FRACTURED CONSENT: PUBLIC PARTICIPATION IN ENVIRONMENTAL COMPLEXITY

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ABSTRACT

The 21st century marks an era of both progress and uncertainty. As our energy needs become greater, many people are concerned that development affects the environment in significantly negative ways. With an increasing amount of research and information, we might expect more participation around issues related to the environment. However, the existence of competing ideologies has led to uncertainty and distrust about the scientific credibility of environmental impact statements, especially those related to the oil and gas industries. A case characterized by uncertainty is decision-making around the use of hydraulic fracturing as a method of natural gas extraction.

To address this uncertainty and complexity in human-environment relationships, there is a need for more precise, non-partisan research to inform environmental decision-making. New participatory tools, such as open source mapping and GPS-enabled sensors, allow citizens to generate and share local, ground-level data that is not only useful to the policymaking process, but also, more transparent to the general public. This form of data collection provides a way to combine local-level research data to location-based information, thereby affording a more in-depth understanding of the sources of pollution and how they relate to the proximity of the energy industry. To explore these possibilities, this thesis addresses the following questions: How do citizens engage in environmental decision-making in the context of rapid energy development? What accounts for failure and success in participatory measures? How can
technology be used to contribute to scientific discussion about environmental issues?
Subsequently, what are some of the barriers and biases of the uses of such tools?
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The first things I ever wrote were mysteries and love songs. Everything is still a mystery and a love song to me.

(And the Pleasure of Life)
Beneath the fog, I miss the hot breath
Of lovers’ abated anticipation
Forgive me, death
I have not forsaken you.
Take caution in your felicitations
For we have not proved our innocence yet
“...[this work] may be the means of giving rise to something better. Could the straggling thoughts of individuals be collected, they would frequently form materials for wise and able men to improve into useful matter.” – Thomas Paine, Common Sense

I haven’t been back to this place in five years. Inexperienced and curious about the world, I impulsively decided to leave the comforts of my home in Louisiana for the mysterious, dusty stretch of land that is Wyoming\(^1\). One week later I found myself driving to Pinedale, Wyoming with only a suitcase of summer clothes, a Toyota Corolla, 19 years of life experience, and a little dose of gumption perhaps mostly fueled by naivety and innocence.

The spark that ignited this research began on that first 1,526 mile-journey out West. In awe of the isolation and vastness of the region, I came to the realization that my entire life has been a conflict between my individuality within the context of a collectively shared environment. In a more tangible way, the very reason for my solitary escape out West was predicated on not only the technological innovations of our era but also on the massive development taking place, which provided the opportunity of relocation for wandering souls such as myself.

This is a research project first and foremost. However, it is also a labor of love as all great endeavors either begin as or come to be. Fortunately, my love of the area preceded this research. Born and raised in rural Louisiana, I find many parallels between the mountainous embraces of the West and the swampy cradle of the South. I find both are communities often misunderstood by the rest of the nation. They both share individualistic political ideologies, but are closely reliant on their communities. I find that people are welcoming but suspicious of change. I find people take their government for granted and have too much confidence in industry and the free

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\(^1\) The name ‘Wyoming’ “comes from an Indian word meaning ‘at the great plains,’ but the plains are really valleys, great arid valleys, sixteen hundred square miles, with the horizon bending up on all sides into mountain ranges. This gives the vastness a sheltering look” (Ehrlich, 1985).
market. All over the world we find similarities in those who are not like us. However, I have come to discover that so much of what makes us different are the institutions and settings in which we are embedded. This particular study will attempt to explore both those attributes that span across humanity and those that are particular to the special community in rural Wyoming that I have come upon by happenstance.
Chapter I: Introduction

