gas industrialization. For most respondents, the history and identity of Bradford County was that of a “working landscape” of rural industries such as forestry and agriculture. Landowners were accustomed to evaluating the way that different productive uses had economic, land, and ecological effects. Many landowners had considerable experience working and leasing their land for productive uses and managing associated systemic health, ecological, and physical risks of resource development.

Under some circumstances, fossil fuel extraction has been framed as culturally continuous with this range of resource uses. In western Pennsylvania, older forms of shallow fossil fuel extraction are ground into the historic experience of rural Pennsylvanians: “These old wells are like a herd of milk,” one producer said of his stripper wells. “You milk them every morning and get a pail of milk” (Miller 2000). It also was common during the early stages of the shale boom for actors to draw conceptual parallels between institutions designed to manage local land resources and mineral management. For example, speaking to Bradford County

landowners, a Penn State Cooperative Extension officer argued the process of mineral leasing was not all that different than leasing private land for forestry.

In local newspapers in the region, some conservationists contrasted this “working rural” idea of shallow gas production with the industrial process associated with deep shale production. Romancing this idea of pastoral gas is an op-ed in the Wilkes-Barre Times Leader from a self-described environmentalist:

In my travels, I have spent a lot of time in the western part of the state, where small gas and oil wells have been a regular feature of the landscape for many years. They generally sit on a small footprint, and appear to have little impact on their pastoral surroundings. I once encountered a venerable, but functioning gas/ oil well in the middle of a lush forest that had grown up around the installation.

While acknowledging that these stripper wells have had “some problems,” he argues in counterpoint to shallow production, shale development “isn't your grandfather's gas drilling” (Smith 2010). In line with this idea of a pastoral “working landscape,” many respondents in the Susquehanna core related broadly to the idea that gas industrialization would disrupt the character and identity of a rural “type of living.” One town official argued:

This is a rural area. That's why most of us are living here is because they like it here. And to destroy this type of living, which it is doing, little by little, 15 years from now it's going to be 15 time worse. And to me that's a problem...Once this is gone, once this roadbed's in, once this pipeline goes up through the mountain and takes a 300 ft. swathe right down through the timberline, that's never going to change. That's going to be done.

The idea that environmental disturbances are eroding the fabric of a “type of living” in what is “a rural area” and community economy was a common point of reference. The rural economy was a frequent counterpoint to urban and global economic dynamics represented by the situation of shale development.

We've always had a local economy and then there's the national economy. The local economy, no matter what the rest of the nation was doing, we kind of just, I have to use a hand gesture; we just coasted along. We had no high spikes, no low spikes; we've always just kind of meandered like this. Until the introduction of gas and oil.

Related to this was a set of anxieties that industrial changes were dislocating “locals” or a “local economy.” Across different sectors, residents were observing rising costs of housing, goods, services, trucking, and labor. Reflecting on the livelihood effects of shale development one person remarked

I mean the good part is that restaurants and hotels, motels, these people are booming now. The bad part is the locals are trying to compete with these people and the local people don't have the funds, you know. Our local person who's working isn't making 30, 40, 50 dollars an hour, but yet you're competing with people who are...

The perspective evokes a service sector variant of the Dutch Disease analysis. One woman worried about rates on accommodation that had “jumped two or three times above what they used to be,” arguing that “the influence of the gas company has just skyrocketed everything in cost here. The gas industry does not seem to have any limit on what they pay for stuff.” He expanded on the way this was putting pressure on long-time residents. At one trailer park he was familiar, “there are older people that have been there for years and years and now they are finding that their rents have gone about three or four times what they were.” Another person described the rise in displacement that this was causing: “People are being asked to leave, so they rere--landowners are renting them out to people who are going to pay for more and more rent.” Reports in the local paper were amplifying concerns about inflation and displacement among long-time residents.



It's starting to really show up. You know, you hear about it but it hasn't really become too much a problem but I did read in the paper a couple of weeks ago, that there are a couple of children in Bradford County that are in foster care only because the parents can't find a place to live.

