PLANNING FOR RESOURCE-RICH COMMUNITIES: LEARNING THROUGH COMPARISONS OF ENERGY BOOMS AND BUSTS IN THE AMERICAN WEST

A Thesis Presented to the Faculty of Architecture and Planning
COLUMBIA UNIVERSITY

In Partial Fulfillment of the Requirements for the Degree
Master of Science in Urban Planning

Callie New
May 2014

ACKNOWLEDGEMENTS

Thank you to Professor Stacey Sutton for guidance and encouragement throughout this thesis process, as well as to Professor Smita Srinivas for providing instrumental insight into the complex task of community planning through industrial development. Understanding the many nuances allowed the people within them to remain the core consideration. Thank you to all the planning agencies I interviewed, the information provided was essential to this work. I admire your efforts and look forward to future conversations.

To my family and friends near and far, thank you for always providing a perfect mix of amusement and diligence, astuteness and truth. Thank you, Cody, for providing a real perception into life in the industry, and for letting me look so deeply into your world. Mom, thanks for braving it with me on that trip to North Dakota in January and Reanna for always checking in. Thank you Dad for keeping me in the loop with newspaper articles I needed to read, again the reiteration that this issue, these communities, these people matter. This is a complex issue with many angles; there is no easy fix. I have truly enjoyed delving deeply into the topic to begin to understand.

ABSTRACT

Through investigating four resource-rich localities through case studies, this research first seeks to describe how short-term resource extraction projects yielded from technological innovations within the industry (i.e. conversion of uranium into nuclear energy, hydraulic fracturing, and horizontal drilling) have shaped the physical, economic and social landscapes throughout the cycle of boom and bust. Findings suggest that without efforts for long-term job creation, investments made in physical infrastructure, community facilities and housing are without purpose. Holding these realities in mind, the situation of present-day Pinedale, Wyoming and Watford City, North Dakota is explored, as these cases are representative of the newest wave of energy extraction due to the development of hydraulic fracturing. The research then seeks to answer under what condition do these resource-rich areas employ mitigation strategies?

The outcome of these strategies is evaluated in order to conceptualize how small boomtowns might follow a trajectory unlike predecessors. Understanding that diversification is the key these boomtowns' survival, this research lastly questions to which strategies and at which point in the cycle should public officials channel efforts? The final chapter seeks to make recommendations for how comparable resource-rich communities may begin to re-strategize local authority to ensure environmental protection. Economic development suggeestions are made to seek to retain key stakeholders within the oil and gas sector while leveraging the ability to use the industry to create efforts for the promotion of long-term community stability in this most recent energy landscape.

TABLE OF CONTENTS

I. Introduction 6
Boom and Bust Conceptual Framework 8
Methodology + Research Design 14

2. Examining the boom and bust in two mid-20th century historic mining towns.....18
Jeffrey City, WY.....18
Thermopolis, WY.....20
Matrix of findings.....23

3. Investigating fracking-led development in two present-day boomtowns.....24
Pinedale, WY.....25
Watford City, ND.....33
Findings: Lessons from Pinedale and Watford City.....38

4. Re-strategizing the energy landscape.....43
Short-term recommendations.....43
Long-term recommendations.....45
Conclusion.....49

References.....51
Appendix A: Examining unemployment rates in resource-rich states (a regression).....58
Appendix B: Sample interview questions.....61

INTRODUCTION

The United States, due to many interrelated issues, has witnessed a massive influx of increased domestic energy opportunities, resulting in a proliferation of oil and gas developers in specific regions of the country. The Obama Administration's "All of the Above" approach for energy production involves a three-part strategy that aims to develop domestic energy supplies, provide consumers with diverse energy sources and cost reductions and to create innovations for a renewable energy future. While the rhetoric initially focused on diversification of the United States' energy profile, the outcome that has emerged is a strategy to lessen reliance on foreign oil through increasing domestic energy sources, largely through the production of oil and gas.

Much of the nation's most recent production swell can be accredited to technological innovations in the industry that have led to hydraulic fracturing ("fracking") of shale rock, which allows hard-to-reach gas and oil to be more readily mined from crevices in the earth. Prior to fracking, tight geological formations prohibited oil and gas to be easily extracted; the new methodology uses water and pressure to open rock fissures and forces the oil and gas to the earth's surface. Multiple iterations of the process eventually empty the caverns holding oil and gas and yield previously unimagined production rates.

The increase is only expected to continue in upcoming years, as resource reserves are continuously found in many places unfamiliar to the oil and gas landscape. Through investigating four localities through case studies, this research first seeks to describe how short-term resource extraction projects yielded from technological innovations within the industry (i.e. conversion of uranium into nuclear energy, hydraulic fracturing, and horizontal drilling) have shaped the physical, economic and social landscapes of resource-rich towns throughout the cycle of boom and bust.

The first two historic cases reveal instances when the decline of the energy sector resulted in communities that did not maintain socioeconomic conditions that existed during the resource boom. The current state of these localities depicts what may occur if economic development planning is left solely to the whims of the extraction cycle. Findings suggest that without efforts for long-term job creation, investments made in physical infrastructure, community facilities and housing are without purpose. Holding these realities in mind, the situation of present-day Pinedale, Wyoming and Watford City, North Dakota is explored, as these cases are representative of the newest wave of energy extraction due to the development of hydraulic fracturing. The research then seeks to answer under what condition are mitigation strategies employed by these resource-rich areas?

The outcome of these strategies in Pinedale is evaluated first, as this small town has already undergone the rapid insertion and withdrawal of the industry and, in many ways,

is looking to maintain the economic vitality that occurred during the boom. By evaluating these past mitigation efforts currently, it is possible to understand the outcome of the strategies. Watford City is studied as a final case, in order to conceptualize how this small town (and others that are likely to occur in the near future) might follow a trajectory unlike its predecessors. Understanding that diversification is the key these boomtowns' survival, this research lastly questions to which strategies and at which point in the cycle should public officials channel efforts? The resulting recommendations aim to suggest how planners and public officials in these communities might fully utilize their leverage and begin to re-strategize economic development throughout all stages of mineral extraction.

CHAPTER 1: AN INTRODUCTION TO PRESENT-DAY NORTH DAKOTA AND BROADER BOOM AND BUST CONCEPTUAL FRAMEWORK

The United States' All of the Above strategy has led to the highest levels of crude oil extraction on American soils since 1997 and the largest amount of gas production in the last 30 years (Department of the Interior, 2013). More drastically, U.S. crude oil rigs in operation jumped from less than 300 in 2009 to 1,324 by 2012 (The White House, 2011). Through the fiscal year 2012 budget, the federal government encouraged oil and gas exploration and development through temporarily lessening the fee and royalty payments and expediting the processes for well approval (The White House, 2011).

In coordination with this policy, the resource-rich state of North Dakota has created a graduated royalty rate system, which lessens the initial royalty fee paid by well operators in the first years of exploration and production. The tax structure in North Dakota has urged developers to begin production immediately, thereby incentivizing growth within the extraction industry; the heavy domestic oil dependence as well as integration of natural gas into the national energy grid has helped procure this push. As oil and gas reserves exist in other places such as Alaska and Texas, the temporarily low royalty payment system in North Dakota has swayed industry actors to come to the area. The state, along with a handful of others, has fully seized the opportunity for energy-induced economic growth.

North Dakota has continuously been named the fastest growing state in the nation since 2011. Similarly to other boom eras in America's history, hundreds of eager workers have crowded rural North Dakotan towns with abundant, previously-untapped resource supplies that are relatively new to the industry. Annual crude oil production in the state has increased fivefold between 2007 and 2012 (U.S. Energy Information Administration, 2013). Per capita GDPs in the state topped 29 percent above the national average in 2012 (U.S. Energy Information Administration, 2013), a phenomenon that has far reaching implications for every aspect of the state's population and economy. While these numbers appear to be positive, evidence from past energy boomtowns present indications that despite this rapid economic growth, the potential for workers and associated revenue to leave these boomtowns as quickly as they came is conceivable.

Although workers are eager to come to the area, many of those working in North Dakota do not plan to stay. Because the resource extraction industry is relatively finite and the mining area is quite spread out in size, many oil field workers instead opt to stay in "man camps" (rows of inexpensive, transportable modular housing units and RVs), giving them the ability to change between fields if necessary. Workers generally don't stay in the area but rather travel back and forth, staying in temporary housing during their working days and returning home during their long spurts of days off. This has created a housing shortage in the area, with

residents reporting they can no longer pay the high rates created from the population influx (Davey, 2010). Rental rates for the same two-bedroom have risen from a mere $300 to $2000 a month (Oldham, 2012).

This housing situation has created a hectic situation for planners and community members alike. Although the state collects almost half of the revenue from the sale of federally owned oil well leases as well as over 12.5 percent of the royalties accrued from the well's production (Bureau of Land Management, 2013), local cities have expressed difficulty not only in managing growth, but also in funding it. The influx caused by the industry has created a large demand for building supporting infrastructure. However, asymmetric information and land use authority skewed toward the state rather than local public actors in North Dakota has created a lack of knowledge and therefore proper planning to prepare for how largely the boom would impact these small towns. Localities are still scrambling to provide necessary infrastructure such as the building stock, housing, public services and water, transit and electricity network needed to support the growing population.

This situation places associated towns in a difficult predicament. While pressure placed on local governments to keep abreast with demographic influx is strong, the question remains whether these cities should respond with rapid infrastructure development, all the while knowing that bust is imminent. Boom and bust towns have plagued American landscapes for years, shouldn't we know better by now? As Frickel and Freudenburg (1996) state, often regions find the "infrastructure to provide more burden than benefit." The rapid "busts" created by the oil and gas and linked industries is a sudden drop in state and local taxing jurisdictions, especially when the loans or bonds for infrastructure and development investments have not yet been paid, or when the maintenance payments for such building stock remain high but the government coffers are suddenly low. However by this point, governments have too much invested in the area to let these spaces become obsolete ghost towns.

Production incentives and subsequent rapid growth indicate that targeting for the oil and gas industry has occurred in this state. In this regard the outcome has been successful, marked by a large movement of energy stakeholders to the area. However, due to the large opportunity for employment and relatively high wages provided by the industry, the oil and gas boom has had a homogenizing effect on the economy; support services for mining have increased by 729 percent between 2002 and 2011 while both the manufacturing and information sectors have declined (U.S. Census Bureau, 2002 & 2011). Efforts toward creating long-term economic diversity are often pushed to the wayside as public officials grapple with the boom. With experts in the state predicting production to last only until year 2025 at the most, it is important to understand, therefore, under what conditions stakeholders can begin to plan and insist on diversification for the

long-term public good of the area.

The prospect of fracking is high in many places across the nation previously untouched by the oil and gas industry, creating a unique opportunity for responsible management and change within this newest domestic energy era. With proper mechanisms, the large public revenue gained can bring about learning capabilities and entrepreneurism that can be put back into productivity. There is clear opportunity to utilize fiscal and human resources from energy booms to craft an industrial policy that converts capabilities, skills and inputs of the oil and gas sector to create both economic and energy diversification and, ultimately, community resiliency.

WHY BOOM?

This chapter explores literature around natural resource management and seeks to understand public officials' motivations behind electing to allow natural resource extraction projects within their locality, as well as detailing evidence of the costly ramifications the industry's rapid boom and bust often imposes. The literature review and introductory archival data in North Dakota reveal that various economic changes occur in communities in terms of goods, services and labor needs and the influx of workers. Among these may be increases in public coffers, large public investments, changes in local labor skill development, a homogenization of the industry mix and, eventually, rapid exodus of the worker population.

Big push literature (Rosenstein-Rodan (1943, 1961) and Murphy et al. (1989) as cited by Sachs and Warner (1999)) infers that countries that are struggling economically need a "push" in order to expand their market. Any large expansion, whether a large government spending program, foreign aid or the discovery and extraction of natural resources constitutes as such a push. Sachs and Warner (1999) found that natural resource booms can "rival that of a typical public expenditure program." Such booms are defined as an increase in world price, or the discovery of new reserves or innovative extraction technologies that create resource removal in previously hard to reach areas.

The theory reasons demand must be defined in order to incentivize industrialization or entrepreneurism to occur within that locality, as firms must find future profits in order to incur the fixed costs of starting a new business. Resource pushes rival those of public expenditure programs as money doesn't have to be raised and then allocated by a government intervention, but rather wealth comes from an exogenous factor and is not specifically created (apart from the investment made in extracting it).

Big push reasoning suggests that post-boom incomes progress just as quickly as during the boom. Sachs and Warner (1999) conducted a study to measure to what extent resource booms serve as catalysts for development by investigating increasing returns to scale (IRS) in both the traded and non-traded sectors of an economy. The study identified

the year just before the ratio of primary exports to GDP rose significantly and also the year when the primary export ratio was approximately back to its pre-boom level. A positive natural resource boom is one in which resources are shifted to the non-traded sector (via consumer spending) and thereby ignite an energetic growth cycle.

Once the industry location has been approved (whether at the federal, state, local or private level) and the resource company has entered a community, direct economic effects generally include a rise in employment and wages, increased tax revenues due to outputs from the industry and an increase in locally purchased goods and services. The amount of the worker influx in a community can differ depending upon the technological [mis]match between supply capabilities of the locality and the demand requirements of the oil industry (McNicoll, 1984). When there is a large mismatch between the skills needed for the resource industry and those found within the locality, the result is larger community impacts. Oil companies are often prepared to hire local employees, but without an appropriate local knowledge base of the industry, have to bring workers into the region, resulting in a boomtown[07].

Larsen (2006) describes the rise in collective demand created by "resource receipts," from industry workers as the "spending effect." McNicoll (1984) describes employees' spending on local goods and services as induced effects, which, when purchased locally, creates excess demand on the economy. The spending effect has been seen in all four case studies discussed in this paper, which have gone through a period of rapid expansion of their economy in order to support the demands of the boom.

MUST ENERGY EXHAUSTION RESULT IN COMMUNITY BUST?

Due to distinctness in demands of the industry, the "factor movement effect" (Larsen, 2006) often ensues, which is characterized as a shift of capital and labor (factors of production) from other industries to those involved in resource extraction. Indirect effects are those such as locally purchased operating expenditures, which created a knock-on impact generated by increasing expenditure links. The increased local demand for goods and services may create a sort of false long-term demand, creating an appreciation of the domestic currency and a loss of total competitiveness in the economy as other, nonoil traded good sectors are reduced. This homogenization within the economy can eventually lead to the "spillover loss effect," or the loss of positive externalities normally generated from non-oil sectors, which are now being crowded out. Larsen describes the factor movement effect, spending effect and spillover effect as being complexly tied to the Dutch disease.