The 21st century marks an era of both progress and uncertainty. From reports on fledgling global economies to natural disasters devastating communities to an increasing demand for declining resources, it is not entirely clear how to approach these issues. As our energy needs become greater, many people are concerned that development affects the environment in significantly negative ways. This concern is evident in the actions of the public and private sectors to alleviate some of the negative effects of development. For example, in response to the Exxon-Valdez disaster of 1989, government limited the actions of industry under the Oil Pollution Act of 1990. Despite attempts to mitigate energy-related disasters, the oil and gas industry “has accounted for hundreds of deaths, explosions, fires, seeps, and spills as well as habitat and wildlife destruction in the United States” (Warman, Doyle, & Mejia, 2010, p. 2) between 2000 and 2010. Since 2010, there have been more than 25 disasters related to energy development, most notably the disaster at Fukushima and the Deep Horizon blowout in the Gulf of Mexico. Energy disasters such as the Deep Horizon blowout impacted the region by spewing 170 million gallons of crude oil and 200,000 metric tons of methane gas into the Gulf (NRDC, 2011). In the short term, a disaster such as this impacts the region by immediately eradicating its wildlife local to the region; however, research (NRDC, 2011) shows that long-term effects on

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2 Montgomery and Smith (2010) report Daniel Yergin’s, chairman of the consultancy IHS CERA, prediction “that world energy demand will increase 32%-40% over the next 20 years.”

3 Some of the limits include the provision of a spill contingency plan, increasing the responsibility of a “vessel or facility from which oil is discharged” (“Oil pollution act overview,” 2011).
wildlife, air quality, seafood safety, and worker and community health are deeply negatively impacted as well.

Notwithstanding the evidence of short- and long-term environmental damage related to industrial development, public participation around these issues has not kept pace. Riley Dunlap’s (2010) commentary on a Gallup poll on environmental attitudes shows that since 2000, there has only been a “slight increase in the percentage of Americans claiming to be active participants in the environmental movement, from 16% to 19%.”

With an increasing amount of research and information, we might expect more participation around issues related to the environment. For example, with greater information about health problems related to cigarette smoking comes greater advocacy to deter smokers from continuing to engage in negative behavior. However, the increase in information and existence of competing ideologies has led to uncertainty and distrust about the scientific credibility of environmental impact assessments, especially those related to the oil and gas industries. For example, a study at Cornell University found that far from being a 'clean' fuel, natural gas contributes to global warming even more than coal (Howarth, Santoro, & Ingraffea, 2011). Howarth et al. (2011) show that when viewed on a “20-year time horizon after emission, the greenhouse gas footprint of shale gas is considerably greater than that for coal or diesel oil.” The following year another Cornell professor, Lawrence Cathles, disputed this research (Cathles, Brown, Hunter, & Taam, 2012). Furthermore, Bloomberg News reports that a study conducted by a University of Texas professor "found no evidence of groundwater contamination from fracking but failed to disclose that the author sat on the board of a gas-producing company with fracking operations in Texas" (“Fracking needs rules,” 2012).
This polarization is due in part to a dramatic decline in federal research and development spending on energy, relegating funding primarily to industry. Science Insider in conjunction with the American Association for the Advancement of Science (AAAS) reports that “U.S. government science funding programs would see their budgets cut by 8.2% in 2013 unless Congress agrees on a plan to trim budget deficits by the start of the new year” (Malakoff, 2012). Furthermore, the issue of energy development is mired with partisan predilections. The Pew Research Center for the People and the Press reports that “nearly eight-in-ten Republicans and Republican leaners favor allowing more mining and drilling on federally owned land; just 46% of Democrats and Democratic leaners support this policy” (Pew Research Center, 2011). This growing divide and dearth in federal funding have contributed to conflicting scientific research (Malakoff, 2012).

To understand human-environment relationships, there is a need for precise, non-partisan, and collaborative research to inform environmental decision-making. However, this is not always acquired through formal processes of engagement. For example, in an attempt to acquire information, citizens often advocate to fund research projects they deem important to the environmental issue at hand; however, once the funding is received, these citizens are often left out of the research process, increasing the level of distrust and misunderstanding regarding scientific issues (Irwin, 2012; Oreskes & Conway, 2011).