There was increasing apprehension among many that these were omens of worse things to come. There are a "lot of the people who can't afford [rising prices]. It's going to get worse I think." This perspective was gaining traction in local communities, particularly those in ring towns that were the focus of more intensive industrialization associated with supporting the industry. "Everyone knows it. Chesapeake know it," remarked one woman of the housing pressures, echoing how taken for granted this perspective was.

Across respondents there were degrees of ambivalence about the gas industry's responsibilities for rural social and economic problems. Anger often was directed instead at community members who were seen as breaching their responsibility for maintaining the collective rural contract that was supposed to be the buffer against disturbances of the sorts created by gas development. Some situated these perspectives on social disruption in the context of collapsing rural social relations—the breakdown of trust and civility. One town official protested

[W]hen they started coming I was pretty much prepared for the way it was going to change the way we live and so on, but I wasn't prepared for the way it's changed the people, you know, the locals are, you know, some are downright unbearable at times.

The circulation of new money was seen as damaging the neighborliness and tight-

knit relations of rural community. Changing human behaviors were damaging families, neighbors, and communities. One landowner described the way that leasing decisions were transforming the identity of families: “Brother against brother, mother against son...Family business is family business—how they get along with each other, how they spend—has always been by each family. But when money comes into an area, it does change priorities. “

Of particular concern was the way that the idea of a property as a generational home for a family was becoming less valued. One landowner described the way families had shifted their thinking of properties as “a place for a potential home in the future, it is now future income.” She described increasingly seeing families consider ways to subdivide their properties to ensure that the properties were put to profitable uses.

These efforts were not welcome in many corners. Said one man about the trend to informally site campers, “Nobody wants a trailer park in their backyard. We have provisions for trailer parks and all that, if they're built accordingly. But that type of thing is going to certainly devalue all these properties down through here.” One resident described the growing neighborhood conflict arising from these sorts of decisions. “But the person who's doing this doesn't care about that. And this is a person that most of us have known for some time.”

Some expressed apprehension that these deteriorating community relations would only increase in time. One long-time resident worried: “[P]eople are getting greedy. You think they're stupid around here but they're greedy.” There was fear that greed was eroding a rural social contract within the community. One

landowner cast judgment on neighbors rushing to industrialize their properties and adapt their businesses by invoking a breach in the rural way of life: “And that's not the way rural people used to think...And the money has taken over what we used to think was common decency to your friends and neighbors.”

In ring towns, these perspectives were manifesting as a sweeping uneasiness about industrialization among managers and residents. One town employee described the situation.

There's a lot of industries that are support to the drilling industry—so people are subdivided into this and this and this, and renting or leasing to all these people. And the impact that some of these rentals have is not good for really the local area. Or we have a couple of pipe yards that are impacting, for example. The road where they're going in and out all the time—the road's covered with mud in the wet time and covered with dust in the dry times. But there's a lot of things like this and people don't seem to care that they're doing this as long as they can get these big bucks.

In sum, there was widespread concern about the capacity of individual, neighbor, and community relations to maintain the core functions and form of rural life.

### **8.3. Conflict and Politics of rural decline**

Anxieties about rural life in the context of gas-driven regional economic development intersected frequently with a broader set of anxieties and political sensitivities about the decline of small agriculture and rural preservation.

Discomforts with strategies to promote industrialization were creating conflict in some institutional settings. For example, particularly in ring towns, there was political sensitivity about the appearance of shifting development support from

policies supporting agricultural resilience to gas transformation. Such towns have tended to be the nexus of industry change historically. They have been in the crosshairs of expansion and decline cycles associated with the restructuring of agriculture and the transition to retail and manufacturing. Reflecting these circumstances, at the time of my research, North Towanda Township, a mixed-use town with a major artery running through it was pushing an effort to rezone its “Agricultural District” to “Agricultural Business District.” The township supervisor argued, “It doesn't make sense to continue to have most of the township zoned agricultural when there are no more dairy farms in the township” (Loewenstein 2011).

Reflecting many people’s discomfort with the decline of this economic pathway and apprehension that it perhaps was being exacerbated by the impact of the gas industry, the local paper came under fire for reporting on the range of gas industry uses that were in planning stages and conditional on such a change in designation. After local officials pushed back against this characterization, the paper subsequently printed a correction. In it, the town zoning officer argued defensively that while they were looking at some gas company uses, the proposal to change the Agricultural District to allow for commercial uses “was something that we were working on for years before the gas industry hit the county” (Loewenstein 2011).