The Dutch disease theory focuses on the belief that resource abundance, particularly

---

01 Important to note, however, is that while a boom draws people from outside localities, a significant proportion of these wages may be paid to non-residents and are usually remitted out of the region (with the exception of some subsistence and entertainment expenditures).

booms, shift resources away from economic sectors that have positive externalities for growth. Studies have shown that countries rich in natural resources tend to have larger service sectors and smaller manufacturing sectors than resource-poor countries. Sachs and Warner (1995) have found that countries with high natural resource endowments have higher demands for non-traded goods (i.e. water, electricity, prepared food). Further, traded good sectors are concentrated on natural resources and therefore have smaller allocations of labor and capital in manufacturing. The authors acknowledge that economies that are weak in manufacturing is not necessarily a negative characteristic, unless the pull away from manufacturing is from a "special" good, and/or has implications for "backward and forward linkages" and "learning by doing" as discussed by Hirschmen (1958) and Matsuyama (1992), respectively. Timmer (1982) further concludes that agriculture is decreased by an increase in the energy industry.

Matsuyama (1992) discusses the loss of learning-by-doing from non-oil sectors (such as manufacturing as a negative externality imposed by natural resource booms. This theoretical framework sees the knowledge base that is required to work in manufacturing valuable to the economy as a whole, and one that can be carried over to individual firms thereby creating a strong, knowledge-based sector. The author sees forces (i.e. a boom) that shift labor away from manufacturing and into a resource-dominated economy (agriculture, in the case of the case studies explored in this paper) as a negative determinant in the economy and one that will eventually hamper growth, as knowledge is lost.

Sachs and Warner (1995) view this instance as one that is less relevant for oil production, as they see this sector as using very little labor and therefore does not directly steal laborers (and knowledge) from manufacturing. The recent boom explored in Pinedale and North Dakota, however, likely disproves this statement, as the oil and gas boom is drawing workers from not only other industries, but far reaching localities as well. This implies that there are an abundance of jobs that are tied to this energy sector, which, as Wood (2005), McNicoll (1984) and DeLong and Williamson (1994) discuss, have their own skills and knowledge base that are needed for employment. Knowledge-based assets are a set of skills that allows its owner to produce and distribute a product at or above prevailing market prices (Amsden, 2001). These assets must be nurtured in the industry as knowledge is tacit, protected, and firm-specific.

If the length of the resource extraction project is considerable, the hosting region (associated boomtowns) likely adapts and local people began to learn skills required of the industry or created linked industries. Frickle and Freudenburg (1996) begin with this assumption, stating that because adaptation is likely, the authors looked into the likeliness of a region becoming "overly adapted" to a given form of extraction (spillover loss effect, Larsen 2006). This

abundance can create a false sense of security ending in a decreased focus on growth-promoting strategies such as non-resource industry investments and high skill labor creation mechanisms. Through negating to diversify the economy while making large infrastructural investments, economies with resource abundance have a tendency to spoil wealth rather than managing it efficiently. This phenomena is also known as the "natural resource curse[08]" (Atkinson, 2003; Larsen, 2006; Papyrakis & Gerlaugh, 2006; Brunnschweiler, 2007; Deacon & Rode, 2012).

In states with both cities and resource-rich rural areas (referred to as "resource banks") the state is incentivized to earn money from royalties paid from extracting resources in the area (Tonts, et al., 2013). Several authors have discussed that because resource booms create excess revenue for the state, there are increased incentives for actors to rent seek rather than promote other, non-resource sector activities that generate growth (Tornell and Lane, 1994; Lane and Tornell, 1996; Karl, 1997). This is defined as individuals or coalitions attempting to take control of or use political or social resources to obtain wealth. The system provides a way for the public sector to capture windfall profits without the creation of a long-term wealth-generating activity (Krueger, 1973).

This has implications for the public sector, as efforts become skewed to keep the system going rather than on the generation of diverse economic activity (ibid). Particularly in areas where public actors are intricately involved in private business ventures, government efforts may become more focused on rent seeking. These actors thereby become less entrepreneurial as, rather than profit seeking to produce new wealth, rent seeking is merely obtaining a wealth-generating product, such as a resource. In this sense, the wheels are spinning for an explicitly consolidated yet finite industry. This is particularly problematic in natural resource extraction projects, as wealth is often accumulated for sole consumption by private, outside actors and not put to use for the common good within the locale.

In terms of public investments, Sachs and Warner (1995) have observed that resource-rich countries are often likely living beyond their means. During the boom, increased incomes afford an extraordinary consumption rate that simply cannot be withheld once the resource is depleted. A cross-country regression conducted by Sachs and Warner (1995) found resource-rich countries to have higher growth rates and higher income levels than resource-poor countries, however, these same countries portrayed a negative relation between natural resource intensity and post-boom growth. Rodriguez and Sachs (1999) conducted a study, in which they analyzed each country's annual growth rate between a span of years in relation to the locality's natural resource-based exports, as measured as a percentage of GDP. The authors found a connection between lower

02 The theory has largely been applied to developing countries such as Bolivia, Mexico and Venezuela (Sachs and Warner, 1999), however Papyrakis and Gerlaugh (2006) claim the resource curse is an equally common threat to developed nations.

growth rates and higher levels of income and claim that "resource-abundant economies grow more slowly precisely because they have an unsustainably high level of income" (278). This is due to political or economic distortions that affect the growth rate and ultimately pull the locality's income to below what it would have been had the economy not been dominated by natural resource extraction.

Hirschman (1958; as cited by Alacevich, 2006) reasons that project development will have a trickledown effect to have wider implications of development within the broader economy. This theory may be tied to path dependency, as if certain technologies, even if less efficient than rivaling products, are picked up by users they become further embedded within society (David, 1985).

The resulting infrastructure that was built to meet the needs of the boom is left without viable economic activity and therefore taxes to sustain the development due to a now homogenous industry mix. This situation is problematic when the booming industry has trickled to a bust, and the region is left with industries that are "linked" to nothing (Frickle & Freudenburg, 1996) as economic growth has focused on the extractive industry rather than representing diversified development. Often, many employees are forced to move to seek employment in other regions, leaving vacant building stock and public investments without purpose.

There is a fine line public officials must navigate in finding a balance of appropriate regulation and oversight at the industry and community level; institutions that work to maintain diversity shrink the ability of rent-seeking activity (Auty, 2006), while competition for rents due to a lack of regulation may induce innovation as entrepreneurs are incentivized to adopt new technology and anticipate market shifts (Krueger, 1974). However this latter point will only apply to firms that are committed to the locality. Foot loose firms have no incentive to stay in the area, but rather would move to the next profit-maximizing locality, thereby creating a community-wide bust.

METHODOLOGY + RESEARCH DESIGN

The purpose of this study is to examine four resource-rich localities that have gone through cycles of boom and bust in order to evaluate and compare the current boom situation fueled by hydraulic fracturing. Each location is reviewed in temporal order, concluding with Watford City, North Dakota, the primary case study of this report. The final chapter seeks to make recommendations for how comparable resource-rich communities may both retain key stakeholders within the energy sector while leveraging the ability to use the industry to create efforts for the promotion of long-term public good in this most recent oil and gas landscape.

RESEARCH DESIGN

The comparison is evaluated based on primary qualitative data generated from site visits and interviews with public officials,

namely those in city or county planning positions. Secondary data is yielded from archival research, which was collected prior to the interviews in order to obtain appropriate background knowledge in order to bridge connections between my research interests and the respondent's experience in a boomtown. By asking open ended, non-scripted questions, I allowed the respondent to narrate their stock of knowledge in a substantive and reflexive manner (Hostein & Gubrium, 1995). The respondent was prompted to provide accounts of events that occurred throughout the boom and bust cycle, as well as why the event occurred and their subjective view of the outcome.

These research tactics have limitations, however, as the interviews yield only one perspective. These limitations are acknowledged, and for this reason archival data was also used to illuminate the discourse around the topic from a multitude of actors. Additionally, in attempting to base the questions and evaluation with literature, it is possible I was searching to see evidence of the impacts described by other authors. While the site visits proved very useful to actually examine the impacts, my view does not come without biases. Nevertheless, I found these methods preferential, as I was able to bridge connections between cases that do not exist otherwise.

Through similarly exploring communities that have attempted to manage natural resource extraction projects and the impacts involved, I was able to gain evidence to support the literature surrounding both the potential economic gains as well as the large-scale issues that can arise in an economy that is heavily reliant on natural resources. These research methods were used in order to understand how the full cycle of boom-and-bust has materialized in four specific communities. By forming a unit of analysis at the community level, the planning strategies used to mitigate impacts serves as an opportunity to evaluate outcomes. Although the details described are specific to the context of each town, the topics discussed have been seen to apply ubiquitously across the most recent oil and gas landscape. Lessons learned from each of these small towns may serve as advisory to current boomtowns.

Based on the outcomes of the bust as described by literature around the topic, the research looked to investigate planning strategies with regard to housing, initiatives for economic diversity, programs for research and development, educational partnerships between industry and public institutions, and public expenditures on infrastructure. From these investigations, I have gained insight into the relationships of state economic and planning policies, resource extraction projects, infrastructural investments and population migrations to the development of resource abundant areas in the American west. The planning strategies are then evaluated in order to situate those that have been more and less successful based on infrastructure investments and type, capacity building (technical training, etc.), housing affordability mitigation efforts, firm-level community outreach and public-

level community development.

SITE SELECTION

This study analyzes Jeffrey City, Thermopolis and Pinedale, Wyoming as well as one current boomtown, Watford City, North Dakota. The localities were chosen due to similar characteristics of population size, demographic profile and political climate. Additionally, each has experienced one or more resource booms in the past and has the potential to continue mining into the future. According to news articles and interviews, these towns have experienced a rapid influx of mining workers, increased crime rates and fluctuations in the housing market. All have struggled to provide appropriate housing, water services and public safety and educational staff.

Jeffrey City and Thermopolis, Wyoming are two resource-rich towns that experienced dramatic growth during the 1970s and 80s but now are classified as depressed socially and economically. An understanding of a bust's "worst-case scenario" has developed through exploring literature around the topic, researching historic details and examining the current situation of these two towns. Pinedale, Wyoming was chosen as a third point of comparison. Current hydraulic fracturing tactics were refined in this small town in the early 2000s, which created a situation very similar to what is occurring in Watford City currently. The industry has since left Pinedale, allowing the planning strategies that were utilized during the boom to be evaluated.

This study then seeks to describe how Watford City, North Dakota is responding to the changes imposed by the resource boom and to compare these strategies against those that have been employed by similar localities. Watford City serves the purpose of a current day boomtown case study, as the oil and gas industry is still deeply emerged in this community and will continue to be for the next decade. Although the small town is following a trajectory very similar to that of its predecessors, it is not too late to implement planning strategies in order to both alleviate current pressures and plan for the emergence of a strong community that is not reliant on oil and gas revenue for survival.

Ultimately, an investigation into how these planning mechanisms are supporting localities against what Wood (1996) terms the "highly erratic" nature of taxation associated with extraction industries illuminated that in each case, there are impacts that still have not been mitigated due to communities using the same toolbox with regard to planning and natural resource management. It is at this point that it became evident these resource-rich should begin to re-strategize; academic reviews of planning tactics used in successful oil towns such as Stavanger, Norway and Aberdeen, Scotland provided non-domestic approaches to natural resource management, and perhaps a different lens from which to view these issues. The resulting recommendations aim to suggest how current and upcoming boomtowns might re-strategize in order to curb the inevitable bust.

CHAPTER 2: EXAMINING THE BOOM AND BUST IN TWO MID-20TH CENTURY HISTORIC MINING TOWNS

The following two historic case studies explored in this paper have failed to avoid the scenario depicted above. In an effort to understand the complexities of a bust or "worst case scenario," site visits, interviews and archival research were conducted in two localities within Wyoming to understand communities that went through a phase of rapid growth fueled by natural resource extraction. As of today, Jeffrey City and Thermopolis can unquestionably be characterized as being in the bust phase. The towns are located 110 miles from each other in central Wyoming; while the two landscapes differ in many regards physically, both illustrate how national policy played out at a local level and resulted in a setting that is depressed socially and economically.

Photo: Dilapidated buildings and infrastructure leave remains of the once booming uranium mine town.

JEFFREY CITY, WYOMING

The small town of Jeffrey City did not exist prior to 1957. Located in Central Wyoming, the area was once a landscape holding acres of sagebrush, antelope and deer range and one cattle ranch, the small town of Jeffrey City sprang up nearly overnight due to the opening of a uranium mine in 1957. This case study serves as the quintessence of a boomtown, as the township would not have been inhabited if it weren't for the uranium-rich ore found in the surrounding hills and the indispensable workers employed to extract the resource.

Jeffrey City is located along Highway 287, connecting northern Interstate 25 and 90 to southern East-West bound Interstate 80. Today Jeffrey City serves more or less as a stop for those passing by; the nearest inhabited towns are located 60 miles to the south and west. Evidence of a once booming town remains in a dilapidated hotel, gas station and school; thousand acre cattle ranches exist on the surrounding countryside. Yet it is hard to find human evidence save the one lone sheriff who makes the occasional traffic stop when people neglect to slow as they pass through the forgotten city.

Fundamental to the uranium mine's opening was the implementation of the Atomic Energy Act of 1946 under the supervision of the Atomic Energy Commission. The act sought to "control the production, ownership, and use of fissionable materials to assure the [nation's] common defense and security" (Nielson, 1966 as cited by Amundson, pp 485). Coupled with the act was national

17

procurement for all phases of mining, including subsidies for exploration efforts led by U.S. Geological Survey and eventual manufacturing capabilities for domestic nuclear energy, demand secured through government buy stations, a minimum price guarantee for ore, and a road building program to provide access to discovered deposits (Amundson, 1995).

Understanding the possibility of this domestic energy package was local restaurant owner Bob Adams, who, after struggling with securing financial backing in order to ensure worthiness for government subsidies for mining, hauling and processing of the ore, was eventually able to coordinate with another local, Dr. C. W. Jeffrey, who offered Adams $250,000 to begin construction. A contract was signed between Western Nuclear Corporation (owned and operated by Adams) and the AEC for the production of nearly 13 million pounds of uranium yellowcake[07] to last from 1957-1970[08]. Production was exceeding government demand and the federal procurement agreement was over by 1967. Suffering Western Nuclear eventually became a wholly owned subsidiary of Phelps-Dodge, who managed to keep the mine and small town running until uranium prices became profitable in the mid-1970s. As uranium became both desirable and accessible in the international free market due to the 1970s oil crisis and advancements in utility companies building more nuclear reactors, Western Nuclear/Phelps-Dodge negotiated contracts with buyers. Jeffrey City officially boomed in 1975 (Amundson, 1995).

Community impacts of the boom and bust:

The small town that emerged was not a typical boomtown; the informally federally regulated mining camp was owned and operated by a single company, essentially representing a monopsony. Federal contracts guaranteed the demand, so long as Western Nuclear/Phelps-Dodge, the only player in the industry, provided the supply. Localization economies which would allow many firms to support the single industry did not occur. Both the mine and nascent Jeffrey City were initially financed by Adams, who was obliged to provide worker housing under contract with the AEC.