As literature on public participation (Baber & Bartlett, 2005; Bessette, 1980; Pettit, 2003) shows, engaging the public in deliberation over policymaking effectively increases citizen trust

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4 It should be noted that in total these figures equal a majority if we hold third parties as a null set. I simply seek to show that there is a slight partisan leaning with regard to extraction on federal lands.
in government and industry actions. However, traditional methods of engagement such as voting, attending public hearings, and writing referendums do not always represent the majority. To better integrate citizens in the policymaking process, including them in the scientific process has proven effective for not only building trust about scientific results, but also contributing to more locally specific information. One example of a successful citizen science project is the Ancient Forest Alliance, which relied on citizens to map the forests important to them. By relying on local citizens as experts, the alliance demonstrated that a grassroots organization of people could effectively chart values with relation to physical space. This form of interaction is often referred to as Public Participation in Scientific Research (PPSR) or citizen science. Public Participation in Scientific Research (PPSR), or community-based research, is defined as an informal science in which the public is directly involved in the process of research in a symbiotic relationship between scientist and citizen. This includes collection and documentation of information characteristic to local-level knowledge.

For citizen science to be effective there is a need for not only volunteered time from citizens, but standardized ways of collecting information (Kingston, 2007; Goodchild, 2007; Estima, 2012). New participatory tools, such as open source mapping and GPS-enabled sensors, allow citizens to generate and share local, ground-level data that is not only useful to the policymaking process, but also, more transparent to the general public. This form of data collection provides a way to combine local-level research data to location-based information, thereby affording a more in-depth understanding of the sources of pollution and how they relate to the proximity of the energy industry as well as individuals involved in the data collection. The ability to do this stems in part from the introduction in 2005 of Google Maps and its Application
Programming Interface (API). As Schlossberg and Shuford point out: “a map can facilitate mutual understanding and common agreement about facts, and can be used to develop trusting relationships across a diverse set of participants” (2005, p. 16).

The emergence of these interactive digital technologies begs the question of whether or not they might be employed to provide citizens with ways to contribute to the documentation and communication of data relating to the environment and, in the process, help to build a more cohesive community oriented toward collective action.

One energy issue that could benefit from more precise information is the use of hydraulic fracturing as a method of natural gas extraction. Hydraulic fracturing is a method of extracting natural gas from the shale gas reserves. To carry out this process a combination of chemicals and mostly water is injected into the rock formation to crack the rock and release the gas. Because we know so little about the potential negative effects on the health of the community—physically, economically, aesthetically, and spiritually—this issue is not only ambiguous but also highly contentious. Although some community members contend that this extraction method will cause irreversible damage to their local area (Koshmrl, 2012; Nolan, John, & Polidoro, 2012; Argetsinger, 2011), others favor hydraulic fracturing on the assumption that it will attract revenue critical to mitigating economic stagnation (Montgomery & Smith, 2010). Some point out that natural gas is a cleaner alternative to energy sources such as coal and oil, making the nation more energy independent (Miller, Loder, & Polson, 2012); however, others fear that the reliance on natural gas will deter efforts to move to renewable energy sources (Ingraffea, 2013; Howarth et al., 2011). Given the nuances of this problem and the way in which information is exchanged
between citizens, governmental agencies, scientists and industry representatives, to what extent do citizens coordinate to make decisions with regard to natural gas extraction?

Specifically, this thesis addresses the following questions:

• How do citizens engage in environmental decision-making in the context of rapid energy development? What accounts for failure and success in participatory measures?

• How can technology be used to contribute to scientific discussion about environmental issues? Subsequently, what are some of the barriers and biases of the uses of such tools?

• To what extent are information and communications technologies (ICTs) being used to mitigate uncertainty in environmental issues? How is or can technological innovations be used for research? Are there opportunities for greater participation?

This thesis researches the above questions and identifies their affordances and constraints.

One way to explore these questions is through a grounded theory methodology using a case study by employing interpretive inquiry through interviews. Case study research is a qualitative research method, which investigates how and why certain phenomena exist with respect to a real-life problem. This approach is appropriate for studying public engagement in environmental decision-making because it allows for the flexibility to encourage the interviewees’ perspective to emerge out of the data, rather than prescribing prior assumptions to the interaction with informants. Case studies provide an opportunity to compare the expectations we hold given our theoretical framework with what happens in practice. The analysis of public
participation informs the fundamentals of collaborative planning and effective citizen participation. Because the nature of this research is exploratory, a case study offers an appropriate area to begin an investigation about the way in which citizens behave in real-life contexts.