Another anxiety frequently articulated was whether new money into the agricultural sector would help adapt the family farming industry or be a tipping point for its collapse. There was widespread apprehension about threshold effects on the agricultural sector, particularly in dairy. Many wondered if income would

cause farmers to simply retire their farms and herds. Incidentally, short-term evidence suggests a more complicated story. There is some evidence that bonus and royalty farm investments are generating an ancillary boom in the agricultural economy of Bradford County. Along a selection of metrics in the U.S. Census of Agriculture for 2012, agriculture during the year of the drilling boom appear more robust than in 2007 on the eve of the boom. There are increases in the total number of farms, acreage, and sales. The data suggests heavier declines in dairy, but trends are same decline as previous decades (U.S. Census of Agriculture 2012).

#### **8.4. Summary**

This chapter returns the study full circle to a discussion of pathways of development. In Texas, the development of shale was associated with an adaptation of a mature industry. In the Susquehanna core, the new trajectory of gas development intersected existing resource pathways that had little intersection with energy development historically. This chapter has discussed how that lack of contact has resulted in a contrasting visions of development and a growing politics of place and transition: What constitutes the right organization of developmental resilience? Is gas development a counterpart to existing rural resource economies, is it a transition away from it, or a threat.

In the last section, I highlighted a perspective emphasizing its threat. This storyline of rural “locality” identified with a strong place attachment to the rural landscape, community, and way of life that framed shale gas in the context of rural community disruption and economic decline. The circulation of money associated

with shale development was amplifying a slow moving rural crisis and increasing the risks of further peripheralization and rural breakdown. This perspective was marked by reluctant support recognizing the need to capture benefits locally, but an erosion of initial support in practice and growing disillusionment with the perceived social disruption of a rural way of life and relations associated with gas development. Prevailing themes included concerns about rural aesthetics, landscape and resource conservation, displacement associated with inflation, neighborly conflict, and the fragmenting of a rural social contract.

On the other hand, a “linkages” storyline and associated practices advocated for rural adaptability and transformation via invigorating pathways of gas industrialization, an argument made in part by downplaying social and public sector risks. The coalition imagined a future of shale gas business linkages. This was more or less risky for some businesses than others. Some business owners had spare capacity; they could comfortably absorb and lose new business without new risk. For them, forecasting the nature of exposure was not important. But for other businesses that were obliged to take on business risk through capital upgrades, the nature of exposure was important. The difference between success and going under depended on evaluating the magnitude and rate of change--whether production-related industrialization would increase, remain stable, or decrease and over what time period. Whether drilling and industrialization would go through an extended period of growth, a violent bust, or volatily “flicker” defined a binary of success or failure. For some of these business owners, the risks associated with uncertainty were suppressing their interest in expanding their business.



## CHAPTER 9: CONCLUSION

Over the coming decades, it is likely that many places around the United States and eventually around the world will be transformed by new efforts to produce unconventional energy. Before this development is fully underway, it is important to better evaluate how these technologies are grounded in the character of particular regions. This study set out to gain a foothold into the ways in which new unconventional energy projects and particular places are co-shaping one another. I have argued that this objective can be realized by engaging and deepening research around sociotechnical transitions and the community experience of resource development. There is much literature on both, though less that has sought to link the two (for one example, see Murphy and Smith 2013). The overarching research questions here are: *How are particular niche projects and regime dynamics shaped by local context. In turn how are local conditions shaped by energy projects? How do they co-evolve as socio-technical projects?* Better dialogue between transitions perspectives and place perspectives can help answer these questions.

In this dissertation, I examined these questions through a case study of shale gas development and transition in northeastern Pennsylvania, which is a new place of energy development that is only recently gaining research attention. A main objective of this dissertation was to address the need to better understand transitions in place through an investigation of interactions between shale energy



technologies and northeastern Pennsylvania as a region and place.