Modular homes were brought in, showing echoes of “plug-in” architecture developed as by Archigram in the 1960s (Martin, 2014). Along with housing, the company built a swimming pool, community church and school building to accommodate the growing population. Families eventually accompanied workers who migrated for the high wages and potential for promotion. Jeffrey City eventually grew from a post office serving a mere 15 people to a functioning community of 4,000. Post-1975 boom, a medical clinic, library, bank, beauty shop, bowling alley, Little League baseball and Boy Scouts organizations, a hardware store, several fraternal organizations, retail stores

03 A stable uranium concentrate powder that must be processed (BLM, 2014).

08 There were several changes in the contract made within this timespan; for further discussion please see Amundson, 1995.

and seven more churches were all developed in the thriving town. In 1977, the small community had its news published in the first edition of Jeffrey City News (Lockhart, 1977 as cited by Amundson, pp 497).

Because Jeffrey City had hardly diversified beyond uranium dependency, innate in the town's survival was a steady resource base and market. In 1982, energy conservation efforts at a national level, environmental scares such as the Three Mile Island accident in 1979, and national orders for utility companies to cease the production of nuclear plants accumulated and resulted in a flood of stockpiled yellowcake into the market. This essentially busted uranium production in Jeffrey City overnight. Anticipating the bust, in June of 1981 the school board terminated 11 teaching contracts in the newly constructed "state of the art" school and local businesses reported losses of 60 percent. Just one year prior marked the peak of production with a worker count of 554; by 1982 it was down to 47 (Menser, 1981 as cited by Amundson, pp 449). With the closing of the town's single industry, no matter the large investments in community facilities and infrastructure, people simply packed up and left.

THERMOPOLIS, WYOMING

Thermopolis, located in central Hot Springs County, is a small town of approximately 3000 residents. County leaders define the economy in four main categories in order from greatest to least importance: oil and gas, coal, dinosaur bones and thermal hot springs (Hot Springs County Board of County Commissioners, 2005). This makeup provides a unique case study for the impact of oil and gas in a seemingly diverse and atypical economic setting.

Oil and gas production has occurred in the area since the first discovery in the nearby seven-mile long asymmetrical "dome" in the Big Horn Basin in 1918. The majority of production has occurred on large expanses of federally managed land in the area. The availability of the land provided relatively inexpensive drilling operations in comparison to profits received; to lease BLM land, oil producers pay an administrative fee of $75 per lease, plus the first year's rent of $1.50 per acre and $2 per acre for any additional year. The operator must also post a bond for $10,000 to ensure compliance with the terms of the lease and to cover reclamation should the operation bankrupt. Experience has shown, however, that reclamation expenses greatly exceed this amount, sometimes requiring upwards of $1 million to recover the landscape to its pre-production condition (Environmental Working Group). Operating on federally managed lands allows for subsidized, inexpensive mineral production.

The height of Thermopolis's boom occurred from the 1960s to mid-80s, when the town was described as a "real going town" (Kidston, 2011); the population reached 6000 people and several shops, including a JC Penney's, Montgomery Ward and Sears, all located in the town, a rarity in similar rural landscapes. Along with oil and gas production, the boom

19

can largely be accredited to two oil refineries, Reda Pump and Empire Oil, which offered many high-wage jobs that didn't require education beyond high school (Kobza, 2014). The town's population and economy have slowly diminished with the closure of both in the 1980s (Kidston, 2011).

Similar to private investments in public facilities that were seen in Jeffrey City, oil companies were instrumental in Thermopolis. The construction of the county's airport in the 1950s (Kidston, 2012), a "second to none" school building (Kobza, 2014) and several community fundraising events (Spring, 2014) all occurred with philanthropic donations and/or tax revenues from the oil industry. In the 1980s, Hot Springs School District was one of the wealthiest in the state[09]. Currently, the newly constructed school building remains largely unfilled, with the school wings converted to hold entire grade levels rather than the school subjects as originally intended (Breining, 2014). It is extremely hard to sell residential real estate with a lack of new people entering the area. Shopfronts are dark and desolate, portraying "for sale" signs and a patchwork of newspapers cover the windows in the large business park that was planned and built, yet never able to come to fruition before the bust set in (Kidston, 2011; Breining, 2014).

Impacts to education were and remain

Photo: Broken windows and vacant buildings stand in the downtown business district.

especially hard hit. Thermopolis today has a significantly high number of at risk students and cases of education neglect, as well as a high percentage of students receiving free and 50 percent reduced lunches compared to other school districts (Kobza, 2014; Spring, 2014). The elementary and middle school's past principal accredits cases of education neglect (that is, parents not getting their children to school upon which local law mandates and supervises attendance) with a lack of value for education in general, as many of the remaining population were able to obtain high paying jobs without seeking post-high school training (Spring, 2014). Today, a lack of higher education limits employment opportunities for many long-term residents; a feeling of "the has versus the has nots" (Spring, 2014) remains in the depressed area.

Budget-wise, however, the school district is stable and able to allocate $16,000 per student annually (Kobza, 2014). Although teaching positions pay competitive wages, it has been hard for the district to retain educators due to the hard culture (ibid). After the oil companies pulled out and left little remaining jobs, local discontent for the

05 Prior to 2006, each locality retained natural resource royalties for the education system; the state tax structure for education has since been adjusted to create equalized wealth in school districts between resource-rich (recapture districts) and resource-poor areas (subsidized districts) (Kobza, 2014).

government and “outsiders” is prevalent.

Archival research has revealed that desperation for the industry to fully come back is strong. News articles urge locals to organize and provide input to BLM to allow fracking to occur in their soon-to-be updated Range Management Plan, and County Commissioners state that oil and gas revenue still accounts for the majority of their revenue base, although these numbers have drastically declined since the 1980s. The county even supports the reduction of State lease royalty to be decreased from 16.67 to 12.5 percent in order to incentivize fracking in the area (here termed “stripper production,” as the wells would be reworked until stripped (emptied) completely) (Hot Springs County Board of County Commissioners, 2005). Despite the opportunity for research, economic diversification and investment due to the plethora of geologic anomalies, agricultural presence, large mineral pools and countless outdoor recreational amenities, the oil and gas industry is still completely embedded in the culture and seen as the only resort for economic growth.

Findings

The following matrix (Figure 1) was created in an effort to evaluate the two towns’ planning mechanisms, based on infrastructure investments and type, capacity building (technical training, etc.), housing affordability mitigation efforts, firm-level community outreach and public-level community development.

Mirrored in both case studies are large public investments in infrastructure, housing and community facilities such as schools, hospitals and recreation centers. Similarly, each locality that has had withdrawal of the natural resource industry has dealt with a collapse in some aspect of the economy due to a large exodus of the population. In the case of Jeffrey City, the once-thriving community is now a ghost town. These case studies illuminate that efforts at the city level deal with the influx of people and mitigate short-term impacts incurred by the boom. However when little is done in terms of economic diversification to give a reason for the working population to remain, the long-term outcome may result in a community-wide bust.

Present day boomtowns in Wyoming and North Dakota should look to the outcome of the planning mechanisms that were used in these towns in order to more properly anticipate the predestined withdrawal of the oil and gas industry.

21

Locality	Infrastructure investment	Capacity building	Economic diversity efforts	Housing and real estate stability	Firm-level community outreach	Public-level community development
Jeffrey City	(Boom) High – funded by mining project developer, as obligated by Federal Atomic Energy Commission. (Bust) Low - Community facilities currently stand vacant.	(Boom) Moderate – skill development only for uranium mining occurred, few linkages or spillovers; no college or vocational school in area	(Boom) Moderate – basic restaurants and shops opened, but no high-wage jobs created outside mining industry. Resulted in massive exodus of population upon mine's closure.	(Boom) High – Modular housing commissioned by project developer and rented at stable, affordable price. (Bust) Low - Housing stock moved to nearby town upon mine's closure.	(Boom) High - Entire community financed by project developer.	(Boom) Moderate - Federal agency required housing and infrastructure to be built by project developer; took little initiatve for public efforts.
Thermopolis	(Boom) High – airport (partially funded by oil financier), hospital and school building constructed during boom phase. (Bust) Public revenues remain high to maintain investments.	(Boom) Moderate – jobs did not require education beyond high school therefore local residents were given increased work opportunities and obtained necessary training. (Bust) Moderate - College or vocational school 30 miles away; outside actors come for archeological research	(Boom) Moderate – basic restaurants and shops opened, but no moderate or high-wage jobs created outside mining industry. Little push or incentive from public sector for tech transfer, linkages, spillovers, etc. (Bust) Moderate - shops and services struggle to stay afloat; new recreation outfitters recently emerged.	(Boom) High - several national chain stores were drawn to the area due to relatively high economic activity. (Bust) Low – currently several foreclosures and vacant Economic Zone.	(Boom) High - several fundraising and philanthopic events created with philantrhopic donations from the oil industry. (Bust) Low - non existent due to lack of industry's presence.	(Boom + Bust) High - increased tax coffers afford well payed educators and programs. Retaining teachers is difficult, however, due to high rates of parental neglect and a perceived negative view toward education.

Figure 1:
Matrix of findings

CHAPTER 3: INVESTIGATING FRACKING-LED DEVELOPMENT IN TWO PRESENT-DAY BOOMTOWNS

The following two case studies explore two boomtowns that have arisen from the "All of the Above" domestic energy strategy. Advocates of this strategy, and specifically those who focus on natural gas, tout the economic benefits of hydraulic fracturing. Natural gas has recently gained tremendous enthusiasm, as many within the industry classify natural gas as a "green fossil fuel." The gas provides comparable electricity to its counterpart coal, but releases lower levels of methane and carbon dioxide as it burns. In some views, this overshadows the adverse environmental effects of the mining practice itself and ability to lessen reliance on international resources. Due to the vast reserves of shale gas within several areas of the United States, natural gas has been lauded in patriotic discourse for its potential to provide national energy independence.

In advocating for developing natural gas extraction projects, public officials may look to the potential of shale gas to attract capital and operating investment and support up thousands of jobs (Hillier & Comfort, 2013). Past experience has shown that mining can bring increased employment opportunities[07] increases in government coffers for royalty generation, low domestic energy prices due to increased supply. Further, cities that are struggling financially may be incentivized with the promise that spending by employees of the industry would increase local spending in non-tradable sectors, such as restaurants, shops, pubs, theatres and hotels. These factors have contributed to the following localities allowing and even incentivizing natural resource extraction projects to enter their jurisdictions.

Pinedale, Wyoming is studied as it represents a phase of "post-boom" in this investigation. The characterization of "post-boom" is used because currently initial drilling, the most labor intensive phase of gas production, has momentarily subsided. Gas firms have entered the production phase of drilling, resulting in fewer employees needed on-site. As the population influx has slowed, the town's infrastructure and building stock are no longer overextending capacity. This phase also provides an opportunity to evaluate the planning efforts that occurred both during the boom and currently, in order to evaluate whether the community is using the same planning toolbox that has been used in prior eras of natural resource development.

---

06 To test the validity of claims that socioeconomic gains are created through the industry during the most recent oil and gas boom, I tested whether there was a significant relationship between unemployment rates and states that have taken advantage of hydraulic fracturing since its deregulation in 2005, compared to states that do not frack. I examine all states within the United States. The test reveals that the average unemployment rate for states that did not have hydraulic fracturing projects in 2010 was 11.17 percent, while states that hosted hydraulic fracturing resource extraction projects in 2010 had an unemployment rate that was 1.08 percent less than those that do not, holding educational attainment, welfare spending and proportion of the population's low wage earners constant. This variable is statistically significant at a 90 percent confidence level (see Appendix A for step-by-step method of regression output).

The second boomtown examined in this chapter, Watford City, North Dakota, is, perhaps undergoing the most extreme resource boom in the nation's recent history. Once a small agricultural community in northwestern North Dakota, Watford City has transformed into the mecca of oil and gas practically overnight. In terms of impacts, both the issues and mitigation methods used in Watford City at this time are extremely similar to those that occurred in Pinedale at the height of the boom in 2008.

PINEDALE, WYOMING

In addition to archival research and site visits, interviews were conducted with City Planner Kate Dahl and County Planner Bart Myers in order to understand the context of oil and gas within this small community.
Background

Sublette County, Wyoming (approximately 10,000 people), is a large mountainous area veined by the upper Green River and located south of Grand Teton National Park between the western side of the Wind River Mountains and the eastern portion of the Wyoming Range. Located within Sublette County is the small town of Pinedale, populated by approximately 2,000 year-round local residents. Aside from traditionally being a cattle ranching community, residents also provide seasonal tourist amenities as people come en route to Yellowstone and Grand Teton National Parks to enjoy the serene natural environment and characteristics inherent in the quiet "cow town." Although there is a permanent population, Sublette County has the highest second home rate (25 percent) in Wyoming, with a large supply of seasonal cabins (Dahl, personal interview).

The surface and mineral ownership of the county is predominantly public, with the National Forest Service, Fish and Wildlife, the Bureau of Land Management or the State of Wyoming managing approximately 80 percent of the land. The Jonah Field and Pinedale Anticline, located approximately 35 miles south of Pinedale, are two large tracts of land containing an estimated 10.5 trillion and 40 trillion cubic feet of natural gas, respectively. Oil mining attempts occurred in both fields in various points of the early to mid-1900s, but were unsuccessful due to the tight geological formation making it difficult to access large quantities of the resource.

The Bureau of Land Management manages 98 percent of the Jonah Field's 21,000 acres and 80 percent of the Pinedale Anticline's 197,345 acres. The remaining land is owned by either the State of Wyoming or privately. This is an important component in terms of the work of the gas industry in this region, as, opposed to what is occurring in North Dakota, national regulatory bodies rather than private property owners are able to negotiate large-scale drilling approvals as well as mitigation for environmental and community impacts.