I began this research with sensitivities to themes of collective action, community disruption, and ill effects of rapid energy development. For this reason, questions were less focused on uncovering a truth about the negative aspects of industry; rather, this research centered on the controversy between residents, workers, government, industry, and scientists that emerged regarding hydraulic fracturing. Therefore, the literature review highlights what has been said regarding public participation, social capital, and collective action. It also reviews literature on citizen engagement in scientific research, and technological tools citizens have utilized to make this process easier. The theoretical sensitivities that emerged from the literature review were used as initial codes in the data analysis. Over multiple reviews of the data, I developed more comprehensive themes.

An area typified by uncertainty and dissent with regard to hydraulic fracturing is Sublette County, Wyoming\(^5\). The reasons for selecting Sublette County, WY are listed below:

- Sublette County, Wyoming is home to some of the largest natural gas reserves in the nation (“State of the County,” 2013).
- It is also a relatively isolated community located in the West—where inhabitants have historically had close connections to the land for survival. Because the community is so isolated, their subsistence has been provided by the main

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\(^5\) For the purposes of this thesis, I will focus on the Pinedale Anticline and Jonah Fields.
industries in the area, which are cattle grazing and tourism—both of which are dependent on the land.

- Furthermore, informal conversations with citizens indicate that the funding of an air quality-monitoring project, which employs mobile sensors and GPS-enabled devices, is currently being discussed.

This case provides a place to investigate how scientists, citizens, the government, and industry are involved in environmental policymaking process through data collection and analysis. To this end, it will first characterize the literature that addresses public participation in environmental decision-making. The thesis highlights some of the important innovations in citizen science that have advanced the collection and communication of data.

The next chapter, Chapter Two: The Contextual Framework, situates this research within the history of Sublette County and the present issue of hydraulic fracturing. It explains the national approach to hydraulic fracturing in an effort to better understand what role small communities can play vis a vis large-scale industries. Chapter Three: Background and Methods explores the case study in Sublette County to understand how citizens in a small community close to natural gas reserves have interacted with science and technology to mitigate uncertainty around environmental impacts of energy development. To do this, I rely on ethnographic field research in the form of interpretive inquiry through interviews. To complement this analysis, this section provides a history of the area to understand how citizens have behaved in the past, and describes how access to information technologies has affected their engagement with scientific issues. Following this, Chapter Four: Data and Analysis: Sublette County, WY examines the extent to which information technologies can be utilized for more robust data collection and
communication. It examines the ways citizens report engaging in environmental decision-making. Next, it will describe the sensor technology, its use in environmental documentation in Sublette County, and its evolving role in citizen involvement in scientific research showing how citizens and scientists have interacted to reduce uncertainty and contribute to more precise, non-partisan data. Finally, Chapter Five: Conclusion offers concluding remarks on ways digital technologies are being used in citizen science with regard to energy development. It presents the findings of the case and relates them to our present state of knowledge about public participation and the use of technology.

This research seeks to enhance our understanding of the possibilities for public engagement in environmental decision-making. This research addresses hydraulic fracturing as the case because it is a timely and relevant issue for the 21st century, one that is highly contentious given the various interest groups involved.
Chapter II: The Conceptual Framework

Our national myths often exaggerate the role of individual heroes and understate the importance of collective effort...the myth of rugged individualism continues to strike a powerful inner chord in the American psyche. Robert Putnam, *Bowling Alone*, p. 24

This research explores how citizens are involved in environmental decision-making with respect to rapid energy development. It strives to understand the extent to which public participation in scientific research occurs in the decision-making process, particularly in cases involving sophisticated communication and information technologies.

This chapter provides a review of the literature related to these issues. First, it considers the literature related to collective action and publicly shared goods such as air, land, and water. Next, it considers the literature that addresses what accounts for participation. This literature addresses not only individual incentives for participation but also collective and institutional. The chapter then examines the literature related to information communication technologies and the role they play in promoting civic engagement particularly in science-related research. Building upon this literature, the chapter lays out a systems approach to understanding citizen participation and the roles different actors play in the case study presented.