My attention to transition dynamics was an outgrowth of an original interest at the outset of this project in the local and regional experience of boom growth and the manifestations of this growth as “boomtown” impacts. It became clear early on in the project that the experience of a boomtown was connected to local experiences grounded in unique regional cultures, histories, and institutions. These contextual factors helped explain ways that each community experiencing shale development had different sensitivities to impacts and different portfolios of options to draw on in responding to the risk and benefit scenarios that are potential future outcomes. The literature on community experience of resource development lays out many of these, and it was my initial interest to study these in the place of a new resource region.

But it also was clear during pilot research that there is something unique about the form and conditions of shale energy development that is shared across many places. There are relations that fuse the physical character of a resource, the industrial organization of extraction, and the technologies used to access resources. These form a flexible assemblage of activity and practices—a socio-technical regime of practice—that can be transported from place to place and exerts top-down pressures on a place, shaping a common character to extraction from one place to another. It became clear that understanding the character of local development also required a better understanding of these dynamics and how they came into being.

In brief, analyzing both regime innovation histories and the local experience of development can add to our understanding of regional transitions. One part of

this argument is that a socio-technical transitions analysis can increase our understanding of the regional dynamics and community experience of energy development. It can sensitize an analysis to a fuller range of contextual factors (“landscape pressures” in the Multi-Level Perspective (Geels 2002)) that influence energy regimes. Socio-technical analysis can bring greater clarity to the relationship between niche projects in place and processes of regime transition, as well as the flip side of transitions—regime resistance, resilience and incumbency.

In the case of shale, a socio-technical analysis emphasizes the historical conditions and responses giving rise to shale extraction as a mode of production. Specifically, while there are many places around the world that enjoy large reserves of shale gas, only in the United States has a shale boom taken place. What is unique to the U.S. is the way that institutions, technologies, and industry organization have co-evolved into a rapid-acting, large-scale, well-resourced system of exploration and production that is resilient to shocks and adaptable over time. Access to cheap credit has made experimentation affordable even at high risks of failure.

The regime is uniquely adapted to institutional conditions such as private property mineral ownership and a liberalized natural gas market in which prices boom and bust. Among other adaptations in recent decades, “walking and talking” drilling technologies and an increasingly mobile and coordinated labor system have increased the velocity and itinerancy of drilling activity. Extraction practices ever more easily transcend the ‘stickiness’ of resources bound to immobile geologies. Industry actors use rapid migration strategies to navigate risk at different scales – moving locally to lock down territory, rotating regionally and nationally in response

to large shifts in the relative price spread between oil and natural gas. These attributes of extraction enable firms to thrive not only in spite of the way that prices boom and bust but because of the way they boom and bust. In these conditions, operators are able to maintain their edge by finding ways to rapidly roll out and roll back large drilling campaigns.

The socio-technical innovations literature offers an approach to describing this mode of production and analyzing its evolution as broad social, organizational, and technical changes over time. This helps to de-emphasize the narrow idea that the shale boom is related simply to fracking as a “disruptive” technology that destabilized a national regime. Taking insight from actor-network approaches, fracking does not operate in a vacuum. Fracking involves a whole assemblage of skilled and unskilled workers, technologies, geologies, gas infrastructure, markets, capital investments, land and mineral resources, and knowledge. Fracking as a form of extraction is operationally reliant on these networks connected to place.

This emphasis aligned well with the community experience of shale production described by respondents during fieldwork. People tended not speak of fracking per se. Reducing a common sentiment about the community experience of development, one respondent characterized the assemblage of technologies and people that make up to drilling rig as an “itinerant factory.” It was the mobility and velocity of the industry and the spatial flickering of industrial activity that was identified time and again by respondents. Consequently, shifting the analytical frame from an investigation of fracking to a socio-technical analysis of the itinerant factory highlights transition dynamics that match the dominant drivers of place

transformation experienced in northeastern Pennsylvania.

The concept of materiality in actor-network approaches is useful here for bridging socio-technical transitions analysis and an analysis of the community experience of resource development. The materiality of shale and shale gas does not just mean whether or not a resource is present or in what quantities, but also invokes the character and identity of the resource and the way it shapes relations among technological artifacts and people.