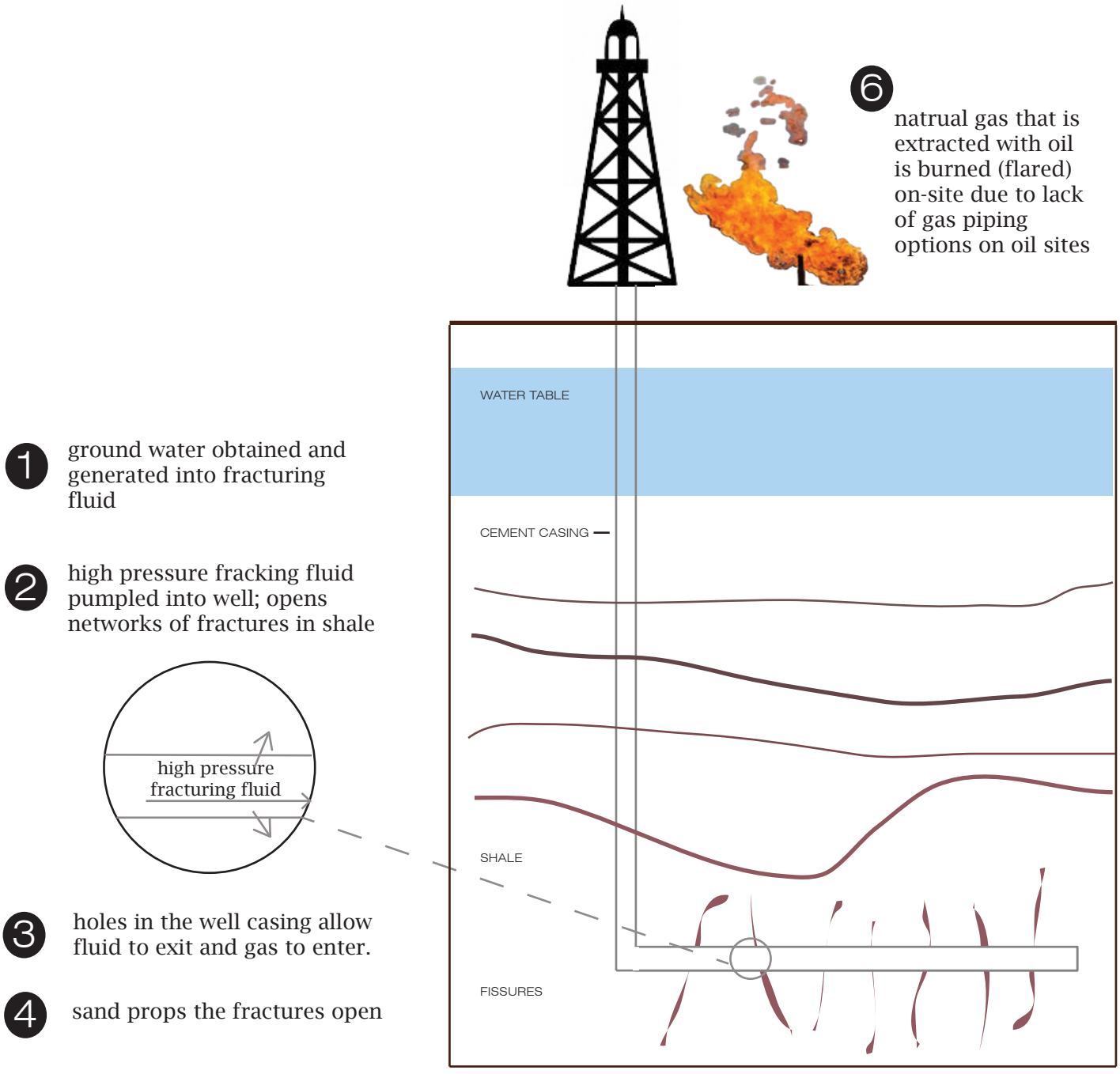
The rediscovery of gas in the Jonah Field and Pinedale Anticline resulted in Pinedale absorbing one of the first major natural

gas booms in the nation in the late 1990s and early 2000s. The boom occurred due to investments both in the private and public sector as well as innovations in the industry. In 1991, three men of the McMurry Oil Company, ignoring the doubt of naysayers, saw a prospect for natural gas investments due to pollution-control laws creating changes in domestic electricity demands for "clean fuel" as opposed to toxin emitting coal. After exploring prospects in Canada, Nebraska and Kansas the small oil company purchased mineral leases for 25,000 acres for the operation of three wells on of BLM land in the Jonah Field (Noble, 2009). One year later, The Kern River Pipeline, a 926-mile public/private investment, was constructed by private companies, the Williams Companies, Inc. and Tenneco Gas Company, and extended from Opal, Wyoming (40 miles south of the Jonah Field) to the San Joaquin Valley in California (Noble, 2009). The infrastructure was built with financial support from state legislature and political backing from Wyoming Governor Mike Sullivan. An abandoned pipeline in the Jonah field would connect new production to the Kern River Pipeline, thus opening up access for supply to meet substantial demand; the McMurry Oil Company began gas research and development.

Because of previous failed attempts in these fields, the McMurry Oil Company knew drilling innovation needed to occur in order to crack or break down the tight sandstone and therefore release and ease the flow of gas. The company hired the gas consultants and petroleum engineers to advance the drilling system. Hydraulic fracturing has been experimented with since the early 1900s, but in September 1992, initial production was recorded in the Jonah Field as two million cubic feet per day (Noble, 2009); a report that gave news of refined technique now commonly called "fracking" (see Figure 2) and the first trace of a technology that would irreversibly change this small town as well as the broader domestic energy landscape.

Pinedale is a unique point of comparison for this study. Although the small town grappled quite seriously with major changes to the social, physical and economic structure of the locality from a major influx of transient workers, the community has also emerged with a new set of tools with which to develop. Specifically, Pinedale now has significantly larger public budget, several new community facilities, a physically revitalized downtown, a rising art scene, and a bundle of functioning non-profit organizations and small local businesses. Pinedale's residential market, however, did not fare as well post-boom, as the community now suffers from a slump in home values subsequent to the slow of gas production. After describing impacts to the area's community feel, residential market and the local economy, the following paragraphs will illustrate how Pinedale has leveraged substantial payoff from gas companies. Considerations as to whether the reinvestments are suitable to maintain economic and residential vitality are discussed.

Figure 2:
Hydraulic fracturing process



Source: author

Community impacts of the boom and bust[07]:

There were several years of coordination and environmental analysis involved between the gas operators and the Bureau of Land Management in preparation for the drilling of upwards of 900 wells (BLM, 2000). As the gas development projects progressed in the Jonah Field and Pinedale Anticline, the Bureau of Land Management is mandated from the National Environmental Policy Act to conduct public scoping. Public feedback was prominent. A public outreach committee was formed, the Pinedale Anticline Working Group (PAWG), which was chartered under the Federal Advisory Committee Act with the intention to gather people from many different specialties (socioeconomic, water, etc.) to look at the issues of fracking and strains on the community. The findings were to be generated into recommendations for BLM to take to mitigate impacts. Among these, were concerns over air quality and wildlife habitat, specifically mule deer and the Greater Sage-Grouse, as well for as strains on infrastructure. Because the drilling technique was so new, residents pled for the well approvals to slow down until they were better able to properly gauge impacts (Gilman, 2012).

Unfortunately, many of the recommendations weren't acknowledged or implemented (Gilman, 2012), leaving people disenfranchised with the public process in general (Dahl, personal interview). Further, there was little coordination between BLM and the city of Pinedale to prepare for the worker influx. Socioeconomic impacts were not a part of impact analysis. Although the gas companies had warned what amount of workers to expect, diligent attention was not paid or communicated through appropriate avenues (Myers, personal interview).

The town of Pinedale was therefore not prepared to handle the influx of workers. Because Pinedale was set up to accommodate tourism there was a small stock of seasonal cabins and hotels available for the transient workers. However this supply quickly ran short, resulting in inflationary prices in the housing market. Workers were paying $1700 to $2500 per month for two bedroom dwelling units (Huntington, 2007). Many housing units of this size were shared between five to seven workers throughout their days on/days off work schedule (Dahl, personal interview). The high demand and resulting inflated prices also carried over to local businesses. Cattle ranchers, one of the fundamental occupations in the area, were labor starved as they couldn't compete with the high wages paid by the oil industry that was needed to hire hands. Hiring mechanics for machinery upkeep was also an issue, as $50 for an hour service now cost $200 (Noble, 2013). Necessary salary workers such as teachers and those with government positions had difficulty in paying inflated rents induced by the boom.

One subdivision, the Barger Subdivision, was developed in the late 1970s and was

07 Bust is used in this sense not to portray a complete loss, as Pinedale is far from in a "bust." In fact, population levels are still well above pre-boom counts. The term is used, rather, to exemplify that the boom has subsided and the gas operations are no longer such a prevalent component of the community.

intended to be developed for summer homes. There was one well and a two-track road serving 700 one acre lots. Public input at city council meetings urged the approval of building permits in this subdivision (Myers, 2014) to ease with the crowded and unfavorable housing conditions. The empty subdivided lots absorbed the majority of the influx and were quickly filled with RVs and modular housing units. A lack of building codes allowed for quick and easy settlements (Dahl, 2014). Hotels were transformed for "extended stay" visitors, as oil companies would call and rent every room in the hotel for the next three years (Conan, 2013). This essentially shut down the tourism industry as vacationers were unlikely to pay inflated lodging rates to stay in worker-filled hotels (Dahl, 2014).

Quick tenant turnover as well as crowded living conditions was creating unfavorable attitudes from local residents toward the gas workers. The majority of the workers didn't have personal ties to the community as they were traveling to the area for work and then returning to their permanent homes during their days off. The workers therefore had less motivation to care about the town of Pinedale, resulting in issues such as increased crime, alcohol-induced debauchery and acting with less respect for the temporary residences (Noble, as cited by Woodard, 2011).

As tension increased, the primary gas company, Encana Corporation, leased and operated approximately 98 percent of the field. They understood the influx of workers was creating strains with the local community. Under pressure from local residents and the local mayor, Encana provided a privately operated man camp near the field (Dahl, personal interview). Both the city and county planner felt the man camps were successful in both removing traffic and crime impacts within town and relieving artificial inflation of the housing market. However, the move also had an impact in terms of local spending as the workers traveled into town less for daily purchases (Dahl and Myers, personal interviews).

Examining planning strategies

The man camp housing units created flexibility, as they were able to be tore down once no longer needed and moved to the next oil and gas location. However water and sewage infrastructure was not present in these locations, resulting in many potable and black water discharge trips, creating a living settlement that is far from self-sufficient as well as one that greatly contributes to road wear and tear and increased vehicle emissions. Further, while threats of crime were removed from the view of the general population, the incidents did not disappear. The man camps represent a difficult trade-off between alleviating burdens for the public, while aiding to the transient nature (and potential for rapid worker exodus) the industry inevitably cultivates.

As production slowed in the Pinedale Anticline and Jonah Fields, workers did leave the area, creating a huge slump in the housing market and many foreclosures

in the Barger Subdivision (Dahl, personal interview). In the county planner's view, the rapid approval of building permits created an eventual bust. According to Bart Myers:

> "I don't think affordable housing was ever our issue because [Pinedale has] always been an expensive place to live. What we did was create too much that supply out-paced demand and it has affected everyone's home prices. I moved here at the peak in 2006 and my house is now worth a third of what it was worth when I bought it 8 years ago. I think that is a direct result that we maybe could have done a better job of – not overreacting and approving every permit that came through the pipe."

One of these permits was for a 200 acre subdivision on the outskirts of town, which was accompanied with a new elementary school. The intention was to have the school be located near the city's new growth. The result is a new elementary school in the middle of nowhere with no surrounding neighborhood, as the subdivision project went under when developers fell $0.5 million short of completion (Dahl, personal interview).

Several restaurants and retail shops also developed in response to the boom, but now, after growing accustomed to a bustling consumer base, the businesses are struggling with how to maintain their revenue flow. The local planning office understands that economic diversification is necessary (Dahl, personal interview). However, creating true economic diversity is difficult in an area so isolated. Pinedale is 100 miles from the nearest railway and highway system or big airport with commercial capabilities; fiber optic infrastructure is inadequate and outdated. As Bart Myers stated, "our economy is gas, cows and tourists, in that order."

The energy for revival is prevalent nevertheless. The city has begun to make attempts to ramp up tourism once again with a downtown revitalization program and town branding strategy that both aim to support local businesses. The revitalization program, named Main Street Pinedale, has developed through the National Trust for Historic Preservation in coordination with the State of Wyoming. Pinedale, after conducting an economic development study, has created a downtown master plan which set the tone and direction for people to work collaboratively. The city also initiated a façade grant program to assist in historic preservation and downtown beautification efforts, to promote of the downtown area and special event planning and to coordinate the organization of multiple actors including the city, non-profits and the economic development council.

Additionally, there has been significant attention placed on the arts. The state conducted a creative vitality study, in which Sublette County scored remarkably well. There has been discussion of mixing efforts for downtown revitalization using local artists. The oldest art organization in the state is located in Pinedale, and has begun working on an artist incubator, which will use city procurement to incentivize production. Once a piece sells, the artist

pays back a portion of the revenue. Commissioning temporary public art in this way can be viewed as a positive strategy for the promotion of artistic endeavors.

A portion of the money to support these efforts has sprung directly from gas operators, who were also fundamental in the development of several local non-profits. Prior to 1999 there were around two or three non-profits in Pinedale. At this point, there are close to 25, who almost all receive funding in the form of community investment grants from gas companies such as Encana, Shell and Lynn Energy (Dahl, personal interview).

Photos:
Local public art displayed in downtown city center.

Signage and wayfinding portrayed on several buildings to display the "western spirit" of Pinedale.

The large gas companies have community investment arms that give grants to local non-profits to address issues such as economic development and environmental and human health. These efforts help the companies maintain positive public relations and mitigate their impacts as well as to report tax write-offs. As the city planner reported, "energy companies typically seem to be very aggressive about it, often because their activities can be more controversial than other industries" (Dahl, personal interview). Public opinion gathered from the BLM-led meetings, attention gained from the impacts to the community, degradation to wildlife habitat, specifically mule deer and sage-grouse, and poor air quality[08] in Pinedale likely signaled a need to the oil operators for these above average philanthropic efforts.

Evaluation of the outcomes

The city now has an enormous operating budget, up $39 million from its $1 million budget just prior to the boom in 1999; royalties from oil and gas is collected by the state, which are then redistributed to the county who distributes it to the various towns. Forward thinking planning has ensured the city's layover budget to remain around $30 million even though tax revenue is now only bringing in $3 or $4 million annually (City of Pinedale, 2013).

Government leaders have used these coffers to urge efforts for infrastructure improvements and investments for new

08 At the height of the boom Pinedale's once pristine air contained ozone levels that exceeded that of Los Angeles (Noble, 2010).

community facilities. A new school has been constructed as well as a library and state of the art aquatic center. Both are highly prized and regarded by local residents as one of the best things that have come from the boom (Noble, 2009). The city used money collected from gas development to upgrade infrastructure systems over a span of six years (Dahl; City of Pinedale, 2013). In 2007, just before the largest pike in gas tax revenue was collected (revenues peaked in 2009), the county, comprised of just 1.4 percent of the state's population, levied 21 percent of Wyoming's entire tax valuation (Sublette Board of County Commissioners, 2008). Tax goes first to the state who then administers it back to the county; the county administers revenue between the three towns for funding related projects of greatest need. Pinedale applied for a grant through the Wyoming Water Development Commission for sewage upgrade (Dahl, 2014) and in less than ten years, the city has been able to pay off debt due to these revenues (City of Pinedale, 2013).

Now that the boom phase has settled, community members have noted that Pinedale is "not the cow town it used to be" (Woodard, 2014). This sentiment is better sweet, however, as the government does have clear management of its operating budget and investments in the locality are evident. In terms of infrastructure, the town has been able to catch up. The upsurge of non-profit organizations, downtown revitalization efforts and public art initiatives are unique in a town of this size; these efforts should be applauded.

On the flip side, the substantial amount of foreclosed and vacant homes due the outward migration of industry workers has impacts on the real estate market and the area's bank lending capabilities. Further, concerns over the decreasing revenue flow as expressed by shop and restaurant owners is a signal of local economic distress. While there have been efforts to evaluate the potential of Pinedale's tourism industry there are divergences among the area's planners as to whether this is a viable strategy. As county planner Bart Myers articulated, Pinedale is 80 miles from popular Yellowstone and the high-scale eateries, hotels, services and cultural entertainment found in Jackson. Pinedale's location at the foothills of the Wind River Range mean people traveling to Pinedale are coming for outdoor amenities located in the mountains, not to dine and shop. Relying on tourism alone is not an adequate economic strategy.