Public participation and the environment. Despite modern-day distinctions between nature and man-made habitats, the natural world does not exist in isolation from the human environment. Rather, the two are intimately related to one another as humans influence nature and the natural world impacts humans. One way of understanding the relationship human decisions and cultural institutions have with the natural world is to explore the ways in which people are involved in environmental movements. At the turn of the last century, the
environmental movement focused on land preservation. Although the movement of the 1950s began to converge around pollution, it was still largely focused on the effects on forests and wildlife. It was not until the late 1960s and early 1970s that environmental justice and health concerns emerged. This was the time when air, water, and land pollution became linked to public health. In fact, from May 1969 to May 1971, the American public’s concern about pollution and ecology went from being the concern of 1% to 25% (Whitaker, 1976).

With an increased emphasis on human health effects of pollution in conjunction with increasing development, and subsequent, mistrust of industry and government, public participation around these issues hit an all-time high. During the height of environmentalism in the United States, many of the federal laws we still use today—such as the Clean Air and Water Acts and the Wilderness Act—were put in place.

To date, the most influential legislation for public participation in environmental decision-making is the National Environmental Policy Act (NEPA) of the 70s. It has not only been the primary way of analyzing environmental impacts, but also the main vehicle for the public to participate in the decision-making process. In the past 10 years, however, “NEPA has come under increasing scrutiny due to the considerable conflict surrounding environmental policies, eroding credibility of science-based policy information, and lack of meaningful public participation opportunities in practice” (Yao, 2006, p. 5).

Research on the effectiveness of NEPA illustrates that public participation has not always led to outcomes desired by the public (Council on Environmental Quality, 1997). Although the deliberative democratic theory (Baber & Bartlett, 2005; Habermas, 2011; Bessette, 1980; Pettit, 2003) behind the creation of public participation initiatives was to allow for a two-way
communication between the public and government, there are still a few barriers to this kind of
dialogue. The communication obstacles to the NEPA process include: technical language,
linguistic and communication style, and institutional, sociocultural and political barriers
(Bamberger et al., 2009). Furthermore, many of the participatory measures provided by NEPA
such as public hearings, public comment periods, and voting are characterized as a one-way form
of communication.

For the purposes of this research, the other important environmental policy is the Clean
Air Act, which authorizes citizen suits and participation in EPA’s rulemaking procedures (Spyke,
1999). This is an important policy because it affects the way in which citizens engage with
policymaking specifically regarding air quality. In addition to the Clean Air Act, EPA has
introduced processes that are not tied to any specific law, but involve consensus building as part
of the participatory framework (Spyke, 1999). This requires that the public be contacted earlier
in the decision-making process, and that a neutral facilitator guide that discussion.

To address the different levels of public participation, the OECD (2001) lists five types of
public involvement important to decision-making (list adapted from Kingston, 2007):

1. Information – government informs citizens (one-way process)
2. Consultation – government consults with citizens (citizen responses are
   usually predetermined by close-ended questions)
3. Deliberative involvement – government engages citizens in consultation
   process
4. Government-led active participation – government instigates consultation
5. Citizen-led active participation – citizens actively engage in decision-making
   process alongside government
Commenting on this menu of options, Kingston (2007) cautions that all too often citizens’ interactions tend to be focused on one-way or closed processes such as information and consultation, which do not provide dialogic methods of participation.

To highlight the importance of a more participatory dialogic interaction, Tang (2005) builds upon older models of public participation and characterizes early stages of public involvement in which the planning authority has most of the decision-making power as ineffectual because the flow of information occurs as a one-to-many interaction. In contrast, the participative model involves many-to-many interactions and power is shared among government and citizens. Figure 1 illustrates Tang’s (2005) model of public participation; Rung 6 of the participative model illustrates the call for “a planning process that involves both the experts and non-experts” (Tang, 2005, p. 27).