In Chapter 5, I described the materiality of shale using the idea of “temperamentality.” Shale is temperamental because it is inconsistent in its porosity and permeability, which poses challenges to exploration and recovery. Variations in its character over small areas define wide variations in well performance within production regions, which marks a complicated geography of commercial risk. Despite advances in fracking, among other technologies, this translated on the eve of Marcellus shale production into a variety of competing and unproven business models within the regime. Most prominent was a “manufacturing model” that placed the itinerant factory front and center in niche-regime dynamics.

A characteristic manifestation of the itinerant factory is what I referred to as spatial flickering. The concept adds to our understanding of the stages of energy development modeled in the energy development literature--in brief, the linear staging of pre-boom, boom, and post-boom. Spatial flickering describes the chaotic regional experience of divestiture, downturn, ramped up production, and re-boom that increasingly differentiates the experience of development as much by space as by time. Better understanding the velocity and mobility of the itinerant factory as a

strategy to put niche projects into place helps to make sense of this spatial dimension of shale development and how development can have contradictory tendencies toward boom and post-boom within small areas, even from town to town.

Plumbing the attributes of the itinerant factory—its velocity and itinerancy—also is a good entry point for considering other observations during fieldwork. For example, the mobility of the itinerant factory was drawn on heavily in policy storylines supporting regional regime stabilization. State actors in Pennsylvania have evoked the mobility of the industry as a justification for limiting the scope of government oversight and taxation on shale development. The situation of policy debates about levying a severance tax on shale gas was used as a case in this dissertation.

The previous paragraphs reviewed ways that socio-technical analysis can add to an analysis of the community experience of development. To pivot, co-shaping also implies influence in the other direction. Through its emphasis on place particularities and regional context, literature on the community experiences of energy development can help sensitize perspectives on socio-technical transitions. The concepts of place and region used in this literature are useful analytical entry points (Murphy and Smith 2013).

The literature emphasizes that development is a process that is negotiated locally. People may resist, accept, or seek to influence development, sometimes to greater or to lesser effect. An important lesson from the literature is that historically and culturally grounded notions of place infused into concepts such as “community”

or “rurality” often are powerful conceptual terrain through which people form the ideas and perspectives used to negotiate social consent or opposition to development projects.

The concept of “place” is taken to mean the experiences, feelings, and meanings that create attachment to the physical features and attributes of a landscape and way of life. The notion of storylines and institutional change (Hajer 1995) can be productively employed as the way to link how shared ideas of place can come to change regional institutions and practices. The prospects of change to a place implied by niche projects can generate narratives that are shot through with anger toward or desire for this change, sometimes generating forceful local politics.

Based on analysis from the case study, there are at least two ways that these observations about place can be usefully extended to research in regional energy transitions. First, it is useful to consider place formation as a process, and one that is both complex and contested. Even when a community might share values of place and the goal of preserving them, there can be multiple interpretations of how a resource development project will interface with existing processes of place formation, based on the uncertainties inherent to the development process. For example, prior to shale gas activity, there were pre-existing anxieties in Bradford County about ongoing stresses to rural place and a rural way of life. Therefore, shale was not seen as simply a disruption of something stable, but as a set of processes interpreted by some as exacerbating existing pressures and for others potentially acting as a *counter-disruption or counter-transformation* of place. For example, shale gas might help to preserve the character of the rural place and way of life by

injecting capital into struggling family farms, therein stalling one of the biggest drivers threatening to transform the rural character of place.

A second way that the emphasis on place in the energy peripheries literature can be usefully extended is to link it more specifically to the role of argumentation in socio-technical regime changes. Bosman's (2014) idea of "discourse regime destabilization" is useful here. The idea of "discourse regime destabilization" describes the way that niche discourses may create disruptions of locked-in sociotechnical imaginaries and potentially decrease their capacity to maintain the incumbency of regime. Alternatively, prominent incumbent actors in a system may discursively frame the dynamics of energy transition by unraveling and reframing existing and evolving storylines.