The existence of oil and gas operations in Pinedale changed the small town's character arguably forever. While local residents and even government members fought the industry's presence throughout, there were also large interests from the scientific community to analyze the environmental impacts in order to create better mitigation strategies for oil and gas drilling. These efforts were often from outside actors in coordination with the Bureau of Land Management. Some were privately funded from the oil and gas operators themselves. One such study examined impacts to greater sage-grouse, a newly inducted member of

Special Status Species designation in the State of Wyoming[09]; others examined the drastic rise in ozone levels[10]. However these reports cover only two aspects of impacts, while the laundry list of effects caused by the natural resource industry is vast.

Evaluating the current situation of Pinedale: Unrealized potential for research and development, capacity building for local knowledge and technology transfer for diversification of economy and energy sector

The natural resource boom that occurred in Pinedale was the outcome of federal targeting specifically for the oil and gas industry. The land used for drilling occurred on federally managed and therefore highly subsidized land; the "All of the Above" strategy spurred large demand for domestic energy therefore incentivizing production. This industrial policy should then go further. A recent study which explored cross state regressions in the US and the effect of natural resources on investment, schooling, openness, innovation and institutional quality found schooling to be the most important and negatively impacted transmission channel for resource affluence and (non) growth in the U.S. (Paprakis & Gerlaugh, 2006). The authors found there to be less urgency to make educational investments in resource-dominated economies, which they attribute to the lack of focus on other industries and/or jobs that require workers to have education beyond high school. This hampers efforts toward technological innovation.

The current domestic energy landscape presents a unique opportunity to reverse these trends. The institutional presence and knowledge provided by the natural resource specialists of the Bureau of Land Management presented an opportunity for immense efforts toward research and development in the oil and gas industry. The presence of the oil and gas operators provided industrial knowledge, labor, capital and machinery for drilling needs, which could have been used to increase human capacity within Pinedale and the surrounding area in the form of skill training. The availability of massive amounts of subsidized federal land brought the final component of the land, labor and capital equation needed for development. This opportunity was not fully seized in Pinedale.

WATFORD CITY, NORTH DAKOTA

In addition to archival research and site visits, interviews were conducted with County Planning Director Walter Hadley and Tax Director Courtney Lovaas.

Oil exploration in the Bakken shale formation (lies under approximately 200,000 square miles of eastern Montana, western North Dakota and provinces of Saskatchewan and

09 Wyoming Wildlife Consultants, LLC. "Greater Sage-Grouse Winter Habitat Selection Relative to Natural Gas Field Infrastructure in Northern Portions of the Pinedale Anticline Project Area in Sublette County, Wyoming. Final Report, Prepared for Shell Western Exploration and Production, LP; QEP Energy Company; Ultra Petroleum. April 2012. http://www.papaoperators.com/PAPA_LGS_Winter_Grouse_Final_WWC_Report.pdf

10 Sublette Board of County Commissioners. "Citizens Guide to Air Quality Management in Sublette County." http://www.papaoperators.com/Resources/AirQualityBooklet.pdf

Manitoba in Canada) traces back to 1953, with horizontal well drilling beginning in the 1990s (Miller, et al, 2008). Led by the Energy Policy and Conservation Act (EPCA) amendments of 2000, the USGS conducted a survey to determine the inventory for onshore lands, regardless of land status (federal vs. non-federal). At this time, USGS determined there to be 3.65 billion barrels of undiscovered oil captured in the Bakken Formation (USGS, 2008). Information of this massive supply, coupled with innovations in drilling technology (in Pinedale) created a profitable drilling situation. Today, North Dakota has surpassed California and Alaska in oil production, second only to Texas (U.S. Energy Information Administration, 2013). As of 2013 the state produced 313 million barrels of oil, outputting an average of 923,227 barrels per day (North Dakota State Government, 2013). Experts project drilling to occur until 2025, but as seen in each of the boom/bust scenarios, operations may cease on a whim.

Community impacts of the boom

Newspaper reports, site visits and interviews with the county planner and tax assessor reveal Watford City is struggling immensely with maintaining adequate road and water infrastructure, public employees and affordable housing.

To visit Watford City at night means traveling on narrow, single lane country roads with little visibility save the long line of head and taillights trailing in either direction or the ominous gas flares for which the industry can now easily be recognized. Within Watford City the long lines of semi and diesel trucks can be seen at any hour of the day as workers travel to and from the well sites for various work or personal needs.

With an estimated forecast of in and outbound truck traffic reaching 60,000 wells (2300 truck trips generated per well) in upcoming years, the Upper Plains Transportation Institute in coordination with North Dakota State University has estimated oil producing counties to need road investments and maintenance needs to reach $3.5 billion by year 2032 with a statewide total reaching $7 billion (UPLI & NDSU, 2012). As of 2011, the North Dakota legislature had appropriated 142 million for county and township roads in oil producing counties; 85 percent of the funding had been claimed at the time the UPLI and NDSU report was published. These investments are seen to provide "major benefits for energy industries and citizens and were a crucial step in building the road infrastructure necessary to sustain energy growth in North Dakota" (ibid, pp ii), signaling enormous public investments are going toward the promotion of this single extractive industry.

In both Wyoming and North Dakota, royalties are also collected by the state through tax and then reissued to the counties first and then townships like an "allowance," based on how much oil and gas is produced there (Hadley, 2014). The gross production tax rate on gas through June 30, 2014 is $.0833 per mcf, while for oil it is 5% of the gross value. The oil extraction tax rate is 6.5% of the gross value;

4% if the well qualifies for a reduced rate; and 2% from qualifying wells in the Bakken formation; and 0% if the well qualifies for an exemption. Tax incentives include reduced rates and/or exemptions that apply for new vertical and horizontal wells, new wells drilled on Native American land, workover, stripper, horizontal reentry and enhanced recovery wells (those used for fracking), and wells that have been inactive for two-years (Rauschenberger, 2014). This laundry list of incentives includes essentially every kind of drilling type that might occur, meaning that very few are paying full royalties in North Dakota at this time.

Nevertheless, there have been large public investments in Watford City for a new elementary school and fitness facility; plans for a new high school as well as a hospital with a critical care facility are in the works (Hadley, 2014). The water supply system was just updated which pumps reservoir water from the slightly larger boomtown of Williston 60 miles north. Although barely finished, this facility is already at capacity, illuminating the severity of the city's scramble to keep up with the rapid growth. It is anticipated that efforts to crack down on people claiming to have a single lot but are actually providing water hookups for work force housing (many people offer upwards of ten truck/RV hook ups on a single lot) should buy some time for the new system to adjust before upgrading again.

The RV hookup scenario has arisen out of a significant housing crisis within the city. Within the past few years, housing values have soared with recent reports stating rental units are now more expensive in North Dakotan boomtowns than the two most expensive cities in the country, New York and San Francisco (Upton, 2014). This poses significant challenges, as the county planner stated, "Not everybody makes oil industry wages." He has found it to be marginal to hire public employees due to the inflationary markets pricing them out of the market. There are temporary housing units for government employees, but this assistance only goes so far; two employees in the planning office are working two or three jobs (80+ hours a week) just to keep up (Hadley, 2014). These women are renting double-wide trailers.

Photo: Private lots rented within city limits for RVs and serve as temporary housing.

Photo: Permanent housing construction being built in January 2014 (time of site visit).

Examining Planning Strategies and Laws

Housing

Because the boom is anticipated to last until 2025, those in the area anticipate the demand for services will only continue to rise. The county planner feels this housing crunch would benefit from the addition of subdivided lots and has pushed for increased private development. A strategy that allows for the streamlining building approvals however may act as a double-edged sword. The addition of market-rate housing alone does not meet the need of those that are not making oil field wages. One apartment housing complex providing a portion of affordable units has been built and is at capacity in Watford City (Hadley, 2014); efforts for additional units are generally left for private actors to control.

Allowing free-market mechanisms to build additional units to meet this short-term demand provides an opportunity for economic gains by private actors, however these efforts may prove hasty as workers switch companies and job locations as opportunities arise; worker/employer loyalty is not typically expected in the sporadic industry. The current population count continues to grow and is extremely hard to measure, as much of the transient working population is living in RVs or temporary units which have been very difficult for the city and county to track. Outcomes in Pinedale show that simply building to meet demand inevitably results in foreclosures and above average vacancy rates.

There should, then, be mechanisms to hold oil and gas developers accountable to create more flexibility for worker housing, which will relieve some short-term inflation on the real estate market. Efforts at the public sector level should focus on policies that prioritize the creation of stable, affordable units. Municipalities like Watford City facing such issues need to focus on regulations that protect long-term residents. Policies must be created that address the production of permanent housing affordability for those of all income brackets to ensure displacement does not occur due to burdens of rent.

Nevertheless, the addition of housing and even investments in community facilities alone cannot retain the new working population as seen in Thermopolis and Jeffrey City. Prior to the boom there was a general exodus of young people in North Dakota as there was little industry aside from farming within the region (Hadley, 2014). The recent trend of young people staying within Watford City signals the town can and should work to create economic resiliency by diversifying the industry mix.

Land Use Controls

Well locations are sited based on resource and are therefore often indiscriminately located, which can create large conflicts of interest as well as place significant impacts on the surrounding area's inhabitants. There are many unlabeled side roads reaching the oil and gas sites that pose safety hazards as well as impediments when interfering with wildlife migration routes. The state put forth a General Environmental Impact Statement

that has approved oil and gas production on a statewide basis, these impacts are often not considered due to the lack of site-specific analysis. In fact, all review for well sighting and drilling approvals occur at the state level in Bismarck, approximately 185 miles from Watford City.

Well permits and approval are regulated differently in North Dakota compared to Pinedale, in that operations are occurring primarily on lands owned by the state or privately. For non-private land, current leases are being purchased through bid at a net rate of $160 in McKenzie County (North Dakota Department of Trust Lands, 2014). This drilling occurs on 3 million acres of State Trust Lands, which leases land similarly to the Bureau of Land Management (access granted for cattle grazing and mineral exploration; range managed for wildlife and plant protection). The land management differs, however, in that responsibility for managing these acres was given to the State of North Dakota from the federal government in 1889 for the purpose of funding public education. Private entities can lease mineral rights at a rate of $10 per acre for a term of five years. Similar to BLM, the major sources of income come from these lease payments and royalties is from oil and gas produced, however on State Trust Lands the lease payments stay within the state rather than being collected by the federal government as on BLM land.

On private land, ownership is often classified as a "split estate" meaning that the person or entity owning the surface rights is often not the same as that of the mineral rights. Upon purchasing mineral rights, the buyer also purchases the right to access the minerals from the surface. Unlike royalty owners, the surface owners whose forbearers have sold off the mineral rights are not awarded royalties from the use of their land. In terms of receiving compensation for damages, surface owners are recommended to consult the average land valuation as determined by the USDA. The most recent document for McKenzie County states that reported average rental rates are $20 per acre (USDA, 2009), while the average mineral royalty payment is much larger.

Royalty payments are given to mineral owners when he/she agrees to allow a developer the right to explore and drill associated acres. The owner generally receives a bonus payment and percentage of whatever is actually produced (termed the royalty payment) percentage is determined through negotiation by the oil and gas company and the mineral owner. While the owner may elect not to participate, this does not mean drilling will not occur but rather that the owner will not receive compensation from production; "like any negotiation, the ability to bargain depends on leverage" (Swanson, 2011). Leverage in this sense is may be the amount of mineral acres owned, how close those acres are to known production and how many companies are competing for the lease. This newfound subsurface wealth found in the Bakken Shale has caused North Dakota to jump 14 spots in the annual rankings of millionaire households per capita from 2012 to 2013 (Morath, 2014). The split

estate system has created a feeling of “the has versus the has nots” (Hadley, 2014), with residents showing early signs of resentment similar to the current perceived sentiment in Thermopolis.

Findings: Lessons from Pinedale and Watford City

The following matrix summarizes these planning strategies both in Pinedale and Watford City, again focusing on infrastructure investments and type, capacity building (technical training, etc.), housing affordability mitigation efforts, firm-level community outreach and public-level community development.

Locality	Infrastructure investment	Capacity building	Economic diversity efforts	Housing and real estate stability	Firm-level community outreach	Public-level community development
Pinedale	(Boom + Bust) Moderate - construction of school, library and water system. Tax coffers still 400% above average to pay for and maintain facilities. No initiative for higher technological infrastructures such as fiber optic cables or data centers.	(Boom + Bust) Moderate - industry requires degrees, skills and certificates in various scientific and vocational trades; few linkages or spillovers occurred in the area or retainied long-term. Studies initiated by outside actors, local residents not involved; College or vocational school 102 miles away.	(Boom + Bust) Low – restaurants and shops opened, but no moderate or high-wage jobs created outside mining industry; long-term strategy dependent on tourism. Environmental studies initiated by outside actors.	(Boom + Bust) Low - Huge inflationary prices on real estate market during boom; somewhat relieved by implementation of man camps; rapid lot subdivision led to collapse of housing market post-boom.	(Boom + Bust) High - implementation of several non-profit organizations, construction of aquatic center partly due to philantrhopic efforts.	(Boom + Bust) High - implementation of several non-profit organizations, local art initiative and construction of aquatic center partly due to community organization. Community leaders effectively leveraged position of boomtown to receive payback from gas operators.
Watford City	(Boom) Moderate - construction of school, library and water system. Implementation of building codes and zoning. No initiative thus far for higher technological infrastructures such as fiber optic cables or data centers.	(Boom) Moderate - industry requires degrees, skills and certificates in various scientific and vocational trades.Some R&D looking to mitigate impacts of flared gas due to tightening of environmental regulations. College or vocational school 60 miles away.	(Boom) Moderate – restaurants and shops opened, spike in supporting industries; no moderate or high-wage jobs created outside mining industry; no long-term strategy currently developed. Environmental studies initiated by oil and gas operators.	(Boom) Low - Huge inflationary prices on real estate market; somewhat relieved by implementation of man camps and rapid lot subdivision (outcome unknown). Lacking affordable options.	(Boom) Low - seemingly lacking implementation of non-profit organizations; data suggests public officials not effectively leveraging ability to demand more from industry.	(Boom) Low - construction of rec center. Lack of regard for local land owners during well approval process; opaque approval and water discharge system

Figure 3:
Matrix of findings

Pinedale: Advocacy and local authorities effectively levered public benefits

In Pinedale drilling occurred solely on federal lands, private land interests were not threatened and therefore impacts to individual property owners was not as large from a nuisance or environmental standpoint. Because drilling was occurring on federal land, well approval was not under local control, per say. The mining act of 1872 mandates that the "multiple-use" guarantee of federal land must include mineral development. Therefore all mining is generally accepted so long as mitigation occurs and environmental impacts studied. Whether these issues are adequately addressed, however, depends on the knowledge of the agency. Federal policy mandates that all oil and gas operations are under the authority of the state in which operations occur. Federal mandates for operations are currently weak, as, for instance, disclosure of chemicals put into water and used in operations is not mandated nor is the capture and use of excess gas. This provided less mitigation measures to be employed; however lessons learned in Pinedale have tightened environmental controls currently in Wyoming (Galbraith, 2014). These are explained in further detail in the recommendations section.

Public outcry was large in Pinedale, nonetheless, due to increases in air emissions and troubling ozone levels, as well as deviant worker behavior noticed in the small community. This yielded the ability to leverage compensation from oil and gas industry, as public effort was galvanized through community advocacy and mayoral efforts. Interviews suggest that payback was large due to a cooperative relationship that was formed between the energy companies and Pinedale's Chamber Director who also serves as the Community Foundation Board. A community foundation endowment was established through this cooperation, in which Shell Energy Company provides grants and proceeds for local non-profits. A state of the art aquatic center was funded through these efforts, and the small community recently constructed a new school, library and downtown revitalization changes. This case study proves that small resource-rich communities do in fact have the ability to leverage payback from the oil and gas industry to be put back into the public benefit.

Watford City: Lack of local control over drilling operations; opacity of the oil and gas industry exacerbated by the state; unrealized leverage for long-term public good

Under North Dakota common law, "the mineral estate is considered the "dominant estate" with the right to extract minerals subject to reasonable use of the surface" (North Dakota Petroleum Council, 2011). The county planner described this as an immense problem, as the state, when approving well locations, does not have up-to-date subdivision data and has approved drilling to occur on or near residential property. However if the property owner does not also own the mineral rights to the land, he or she can do nothing to stop the drilling from occurring. Surface owners, apart from

opting to sell their land and leave the area, are left with little option to bear the brunt of impacts and nuisance without receiving monetary gains.

The Oil and Gas Production Damages Act of 1979 ensures that surface owners are given a 20-day notice before construction activities occur (including a surface plat indicating the location of the well, well pad, proposed access road, and any other matters requiring use of the surface) and are awarded fair compensation for a loss of agricultural production and income, lost land value and/or lost use and access of the surface owner's land. Spatial requirements state a well must be at least 500 feet from any occupied building; surface owners may expect well activity to occur anywhere from 30 days to 30 years (Hadley, 2014; North Dakota Petroleum Council, 2011).

Photo: Several large gas flares constantly burning directly adjacent homes in the outskirts of town; driveways being used for storing heavy machinery and trucks.

These surface impact stipulations are too loose. Local governments must be given the authority to intervene in this practice in order to oversee their purported duty of ensuring public welfare.

The rapid and indiscriminate drilling approvals occurring at the state level provides an indication that "carrots" in the form of economic incentives are leading to rent-seeking and driving the process for market expansion (Amsden, 2001). Yet "sticks" or even proper deliberation for the community absorbing the impacts is lacking. The absence of local authoritative control over well approvals coupled with the state's clear deficiency of coordination or forethought for private landowners and the public in general portrays danger for North Dakota. Kiefer and Miller (1984) mention government solutions to manage and/or fund growth, such as requirements for payments from major developers that are responsible for growth, slowing growth through adherence to comprehensive land-use plan, state and federal grants given to localities and impact fees on new residents. As seen in the in Pinedale, leveraging political will at the city level even in the absence of local well approval allowed the small town to effectively gain revenues for multiple community outreach and revitalization programs. These methods have not been fully realized in Watford City.

The data provided in this research indicates that public outcry in North Dakota is not as unified, perhaps due to some local mineral owners being largely compensated, while

those with only surface ownership don't have as much of a voice and/or power to resist due to the Split Estate land use law. Additionally, the political climate is largely pro-drilling, evidenced by the entire state undergoing the rapid transformation of the oil and gas industry. Despite this, the cumulative findings of this research demonstrate that interventions must occur from the public sector in order to provide more local control over drilling practices and better guide operations from an environmental standpoint.

To learn from the pros and cons in Pinedale, both in their the ability to leverage payoff from oil and gas operators, as well as the missed opportunity for research and development, the silver lining here is the prospect to create further initiatives for the process in order to develop local expertise and subsequent spill over into other sectors. Through understanding the high payoff received from oil and gas operators in places such as Pinedale, public officials in North Dakota should line up their bargaining power in order to insist these firms' operators make credible commitments. Even the often vilified company Wal-Mart has been seen to take the high road in terms of employee compensation and the pricing of goods (Tilly, 2006). Through becoming knowledgeable of operations in other places, public officials were able to insist on things such as affordable commodity goods, unionization and high wages.

Rather than allowing the hast pace of the drilling operations and negating environmental oversight, the following strategy will detail how future planners might learn from the predecessors and begin to leverage efforts, both short and long-term, that work toward the vitality of their cities and laborers that make them function.

CHAPTER 4: RE-STRATEGIZING THE ENERGY LANDSCAPE

The lack of authority for well approvals, regulation and maintenance control at the local level, coupled with uncertainty as to the industry's presence in the community has created an extremely opaque system. In terms of environmental impacts the oil and gas industry is perhaps the most criticized of any. However the industry's regulatory bodies are perhaps worsening these claims. Due to the Energy Policy Act of 2005 and the "Halliburton Loophole," oil and gas companies are exempt from the Clean Water and Policy Act. Fracking utilizes enormous quantities of water that are injected with chemicals, yet this law does not mandate the operators disclose what these chemicals are. As a public official, Mr. Hadley isn't even notified where the highly contaminated wastewater is dumped within the boundaries of the county. Again, this is all determined by the state. Important to note, is that it is common practice within hydraulic fracturing for the water to be reinserted deep into the drill hole in order to stabilize ground pressure from the removal of gas. Although industry experts claim this has little implication for nearby groundwater, the truthfulness of these claims is vastly unknown, as substantial time and research has not been dedicated to this new drilling practice.

The following short-term recommendations are provided for Watford City:

1 - Local control given to county for well approvals; proper compensation given to surface land owner.

A regulatory body should be formed and given judicial authority to observe, monitor and ensure enforcement of the following oil and gas operation stipulations:

1. Currently, oil and gas companies are exempt at the federal level (due to the 2005 Halliburton Loophole created in the Clean Water Act (42 U.S.C. 300 h(d) under Vice President Dick Cheney) from disclosing the chemicals used in the fracking fluid, should competitors try to recreate the propriety mix. Local control should be more stringent; chemical type and quantity used in the mix should be disclosed and approved by appropriate specialists prior to operation commencement.

2. Oil and gas companies should test wells or springs within one-half mile from the drilling site, both before, during and after drilling. These tests would measure temperature, bacteria, dissolved gases such as methane and propane as well as a number of chemical compounds. Any changes observed in ground water should result in termination of operations immediately and until mitigation efforts (water filtering, cleaning, etc.) are successfully employed[11].

11 A similar precedent is provided in Wyoming (Galbraith, 2013), however testing occurs only before and after operations rather than during the drilling process. This requirement is meant more so to provide data should legal litigation ensue to prove or disprove that fracking actually impacted water.

3. Oil and gas companies must monitor air pollutants. If these pollutants are seen to rise, pipes must be checked for leaks and fixed when necessary. If leaks are not the source of extra emissions, production must cease until the source is found.

4. Current U.S. fracking operations result in approximately 30 percent of all gas drilled to be "flared" or burned on-site. On a worldwide scale, this amount is 5.5 percent. Flaring occurs due to a lack of proper processing capabilities and/or piping. When the pipe is drilled deep into the ground and the pressure, chemicals and water are pumped down in order to release oil from the fissures in the rock, a substantial amount of methane and natural gas is sent to the surface as well. In theory, these chemicals could be stored to be processed and sold for electricity, however due to a lack of appropriate storage capacity and infrastructure it is often less costly for oil and gas operators to simply burn the excess on site rather than building the necessary storage and piping. Needless to say, flaring has large environmental repercussions, as the unnecessary gas combustion leads to an increase in carbon dioxide and greenhouse gas emissions.

5. North Dakota oil and gas operators are exempt from adhering to flared gas laws within the first year of operation (H.R., 2013). This law should be revoked and oil and gas operators should be required to utilize appropriate technology to capture the excess gas and methane, such as a pipeline or, ideally, connector at the wellhead in order to power an electrical generator used on-site. By using excess gas to fuel drilling operations, this second option would also reduce the amount of diesel fuel that is normally used to run generators on well sites. Oil and gas operators should be responsible to fund and carry out all reclamation post-drilling operation. Reclamation should occur to leave the landscape as close to pre-drilling conditions as possible, including the re-establishment of healthy topsoil, native vegetation and topographic contours. For reclamation activities oil and gas operators should hire the workforce to come from the associated township for these activities in order to create stable and local job creation. A bond should be collected prior to operations of $500,000 [12] in order to ensure reclamation activities are properly met.

6. Public benefit fund should be created, in which a percentage of all oil and gas profits are collected by the associated locality. These funds will be in addition to any royalties and/or concessions received at the state level. These funds may be used for community facilities, infrastructure, education or research and development initiatives or general community development topics.

12 Operators are generally expected to post a bond of $10,000 to ensure compliance with the terms of the lease and to cover reclamation should the operation bankrupt. Experience has shown, however, that reclamation expenses greatly exceed this amount, sometimes requiring upwards of $1 million to recover the landscape to its pre-production condition (Environmental Working Group, N.D.)

Long-term Recommendations:

North Dakota is taking advantage of expanded state and city coffers during this boom as seen in the large road and water system investments, which is in line with Wood (1996), who looks to government spending of royalties, severance fees and other forms of taxation from resource production to fund such projects. Headwater Economics (2013) however advise for a savings mechanism to be put in place to "ensure lasting fiscal benefits" of the resource; royalty funds are inherently difficult to manage, as they are dependent upon the finite nature of the resource. Further, the prices sway with the world market economy and can prove to be highly erratic even throughout the life of the project. It is irresponsible therefore for the government to rely upon lasting production and associated tax revenues from oil and gas as it will slow down steeply once the finite resource is depleted.

These funding mechanisms should therefore go further. Channeling tax revenues not only toward physical structures but also to support a diverse economic strategy would help to alleviate the uncertainty of the industry within the region and begin to bring transparency to the extraction process in North Dakota.

Environmental issues are ominous in the natural resource industry, and regulation to make the processes and inputs involved in extraction more transparent is lacking in North Dakota. In all cases, governments and industry leaders have tried to ameliorate impacts through the channeling of revenue to infrastructure and community investments. This is imperative. If adequate funding to support the rural areas that are absorbing the shocks of boom-and-bust economic cycles is not given, a compounded problem is created as these areas are often more economically and socially vulnerable than cities (Tonts et al., 2013). However, as seen in each locality that has had a rapid influx of the natural resource workers, physical investments are not enough. Further, these efforts may be seen as an effort to mask the outcome of an industry whose future impacts are unknown.

The following two-part long-term strategy details how stakeholders may divert these contentions and regulate the state-industry relationships in specific ways in order to ensure the long-term environmental and economic public good.

Create efforts toward industrial and environmental research and development to make the leap toward energy diversification

1. Utilize environmental regulations to form partnerships between the industry and educational institutions and create an opportunity for innovation within the industry.

Due to the immense environmental impact the oil and gas industry has on drilling sites, firms may be expected to act as partners to help achieve and innovate environmental protection. To encourage this, governments have the ability to use carrots and sticks to encourage firms to use "high road"

strategies of promoting effective regulation, enforcement of fair tax burden, or enforcing socially and environmentally beneficial technologies (Block, 2008). In this sense, the government should "set rules for the game, as well as directly intervene in the play" (Lall, pp 171). Through changing "a complex interaction of incentives" (ibid) governments should act to push innovation for environmental betterment. Amsden (2001) finds governments to influence path dependency; the current regulatory environment set up by the government which focuses heavily on extractive industries is creating little incentive to deviate away from the current environmentally degrading oil and gas practice.

Incentives should instead guide the use of the capabilities, and "selectively stimulate, complement and reinforce entrepreneurship" (Kesidou, 2004) and thereby beneficially affect the competence, expectations and attitudes of the industry. This would occur through penalizing environmental degradation, pushing for industrial "best practices" and creating industry/education partnerships to work toward innovation (Lester, 2006). Environmental benchmarks must be created to which industry actors are then incentivized to meet and exceed. For the oil and gas industry specifically, records should be in place to measure the amount of water used and re-used, the amount and type of chemicals used in the fracking process, the amount of gas wasted due to on-site flaring and proper location sighting for water disposal. These records should then be used for benchmarks with incentives in place to continuously improve. Clear expectations should be defined in order to gradually isolate and then withdraw funding from the firms that do not meet standards (Block, 2008).

Additionally, incentivizes to urge the innovation of new production technologies, introduce product or service enhancements or improve on those that are currently in practice should be set in place. Currently, technology is available to capture flared gas and studies aiming to purify wastewater have occurred; however few industry leaders are latching on due to the lack of mandate to do so. Without giving incentive to invest in research and development for industrial technology or penalizing firms for environmental contamination, the industry has little motivation to improve practices. Performance benchmarking can begin at the public sector, which will eventually translate to focus on competitiveness (Gore, 2000) as firms widely begin to comply and are therefore pushed to innovate.

Both the externalities and uncertainties present within the industry provide an opportunity to protect domestic technological learning as "information linkages are imperfect and basic capabilities are in the preliminary stages of development" (Lall, 1992). The state should guide economic growth through embedding policy goals in social mores (Kesidou, 2004), such as the prioritization of clean drinking water and air. Further, through creating industry-specific projects, "inter-organizational networking can actually bind together separate interests,

personal and group-level aspirations and existential values, and therefore contribute coherence and mutual understanding" (Srinivas, et al., 2008). Over time, multiple actors form "cooperative articulation" (Sabel, 1992) as they begin to speak the same language and delve more deeply into research. This strategy would allow public actors, in coordination with the oil and gas industry, to seek to ameliorate the stark environmental outlook while strengthening the industrial knowledge of the region.

A place-based strategy is critical for the research and development of industrial innovation. Embedding a research institution in the region increases the retention of stakeholders as universities represent a stable presence within their locality. This would decrease the risk of boom and bust that is inherent in the resource industry. Currently, there are two college-level institutions in nearby Dickinson (approximately 60 miles north of Watford City) and Williston (approximately 60 miles north) that offer a broad spectrum of undergraduate degrees. Both cities are also situated on the Bakken formation and therefore experiencing similar effects of the boom. While Dickinson State University offers more traditional degrees, Williston State University offers training related to the oil and gas industry such as diesel and welding training and opportunities to obtain a Commercial Driver's License, Industrial Safety and Lease Operator certificates.

These courses offer the space for discourse around the extraction process, tacit knowledge obtained from learning by doing and a network of willing laborers. Ultimately, the courses offer the skills needed to join the industry as it currently operates. The opportunity to enhance the technological dynamism of the industry is present. A partnership between these universities and industry leaders should occur with a goal of strengthening and modernizing production operations by increasing knowledge capacities and linkages. Technological capacities that nurture knowledge-based assets are production capabilities, process capabilities, and innovation capabilities (Amsden, 2001). Universities have the space, tools and willing learners at hand to contribute to these processes, while firms, with more knowledge of the industry than outside actors (Lall, 1992), have experts within the field to share skills and knowledge. These two actors are fundamental to the innovative process; technical projects provide an opportunity to exchange information and build new partnerships (Srinivas, et al., 2008).