The presentation in Chapters 3 and 4 of the history of natural gas and the adaptation of regime technologies for shale illustrates a variety of ways that discourse is important to shaping transition dynamics. First, discourse about Southern dependency was key to building support for market liberalization. In turn, this institutional change pressured the regime to make the incremental adaptations that set the conditions for later niche shale experiments. Second, environmental discourse and security discourse were fused into a bridge coalition that was influential throughout the 1980s and 1990s in efforts to expand the natural gas system and make it more responsive, rapid, and efficient.

In some instances, the content of storylines may emphasize place attachments. A vibrant politics of place has been a prominent amplifier of shale gas storylines in New York and Pennsylvania. The moratorium in New York is a reminder that the

institutionalization of these storylines can have existential implications for a regional energy regime. In Pennsylvania, on the other hand, discourse in support of development has drawn on concepts of place to argue that the itinerant factory might support the erosion of rural landscapes. These ideas have aligned state and local actors and contributed to rapid spread of drilling, contributing to regime stabilization in place.

Importantly, these *place* dynamics can be represented in institutional arguments at multiple scales and may influence regime discourse operating in other energy regions. Increasingly, the place-specific niche storylines of anti-frack and abundance coalitions are chipping away at institutionalized “bridge fuel” storylines of the transition coalition. The bridge idea historically has been foundational to making sense of federal support for natural gas, and this sense-making project is currently under strain.

What follows from these observations in the previous paragraphs about processes of place formation and discourse is that it is important in analyses of energy transitions to consider the multiple and parallel processes of place that resource development intersects with and the way these are drawn into argumentation about transitions: Multiple stressors on place condition how people anchor their place attachments to the changes proposed by development. In contrast to simply accepting, opposing, or denying the transformations of place implied by development, people may believe and argue that one global change process may be transformed by another. Paying attention to the complex processes of double exposure (Leichenko and O’Brien 2008) and how these are given meaning



and emotional expression in arguments about energy technologies is an important way to think about the ways actors can draw on local and regional concepts to shape energy transitions.

Finally, I turn to the idea of “region” that is important to literature on local experiences of energy development. The concept of a region describes a social-spatial unit constructed by culture and institutions that has durability historically that extends beyond any one individual’s understanding of place. Things such as land ownership patterns, political cultures, structures of local government, resource practices, and institutions such as Farm Bureaus—all of these are forms of social organization that make a region’s unique character. Put another way, there are *territorial* path dependencies constituted by institutions, cultures, infrastructures, and resources in *place* (Coenen et al. 2012).

Niche energy projects may be introduced into a region that has developed over centuries. While a sociotechnical regime has a common identity and niches have standard models to guide them, these inherent characteristics of a region condition different niche-regime dynamics in practice in place. A geographically-sensitive analysis emphasizes that there is not one set of pressures on one regime, but that competing and sometimes contradictory pressures result in a multiplicity of “parallel regimes” in different regions (Murphy and Smith 2013).

For example, in Texas, the itinerant factory worked well initially, because it was incubated and assembled in the context of a mature regional oil and gas system with established institutions. The situation in the Susquehanna core is more akin to what Martin and Sunley (2006) refer to as industrial transplantation. Here

assembling an itinerant factory was much harder and required new knowledge, linkages, and institutional innovations.

In chapters on local government and landowner responses, I detailed the way the particular context of northeastern Pennsylvania as a region shaped these interactions and the variety of ways that new practices were emerging to fill voids in institutions and networks. For example, most of the land in the region is privately owned, as are the mineral rights. This regional characteristic positions private landowners and the private leasing process as defining agents in the transformation of the physical landscape, the character of regional gas development, and the community distribution of environmental risks. This gives a different character to niche-regime dynamics than in areas in the West where mineral rights and land are often publically owned. But leasing for modern drilling in northeastern Pennsylvania also introduced pressures to change how leasing was organized. Landowners groups were an innovation to address the fact that the existing system of land management not have the capacity to aggregate leases as quickly and efficiently as gas operators wished. This is one of many ways that attempts to put the “model” of the itinerant factory into practice meant negotiating ways to both adapt niche practices to local context as well transform local conditions.

More generally, the idea of parallel regimes has implications for how we think about regime transitions and also regime resistance, which is the “flip side” of transitions (Turnheim and Geels 2012). Transitions and resistance do not occur at any one socio-spatial unit such as the state. Focusing on history and geography can help understand the localized basis of regime transition or regime incumbency.