By offering Federal revenue, industry participants are incentivized to begin cooperating with regard to research and development as a consortium of efforts will more quickly solve large-scale technical challenges that are inherent in the industry. As previously discussed, incentives for the oil and gas industry are already in place through the relaxed royalty system and heavily subsidized land lease fees on State or Federally managed land; U.S. firms are historically dependent upon federal funding for innovation (Block, 2008). Therefore, it is not unreasonable to suggest realigning these

mechanisms in order to prompt innovation for the sake of environmental protection, economic resilience and community sustainability. Ultimately, large firms may begin to see the benefit of collaboration and continue to finance this strategy (ibid).

In theory, this strategy is an easy sell for industry leaders and governments alike. Such improvements will expand production and export capacity (Kesidou, 2004). Public officials should exercise the salient mission of protecting domestic technological learning and expanding the space for public deliberation on the direction of industrial change. Economic adversity can increase the incentive of forging such relationships (Srinivas & Viljamaa, 2008).

2. Plan for existing industry to go into decline; divert core technologies to make the leap to renewable energy creation

Due to the finite nature of oil and gas in the region, it is imperative these communities begin to diversify the economy into other industries. A successful strategy utilized in Norway during the oil rise of the 1970s and 80s, provides insight from a country that has broadly been characterized as successful in handling the boom.

When oil was found in the North Sea in the 1970s, coordinated efforts at the national, regional and local level promoted local capability building in order to support the industry. Although many outside laborers were drawn to the region, the country enlisted specific stipulations that required foreign companies to assist in technology transfer for local industry workers. In concert with this, the creation of a higher education institute including a technical college and public research institute, which enabled research capabilities in related fields. Local shipbuilding and construction companies were supported through this strategy and able to enter the oil and gas arena. Eventually, local oil companies and the non-oil sectors built the capacity to compete on an international level (Hatakenaka et al., 2006) and enabled the country to better absorb oil induced boom-and-bust fluctuations within the economy.

In North Dakota, industry diversification could easily also translate into energy diversification, as the labor, machinery and capital inputs for renewable energy are similar to those of non-renewables. Historically, the Department of Energy has "nurtured a wide range of energy-saving technologies, but there has been a long-term failure in the Executive Branch to expand the scale of these efforts enough to reduce the economy's dependence on fossil fuels" (Block, pp 25). However, spending for renewable energies has never been relative to that of oil and coal based technologies (ibid).

These opportunities are currently limited due to a gap between the demand for capital to finance renewable infrastructure projects and the supply of private capital to fund such projects (McElmurray, 2013). Due to the realization of cheap, abundant natural gas a perception in society has been created that

energy is not scarce and therefore there is a lack of pressure to incentivize investments in renewable infrastructure projects - especially ones that look expensive and irrational compared to natural gas from a developer and investor standpoint.

States that have traditionally been nonrenewable energy producers may be less likely to implement state- or city-wide policies that promote renewable energy projects such as Renewable Energy Certificates, Credits or Standards, which would minimize the cost of utility company compliance and incentivize production by urging utility companies to source a percentage of their electrical generation from nonrenewable resources. Further, there isn't a Renewable Portfolio Standard policy on a national level (U.S. EIA, 2012). Consequently the door isn't open enough for developers to enter the market and there is lack of incentive for private capital suppliers to back such projects.

A government-led strategy may be employed to utilize the industry/university partnership in order to "open windows" (Block, pp 5) to create avenues for ideas to flow, connect various industry actors including those not involved in the oil and gas sector, and coordinate investments by a range of investors. Similar partnerships have existed domestically between Georgia Tech and the Department of Energy for research and development regarding wind turbines. The university was funded at the federal level to focus on a specific technological challenge and build networks between similar academics and relevant business firms (Block, 2008). Commitments to support necessary technology infrastructure such as fiber optic cables or diversification of the electrical grid coupled with regulatory frameworks such as the implementation of Renewable Energy Standards are also fundamental in order to create confidence among stakeholders. Targeting for energy diversification is appropriate to "stimulate the learning effects that will improve productive efficiency" (Kesidou, pp 110) as well as promoting spillover effects for non-energy related work within the economy.

North Dakota and other resource-rich regions have economic climates that are increasingly reliant on the oil and gas industry, it is imperative these regions form an institutional environment that supports innovation and collective learning to undermine the current technological trajectories and path dependency of the oil and gas industry.

CONCLUSION

Aiming to research alternative energy alongside oil and gas development would help to legitimize the already intact energy sector procurement, while attempting to ameliorate the strong public backlash that looms with the insertion of the natural resource industry in a community. Collaborating with a university will relieve some of the unknown aspects of the community's fate as a boomtown, as universities provide a long-term, stable presence (Lester, 2006). By funding research and development to improve the industry, the drilling process will be made more

transparent and economic growth enhanced; “the links between innovation, productivity growth and prosperity are increasingly well recognized around the world” (Lester, 2006). Seeking to diversify the economy will enhance the community’s resiliency once the oil and gas sector has left.

The term “public good” has been used frequently throughout this paper, yet the term is never officially defined. As the oil and gas industry remains in these communities, a pressing question lingers. Should these communities bear the environmental and socioeconomic impacts for the “public good” of national electricity? Should these communities bear the impacts for the “public good” of wealth generation for a handful of powerful companies? Should these communities be given the choice? The answer to the latter is irrefutably yes. Continuing on the current trajectory is skewing the power, both monetarily and in terms of decision making, away from those within these communities. The fossil fuel path-dependency is further entrenched; efforts toward energy diversification are undermined.

The oil industry might aim to eradicate the “has versus the has nots” situation it as created, and begin to work toward the concept of renewable energy as a common public good. An alignment of efforts toward research and development within the energy sector should be predominant in order to truly craft an “All of the Above” domestic energy strategy.

REFERENCES

Alacevich, Michele. "Visualizing Uncertainties, or How Albert Hirschman and the World Bank Disagreed on Project Appraisal and Development Approaches." The World Bank Information Management and Technology Network Knowledge and Information Services Unit. November 2012. Accessed April 7, 2014 http://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-6260

Amsden, Alice Hoffenberg. "Industrializing Late" in "The Rise of "the Rest": Challenges to the West from Late-Industrialization Economies." Oxford University Press, 2001.

Amundson, Michael. Home on the Range No More: The Boom and Bust of a Wyoming Uranium Mining Town, 1957, 1988. Western Historical Quarterly. 26, pp 483-505. Western History Association. Winter 1995. Web. http://www.sublettewyo.com/ArchiveCenter/ViewFile/Item/87

Atkinson, Giles, and Kirk Hamilton. "Savings, Growth and the Resource Curse Hypothesis." World Development 31.11 (2003): 793-807.

Auty, Richard Natural resources, capital accumulation and the natural resource curse. Ecological Economics. 2007. 61, pp 627-634

Blanchard O. and L. Katz. (1996). What we know and do not know about the natural rate of unemployment. National Bureau of Economic Research, Cambridge, MA. http://www.nber.org/papers/w5822.pdf?new_window=1

Block, Fred. "Swimming against the current: The rise of a hidden developmental state in the United States." Politics & Society 36.2 (2008): 169-206.

Bluestone, Barry and Bennett Harrison. 1982. The Deindustrialization of America.

Bjorlykke, Cecile. Islands and oil – locality and structure: The consequences of larger oil investments in two local communities. Shetland in Great Britain and Oygarden in Norway. 1996

Breining, Beth. "Interview with Thermopolis past language arts teacher." Personal interview. Jan. 2014.

Brunnschweiler, Christa. Cursing the Blessings? Natural Resource Abundance, Institutions, and Economic Growth. World Development. 2007. 36, pp. 399-419.

Bureau of Land Management. Pinedale Anticline Natural Gas Exploration and Development Project Environmental Impact Statement. Sublette County, Wyoming. 2000. http://www.blm.gov/wy/st/en/info/NEPA/documents/pfo/anticline.html

Bureau of Land Management. "Chapter 2: Proposed Action and Alternatives" in Gas Hills Uranium Project Final Environmental Impact Statement. February 2014. Accessed http://www.blm.gov/wy/st/en/info/NEPA/documents/lfo/gashills.html

Cheshire, Lynda. A corporate responsibility? The constitution of fly-in, fly-out mining companies as governance partners in remote, mine-affected localities. 2009. Journal of Rural Studies 26, pp 12-20.

Conan, Neal, John McChesney and Ann Chambers Noble. Gas, Oil Booms Bring Complications to Small Towns. NPR, Talk of the Nation. February 11, 2013.

Conley, Timothy G., and Giorgio Topa. "Socioeconomic distance and spatial patterns in unemployment." Journal of Applied Econometrics 17.4 (2002): 303-327. Web. 30 Oct. 2013. http://onlinelibrary.wiley.com/doi/10.1002/jae.670/full

Dahl, Kate. "Interview with Planning and Zoning Administrator." Pinedale, Wyoming. Personal interview. Jan. 9, 2014.

Davey, Monica. "North Dakota Has Jobs Aplenty But Few Places to Live." The New York Times, April 20, 2010. http://www.nytimes.com/2010/04/21/us/21ndakota.html?_r=0. Retrieved October 30, 2013.

David, Paul A. "Clio and the Economics of QWERTY." The American Economic Review 75.2 (1985): 332-337.

Deacon, Robert T. and Ashwin Rode. "Rent Seeking and the Resource Curse." September 26, 2012. http://www.econ.ucsb.edu/~deacon/RentSeekingResourceCurse%20Sept%2026.pdf

Environmental Working Group. "Chapter 12: EWG Recommendations" in Who Owns the West? An Investigation into Oil and Gas Leases. http://www.ewg.org/oil_and_gas/execsumm.php

Finewood, M. and L. Stroup. (2012). Fracking and the Neoliberalization of the Hydro-Social Cycle in Pennsylvania's Marcellus Shale. Journal of Contemporary Water Research & Education, 147, pp. 72-79. http://onlinelibrary.wiley.com/doi/10.1111/j.1936-704X.2012.03104.x/pdf

FracTracker Organization. (2010). http://www.fractracker.org/map/

Galbraith, Kate. "Strong Rules on Fracking in Wyoming Seen as Model." The New York Times. 22 Nov. 2013. Web. 21 Apr. 2014. <http://www.nytimes.com/2013/11/23/business/energy-environment/wyomings-strong-fracking-rules-may-be-a-model.html?_r=0>.

Gilman, Sarah. "Citizen oversight fizzles in Wyoming gas patch." High County News. November 6, 2012. Web. February 20, 2014 http://www.hcn.org/blogs/goat/citizen-oversight-fizzles-in-wyoming-gas-patch

Gore, Charles. "The Rise and Fall of the Washington Consensus as a Paradigm for Developing Countries." World Development, 28.5 (2000):789-804.

Hadley, Walter. "Personal interview with McKenzie County Planning Director." January 13, 2014.

Hatakenaka, Sachi, Petter Westnes, Martin Gjelsvik, and Richard K. Lester. “From ‘Black Gold’ to ‘Human Gold’: A Comparative Case Study of the Transition from a Resource-Based to a Knowledge Economy in Stavanger and Aberdeen.” MIT IPC Local Innovation Systems Working Paper 06-002, 2006. Retrieved March 11, 2014. http://web.mit.edu/lis/papers/LIS06-002.pdf

Hirschman, Albert O. The Strategy of Economic Development, New Haven: Yale University Press. 1958.

H.R. 1134, 63rd Cong. (2013) (enacted).

Huntington, Rebecca. Pinedale Weighs in on the Housing Crisis. Wyoming Public Radio, Open Spaces Podcast. June 18, 2007. Web. February 5, 2014. <http://wyomingpublicmedia.org/post/pinedale-weighs-housing-crisis>.

Jones, Peter, David Hillier, and Daphne Comfort. “Fracking and public relations: rehearsing the arguments and making the case.” Journal of Public Affairs 13.4 (2013): 384-390. Web. 11 Nov. 2013 http://onlinelibrary.wiley.com/doi/10.1002/pa.1490/pdf

Kesidou, Effie. “Chapter 5” (The political economy of technology policy: The automotive sector in Brazil (1950–2000)) in Mani, Sunil, and Henny Romijn, eds. “Innovation, learning, and technological dynamism of developing countries.” United Nations Univ. Press, 2004

Kidston, Martin. “Hot Springs County moving forward with new airport.” Billings Gazette. April 3, 2012. http://billingsgazette.com/news/state-and-regional/wyoming/hot-springs-county-moving-forward-with-new-airport/article_dfe57817-5776-5df6-a79a-1f993998e142.html

Kidston, Martin. “Town of Thermopolis down but not out.” Billings Gazette. March 24, 2011. http://billingsgazette.com/news/state-and-regional/wyoming/town-of-thermopolis-down-but-not-out/article_5742766a-0375-5895-8076-8e86152afbc3.html

Kiefer, David, and Jan Miller. “Public budgets and public capital in boom towns.” Policy Sciences 16.4 (1984): 349-369. Web. 13 Oct. 2013. http://link.springer.com/article/10.1007/BF00135954#page-1

Kobza, Marty. “Interview with Thermopolis past Superintendent.” Telephone interview. Jan. 2014.

Kolstad, Ivar and Arne Wiig. It’s the rents, stupid! The political economy of the resource curse. Energy Policy. 2009. 37, pp. 5317-5325

Krauss, Richard. “Applying Creativity to a Byproduct of Oil Drilling.” The New York Times 17 Dec. 2013, sec. Energy & Environment. Web. Accessed 17 Dec. 2013. <http://www.nytimes.com/2014/01/30/business/energy-environment/industry-in-north-dakota-promises-to-reduce-flared-natural-gas.html?_r=0>

Krueger, Anne O. “The Political Economy

of the Rent-Seeking Society." American Economic Review 64.3 (June 1974): 291-303.

Krugman, P. (1994). Past and prospective causes of high unemployment. Economic Review-Federal Reserve Bank of Kansas City, 79, 22-23.

Lall, Sanjaya. "Technological capabilities and industrialization." World Development 20.2 (1992): 165-186.

Larsen, Erling R. Escaping the Resource Curse and the Dutch Disease? When and Why Norway Caught up with and Forged Ahead of Its Neighbors. American Journal of Economics and Sociology Vol. 65, No. 3, Natural Resources, Taxation, and Regulation: Unusual Perspectives on a Classic Topic, (2006): 605-640. Web 11 Oct. 2013. http://www.jstor.org/stable/27739583

Lester, Richard K. (Ed.) Universities, Innovation, and the Competitiveness of Local Economies: A Summary Report from the Local Innovation Systems Project—Phase I. Industrial Performance Center Massachusetts Institute of Technology, IPC LIS Project, 2006.

Martin, Jonathan. "Urban Design." Land Use Planning. Columbia University's Graduate School of Architecture, Planning & Preservation, New York. 1 Mar. 2014. Lecture.