Concepts of place and region are good correctives here. How do regional developmental context, resource history, and resource materiality, among other things, give character to regional dynamics of regime resistance and transition?

Geels (2014) notes that regime resistance can take a variety of strategic forms: instrumental, discursive-framing, material, and broader institutional forms. A geographic perspective underscores that each of these forms of resistance are asserted at different times in place, distinguishing *regional* assemblages of transition and resistance. This study has highlighted the regional dimensions of many of these strategies at different points. For example, regional resource pressures triggered Mitchell Energy to experiment in new materials and technologies. And discourse coalitions in the northeastern state have been central to the strategies of destabilizing and stabilizing regional regimes.

All of the observations presented in this conclusion have implications for research on energy transitions, particularly those focused on transitions to low-carbon energy regimes. There are many shared contextual pressures on fossil fuel regimes, ranging from new policies associated with climate change to resource constraints. We are in an era in which fossil fuel regime actors are pushing hard to maintain their incumbency. One way to build regime resilience is to organize around new technologies and bring “niche projects” to scale within a regime. A significant effort in this regard over the last few decades has been to develop niche technologies and modes of industrial organization to lower the costs of and risks to drilling and exploiting previously uneconomic unconventional geologies for natural gas and oil. Shale is emblematic in this regard. The situation in northeastern

Pennsylvania can be conceived as one experimental setting for putting into practice niche projects. For those pursuing research on decarbonization and the transition to low carbon regimes, the insights from socio-technical analysis and resource development literature can offer a way to better analyze the geographic dimensions of regime resistance and regime incumbency and situate places like northeastern Pennsylvania front and center.

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## APPENDIX I

Perspectives of key informants on matters of concern for local decision-making  
about shale development

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### Industry Drivers and Process

- ➡ Fear of capital flight and taxation
- ➡ Long-term demand
- ➡ Lack of information on industry land strategies and drilling decisions
- ➡ Lack of information leasing

### Social

- ➡ Changed community ties
  - Leasing creates conflicts in families
  - Individual greed, neighborliness breaking down, rural community disorganization
  - Exacerbating existing social divisions, e.g. old-timers and seasonal residents
- ➡ Changing sense of place, home, and landscape
  - Changes are disrupting family relations
  - People are thinking more about income than home

- Marginal places are now becoming nicer
- Places we knew are changing and disappearing
- This is a pastoral area but now the rural landscape is disappearing
- Disproportionate impact on ring towns
- ➡ Tourism: Will it decrease or increase?
- ➡ Population growth
  - Uncertainties about growth
- ➡ Increase in crime
  - High risk behavior, drunkenness
  - Petty and violent crime increases
  - Burden on police department
- ➡ Housing
  - Home and rental inflation and displacement, evictions of lower paying renters
  - Hotels and RV sites booked
  - Impacts of new hotels and housing developments
- ➡ Traffic
  - Congested roads
  - Increase in traffic accidents
  - Localized growth in air pollution
- ➡ Public safety
  - Emergency preparedness for drilling safety incident
  - Enough emergency personnel

- Mapping drill sites for emergency response

## **Economic**

- ➔ Tracking direct, indirect, and induced multipliers
- ➔ New opportunities to contract support services: catering, refrigeration, accounting, legal, sanitation
- ➔ Opportunities to support drilling operations: welding, trucking, construction
- ➔ Regional growth through linkages between industry and local businesses
- ➔ Local businesses doing well - restaurants, hotels, gas stations
- ➔ Inflation and rising cost of living
- ➔ Increasing inequality between haves and have nots
- ➔ Leasing income – signing bonus and royalties
- ➔ Mineral income from gas keeping farmers afloat
- ➔ Vacant downtown office space and warehousing mostly leased
- ➔ Money leakage from community
- ➔ Concerns about general price inflation, e.g., CDL drivers are in short supply and increasing labor costs
- ➔ Business risk - How risky are expansions and investments to attract industry business?
- ➔ Farming industry
  - Farmers getting out of business
  - Decline in dairy farms
  - Agricultural land transitions

### ➡ Jobs

- Growth of new service jobs at existing businesses
- How to develop entrepreneurial opportunities
- Possible to train for drilling and industry jobs?
- Are workers always going to be imported? Just the nature of the industry?

### ➡ Dependency and overleveraging

## **Land and mineral**

### ➡ Mineral ownership and split estates

### ➡ Lease terms

- Bonus and royalty rates
- Primary terms, held by production status, and renewal
- Unitization and pooling—forced pooling? Pugh Clause
- Surface rights
  - Approval of access roads and well pads included?
  - Permitted structures
  - On-site storage or transport of waste?
  - Reclaiming land after drilling
  - Pipeline right of way included or not?

### ➡ Equity for landowners who signed early lease – unfair burdens of unanticipated scale of drilling

- Surface disruptions and surface leases

- Implications of drilling on conservation programs
- ➔ Informational biases - some landowners have better access to information
- ➔ Landowner groups - Some signed on to landowners groups, others did not
- ➔ Clean and Green designation
- ➔ Skewed property distribution
- ➔ Gap between larger landowners and existing income and land poor populations

### **Local Government and Planning**

- ➔ Internal workforce capacity
  - Increased workload to address zoning and building permitting, inspections of roads and rebuilding
  - New demands on time at local agencies mean increase in hours
  - Lack of expertise to address new mandates
  - Need to augment labor force to address workload
- ➔ Increased demand for local and county services including
  - Industry demand,
  - Immediate health and safety
  - Long-term education and other services.
  - Oversight and permitting
- ➔ Industry co-opting talented staff (police, conservation, economic development)
- ➔ Demand for new services – information,

- ➡ Jurisdictional limitations to addressing new problems
  - Nature of problems crosses jurisdictions and institutions
  - Authority being trumped by state executive
- ➡ Demands for institutional changes and new authorities
- ➡ Inadequate communication and coordination
  - Poor communication pathways within and among offices
- ➡ Access to industry
  - Citizens advisory committee
  - Landowners unable to contact companies
  - Maintaining relationships with gas companies
- ➡ State pre-empting county jurisdiction, e.g. conservation-relate permitting
- ➡ Taxation and relations of responsibility
  - Are local burdens compensated by local gains, i.e. economic development and increased property value
  - Who should pay for direct support to the industry--roads, oversight and permitting, etc.?
  - Severance tax vs. impact fee
  - Reallocation of funds in state oil and gas fund to service general state budget
- ➡ Lack of information about the industry
  - Where will drilling take place?
  - When will drill happen?



- ➡ Planning issues under-reported by public and not investigated
- ➡ Cultural opposition to zoning and local planning vision
- ➡ Local zoning and jurisdiction
  - Legal questions about authority of local zoning relative to state oil/gas law
    - Zoning to keep development out versus zoning to control where it takes place
    - If there is no pre-existing zoning framework, then can't zone
  - Scale of zoning
    - Some towns have zoning in place; others do not.
    - Countywide zoning versus town-by-town zoning
- ➡ Public and community infrastructure
  - Roads
    - Bonding, road degradation, control over repairs, road upgrades
    - New roads and rights of way,
    - Responsibility for future upkeep
  - Water, sewer for man camps and RV set-up

## **Environment and Health**

- ➡ Groundwater
  - Protecting well water
  - Physical protection
  - Legal protection through well testing

- Cost of pre-drilling well testing
  - Drilling
    - Gas migration pathways
    - Chemical additives in fracking fluids – water and health
    - Disposal of tailings –burying, exporting out of state, processing
    - Flow back processing and disposal and associated surface risks
    - Brine and radioactivity
    - Sewage treatment plants not adequate
  - Water withdrawal for hydraulic fracturing
    - Where is water being withdrawn?
    - How does permitting take place in different areas, different levels of oversight?
    - How is it being transported, who trucks it?
    - What is the water market? Business opportunities and appropriate role of public water supplies
  - Habitat conservation and fragmentation
  - Land use change
    - Forest fragmentation
    - Agricultural land conversion directly from drilling or indirectly from farmers transitioning away from farming
  - Air pollution
  - Surface impact of infrastructure such as pipelines and compressor stations
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