Matsuyama, K. "Agricultural Productivity, Comparative Advantage, and Economic Growth." Journal of Economic Theory. (1992): 317-334. Web. 12 Oct. 2014

McChesney, John. The West as Carbon Colony: Echoes of Boom and Bust. Rural West Initiative, Bill Lane Center for the American West. Stanford University. July 5, 2012. Web. Feb. 5, 2014. <http://www.stanford.edu/group/ruralwest/cgi-bin/drupal/content/west-as-carbon-colony>.

McElmurray, Brannen. Financing the Green Economy: Markets, Business and Politics. Lecture. Columbia University's School of International and Public Affairs, New York. 4 Feb. 2013.

McNicoll, I. Pattern of Oil Impact on Affected Scottish Rural Areas. 1984.

Miller, Brent, John Paneitz, Michael Mullen, Raymond Meijis, Karl Tunstall and Mario Garcia (2008). The Successful Application of a Compartmental Completion Technique to Isoloate Multiple Hydraulic-Fracture Treatments in Horizontal Bakken Shale Wells in North Dakota. Conference Paper. Society of Petroleum Engineers. https://www.onepetro.org/conference-paper/SPE-116469-MS

Morath, Eric. "Where are the U.S.'s Millionaires?" The Wall Street Journal. January 16, 2014. http://online.wsj.com/news/articles/SB10001424052702304603704579324582732899244#2

Nickel, S. Unemployment and Labor Market Rigidities: Europe versus North America. The Journal of Economic Perspectives, 11, 3. pp. 55-74. 1997. http://www.jstor.org/

stable/2138184?seq=10

Noble, Ann Chambers. Pinedale, Wyoming. Wyoming History Encyclopedia. http://www.wyohistory.org/encyclopedia/pinedale-wyoming

Noble, Ann Chambers. The Jonah Field and Pinedale Anticline: A natural gas success story. Wyoming History Encyclopedia. 2009. http://www.wyohistory.org/essays/jonah-field-and-pinedale-anticline-natural-gas-success-story

North Dakota Department of Trust Lands. "Current Auction List" in Oil and Gas Leasing. January 3, 2014. http://land.nd.gov/minerals/oilandgasleasing.aspx

North Dakota Petroleum Council. Surface Owner Information Center. 2012. http://www.ndoil.org/?id=184

North Dakota State Government (2013). 2013 Monthly Statistical Update – Industrial Commission of North Dakota Oil & Gas Division. North Dakota Drilling and Production Statistics. https://www.dmr.nd.gov/oilgas/stats/statisticsvw.asp

Papyrakis, Elissaios, and Reyer Gerlagh. "Resource Abundance and Economic Growth in the United States." European Economic Review 51.4 (2007): 1109-039. Web. 11 Oct. 2013.

Rauschenberger, Ryan. Oil and Gas Tax. Office of State Tax Commissioner, North Dakota State Tax Department. http://www.nd.gov/tax/misc/faq/oilgas/index.html#Question1

Roberts, Phil. "Chapter 9: History of Wyoming Oil" in A New History of Wyoming. http://www.uwyo.edu/robertshistory/new_history_of_wyoming_chapter_19.htm

Rodriguez, Francisco & Jeffrey Sachs. Why do Resource-Abundant Economies Grow More Slowly? Journal of Economic Growth 1999. 4:3, pp 277-303.

Sabel, Charles F. "Learning by Monitoring: The Institutions of Economic Development." Working Paper No. 102, Center for Law and Economics, Columbia Law School. 1993. Accessed 1 March 2014. http://www.law.columbia.edu/null/Working+paper+No?exclusive=filemgr.download&file_id=64129&showthumb=0

Sachs, Jeffrey & Andrew Warner. Natural Resource Abundance and Economic Growth, working paper. National Bureau of Economic Research. 1995.

Spring, Matt. "Interview with Thermopolis past Principal." Telephone interview. 20 Jan. 2014.

Srinivas, Smita, and Kimmo Viljamaa. "Emergence of economic institutions: Analysing the third role of universities in Turku, Finland." Regional Studies 42.3 (2008): 323-341.

Srinivas, Smita, et al. "Varieties of Innovation and Welfare Regimes: The Leap from R&D Projects to the Development of City-regions." European Planning Studies 16.9 (2008):

1267-1291.

Sublette Board of County Commissioners. State of the County 2007-2008. <http://www.pinedaleonline.com/stateofcounty0708web.pdf>
Sublette Board of County Commissioners. State of the County 2012-2013. <http://www.sublettewyo.com/DocumentCenter/Home/View/388>.

Sublette County. Natural Gas & Oil Statistics. 2012. <http://www.sublettewyo.com/index.aspx?NID=272>.

Swanson, Joshua. "The Fine Print Matters: Negotiating an Oil and Gas Lease in North Dakota." North Dakota Law Review 87.703. 2011. 703-16. Accessed 10 Apr. 2014. <http://web.law.und.edu/LawReview/issues/web_assets/pdf/87/87-4/87ndlr703.pdf>.

Tilly, Chris. "Wal-Mart and its workers: NOT the same all over the world." Conn. L. Rev. 39 (2006): 1805.

Thoren, Cortney. "Interview with Thermopolis current guidance counselor." Personal interview. Jan. 2014.

Tonts, Matthew, Kirsten Martinus, Paul Plummer. Regional development, redistribution and the extraction of mineral resources: The Western Australian Goldfields as a resource bank. The University of Western Australia, 2013. Applied Geography, pp. 1-10.

Town Council of Pinedale, Wyoming. State of the Town 2012-2013. Print.

Upper Great Plains Transportation Institute & North Dakota State University. "An Assessment of County and Local Road Infrastructure Needs in North Dakota." Report submitted to 63rd North Dakota Legislative Assembly. September 20, 2012. Web. http://www.ugpti.org/downloads/2012_road_investment_needs_final_report.pdf

Upton, John. "Rents in this North Dakota oil town are now higher than in NYC or San Francisco." Grist. February 18, 2014. http://grist.org/food/rents-in-north-dakota-oil-town-now-higher-than-in-nyc-or-san-francisco/

U.S. Energy Information Administration. "Today in Energy." February 3, 2012. Accessed http://www.eia.gov/todayinenergy/detail.cfm?id=4850

U.S. Energy Information Administration. Crude Oil Production. Petroleum & Other Liquids. 2013. http://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_m.htm

USDA, National Agricultural Statistics Service. 2009 County Rents and Values. March 2009. http://www.nass.usda.gov/Statistics_by_State/North_Dakota/Publications/Land_Values_and_Farm_Numbers/pub/crents09.pdf

USGS (2008). National Assessment of Oil and Gas Fact Sheet – Assessment of Undiscovered Oil Resources in the Devonian-

Mississippian Bakken Formation, Williston Basin Province, Montana and North Dakota. https://www.dmr.nd.gov/ndgs/bakken/PDF/USGSBakkenAssessmentProject.pdf

Western Exploration and Production, LP; QEP Energy Company; Ultra Petroleum. April 2012. http://www.papaoperators.com/PAPA_LGS_Winter_Grouse_Final_WWC_Report.pdf

The White House. "Blueprint for a Secure Energy Future." March 30, 2011. Accessed March 31, 2014. http://www.whitehouse.gov/sites/default/files/blueprint_secure_energy_future.pdf

Woodard, Claire. Cow Town to Boom Town: A Series of Multimedia Essays. Rural West Initiative, Bill Lane Center for the American West. Stanford University. June 2011. Web. February 5, 2014. <http://www.stanford.edu/group/ruralwest/cgi-bin/drupal/energy/boomtown-introduction#video>.

Wyoming Wildlife Consultants, LLC. "Greater Sage-Grouse Winter Habitat Selection Relative to Natural Gas Field Infrastructure in Northern Portions of the Pinedale Anticline Project Area in Sublette County, Wyoming. Final Report, Prepared for Shell

APPENDIX A

With a goal of examining the validity of the claim that resource extraction projects boost labor opportunities, this regression model uses 2010 American Community Survey five-year estimate data for all 50 states. The model tests whether there is a correlation between fracking and unemployment rates, holding other factors that contribute to labor opportunities constant. An independent dummy variable was added in order to test the level of significance and potential correlation of unemployment rates in states that allow hydraulic fracturing drilling with those that don't.

Each state's percentage of those over 25 with a college level (4 year degree) educational attainment within the population was controlled for (U.S. Census Bureau, ACS, 2010), as it is widely presumed that education leads to increased employment opportunities. Welfare spending, or a system that collects taxes that are used to support the poor, unemployed or other groups perceived as needing assistance was included. Krugman (1994) evaluated the question of how a welfare state might create unemployment by comparing the amount of money paid by the government to welfare in several European countries and the United States. He found "the generosity of Europe's welfare states is in some sense responsible for the rise in their unemployment rate" (57). Many align with this theory, believing that federal handouts lead to sloth and lower worker productivity among populations. This theory is a hot topic today, as government officials have historically pointed to welfare spending as one cause for high unemployment rates. The amount of revenue each state pays toward (US Bureau of Economic Analysis & US Government Printing Office, as compiled by US Government Spending, 2010) divided by total population provides evidence as to whether increased welfare spending is in fact correlated with higher rates of unemployment.

Finally, a variable was added measuring the proportion of low income households (those paying less than $25,000 a year[13]) within each state (Census Bureau, 2010). Blanchard and Katz (1996) found that when job conditions are poor, workers might opt not to work and instead rely on federal subsidies such as unemployment checks. In a depressed labor market, such as the one many localities faced in 2010 after the economic crisis of 2008, workers might be willing to settle for a lower working wage, and therefore their bargaining or bottom-line wage may decrease. This will lower overall wages, "which makes a worker indifferent to being employed or unemployed" (Blanchard and Katz, 2010). The researchers stated, "People facing poor work opportunities relative to their [bottom-line] wage are likely to spend some of their time in and out of employment." Although this variable was not a statistically significant determinant of unemployment, the theory supporting including this variable in the model is strong. I believe this variable may be more telling

11 The U.S. Federal Poverty Guideline considers families of 3 earning less than $19,530 to qualify for welfare (average household size was 2.6 for this year of analysis).

with the addition of more observations and I decided to keep this variable in my model.

Variables Considered but Excluded from Model

With the charge of providing measures of spatial dependence in Chicago in relation to unemployment, Conley and Topa (2002) generated a variable measuring the average distance traveled to work among several neighborhoods in Chicago. This variable was chosen based on the belief that the social networks that are developed through a person's existence within their town and neighborhood may contribute to a person's job acquisition process. The researchers found there to be "a strong positive and statistically significant degree of spatial dependence in the distribution of raw unemployment rates" (304). Following this vein, a variable was considered that would measure the percentage of people that work within their own state (US Census) will be important in portraying commuter patterns; a state with a high percentage of commuters may similarly have high unemployment rates, due to the potential difficulty for immobile populations to reach work if such opportunities are not available within the state. This variable was excluded due to the model and other statistically significant variables becoming less significant when the variable was added. This is likely due to the data revealing very few states having high residents traveling out-of-state. This variable may be more telling when utilized at a smaller unit of analysis, such as at the city level.

The rate of population change between 2005 and 2010 (U.S. Census Bureau, ACS, 2005, 2010) was considered to determine whether large influx/exodus of people, presumably in the labor market, correlate with changes in rates of employment. Blanchard and Katz (1996) argue that larger flows of people will lead to higher rates of unemployment (particularly in the unskilled labor force). This variable is interesting in terms of boomtowns, as these areas are characterized by exactly that: large flows of people into labor market. Hydraulic fracturing became deregulated in 2005, therefore the correlation between unemployment rates and population change within this time span may have been particularly telling. This variable was also excluded due to the model and other statistically significant variables becoming less significant when the variable was added. I believe this occurred because states did not differ much in population change rates, with no states experiencing negative growth in the years examined. Again this variable may be more telling when utilized at a smaller unit of analysis, such as the city level.

Finally, in order to control for age demographics, a variable was considered that measured the percentage of the population within working age (U.S. Census Bureau, ACS, 2010). Because this population is the bulk of the labor force, it might be influential in determining whether there is a relationship between unemployment rates and areas with high or low proportions of those in the labor force. Nickel (1997) provided a similar variable when comparing

unemployment rates in the United States versus Europe. The regression revealed that although the variable did not make the model as a whole insignificant, this variable was only significant at a 10 percent confidence level and was therefore dropped from the analysis.

Secondary Data Sources:

U.S. Census Bureau, ACS, 2005 & 2010: Demographic and Housing Estimates (DP05) – Percentage of population between 18 and 65 years; Rate of population change between 2005 and 2010; Educational attainment household income

Commuter Adjusted Daytime Populations – Percentage of population that works within state of residence

US Bureau of Economic Analysis & US Government Printing Office, as compiled by US Government Spending, 2010: State welfare spending (divided by population to control for differences in states' population size)

FracTracker.org: state fracking data

Regression model in equation format
Unemployment rates = [non] fracking state + educational attainment + state welfare spending + proportion of low wage population

Results
States that host hydraulic fracturing resource extraction projects have an unemployment rate that is 1.08 percent less than those that do not, holding educational attainment, welfare spending and proportion the population's low wage earners constant. This variable is statistically significant at a 90 percent confidence level.

With every percentage increase in a population's college level educational attainment, the unemployment rate decreases by 16 percent, holding welfare spending, resource extraction projects and the proportion of a population's low wage earners constant. With every additional dollar spent on welfare by the state, the unemployment rate increases by .00199 percent, holding the aforementioned variables constant. These variables are statistically significant at a 95 percent confidence level. Finally, with every percentage increase in low wage earners in a population, the unemployment rate increases by 1.8 percent, holding other variables constant. This variable is not statistically significant, but remained in the analysis due to theory.

APPENDIX B: SAMPLE INTERVIEW QUESTIONS

- When did hydraulic fracturing begin in your area?
- Why did the state decide to allow fracking? Were there any hesitations?
- What is the major motivation behind allowing fracking to occur?
- Has here been public opposition?
- Can you describe any major changes within nearby communities that have occurred due to oil and gas development?
- Has your state had any boom or bust towns in the last 20 years?
- Have there been any projects or policies in place to support communities that are hosting such projects?
- How are royalties spent and/or invested?
- Is royalty spending decided by the state or locally?
- Is there a specific political model you follow with regard to royalty management?
- What is the long-term plan for mineral development in your area?
- Have there been major investments or improvements made at the city level in order to absorb impacts? For instance have there been infrastructure improvements, additional housing units, changes to educational facilities and/or staff, economic development initiatives?
- Do oil and gas project developers pay any sort of exaction or fee to the city?
- Can you describe the coordination involved between permit approvals and building plans to meet the influx of people?
- What is the environmental review for permit approval?
- What is the coordination between federal agencies (BLM) and the city for energy development?
- How do you balance inflated prices due to the energy boom with accommodating local residents and tourists?
- Are there initiatives to diversify the economy? For example, are there pushes for people to work in other sectors than energy and supporting industries?
- Education initiatives?
- Do universities and/or colleges benefit from the boom? How?
- How has the tax structure changed ?