Figure 1

*Tang’s Model of Public Participation*
This participatory approach not only provides greater feedback among citizens, government, and scientists; it can also induce a more positive public perception. Studies on watershed partnerships, for example, found that as the number of participants increased so did the positive perception of human and social capital (Dietz & Stern, 2008). Employing a case study approach on public participation, Beierle and Konisky (2000) found that participation not only achieved their social goals (incorporating public values into decision-making, resolving conflict among competing interests, and building trust in public agencies); it also helped to make the “process of participation [appear to be] more important than the context in which participation took place” (2000, p. 598). Beierle and Konisky’s findings support previous work.
on the importance of dialogic communication in participation processes. It shows that the participation is contingent on a successful process defined as 1) deliberative processes that emphasize consensus; 2) two-way communication between participants and government agencies; and 3) government commitment (Beierle & Konisky, 2000). This study as well as the literature on public participation, illustrate that two-way exchanges allow individuals to perceive themselves within a greater whole. In this way public participation is more than a democratic right focused on consensus building, but also as a means to an end to obtain better policy outcomes viewing policymaking as a process in which the public should be involved.

However, Parkinson (2003) shows that participants should also meet requirements such as reciprocity and the willingness to be persuaded or change previous preferences. These criteria illustrate some of the flaws in deliberation and suggest that it often results in nothing more than speech-making. With public deliberation there is a possibility that the most powerful or charismatic speaker will sway others to accede to the dominant party. Benjamin Barber writes, “In our real world of corrupted, minimalist democracy...we confound opinion and knowledge and sometimes even seem to think that by denying expert science we honor ‘democratic’ thinking” (Barber, 2013). Furthermore, those who participate in deliberation are typically motivated by existing interests, which exacerbate the difficulty involved in changing preferences (Parkinson, 2003).

While deliberative decisions are not legitimate if some are excluded from the forum; “bringing more than a few people in would quickly turn the event into speech-making, not deliberation” (Parkinson, 2003, p. 181). In such cases, there is an implicit exclusion because some citizens are more likely to articulate their arguments than others, making reaching a
consensus incredibly difficult. Baber and Bartlett (2005) have found, for example, that well-educated males tend to dominate heterogeneous juries (Baber & Bartlett, 2005).

To deal with these issues, the public has been brought into scientific research and environmental decision-making in more deliberative ways (Ostrom, 1990). For example, the inclusion of the public in the process of research goes beyond the notion that participation is a democratic right, to which citizens should be provided access, to the idea that participation should be part of policy formation (Rydin & Pennington, 2000). The hope is that, by having citizens assist in policy formation, policy outcomes will be “more in tune with society’s values and preferences” (Rydin & Pennington, 2000, p. 155).

As the literature on public participation has shown, in a democratic society, it is critical that citizens are represented in the policymaking process. However, the idea of employing citizens as active participants in the policymaking process brings up questions of whether or not a collective can effectively govern collectively shared goods.

**Collective action.** To influence policies, citizens engage in governing common-pool resources. Common-pool resources (CPRs)—defined by Ostrom (2003)—are goods characterized by “difficulty of exclusion and subtractability of resources units and are threatened by overuse leading to congestion or even destruction of the resources” (Ostrom, 2003, p. 239). CPRs share two characteristics: a) it is difficult to exclude beneficiaries from using them and b) one individual may harvest the resource, making it unavailable to others (Ostrom, 1994). This definition is most suitable for the collectively shared aspect of environmental goods such as air quality, water quality, and public land. Because these goods are globally shared goods, they are
typically subject to centralized governance or privatization given the difficulty in reaching consensus on how to collectively manage them (Ostrom, 2003). Given this dynamic, how does collective participation around these publicly shared goods occur?

Mancur Olson’s (1965) widely cited work on collective action concludes that even if it is best for a collective to cooperate, individuals will rarely take action because they seek to maximize their personal welfare. This logic suggests that when cooperation does occur, participants’ commitment “is likely to be highly unstable” (Rydin & Pennington, 2000, p. 158).

What is problematic about collective action and public goods? Is the root of the problem the individual in the context of a collective? Or perhaps a collective entity is entirely distinct from the individuals who comprise it?

Because the environment is a publically shared good, problems related to it will likely require intense discussions from various interest groups. Not surprisingly, global public goods are mired by collective action problems not only because they are complex and therefore difficult to solve, but also because it is hard for individuals to identify how they might affect the results. As well, they can share the benefits even without participation. As a result, individuals often forego the burden of participation (Ryfe, 2005; Olson, 1965). Given Olson’s analysis of internal group dynamics and assuming that individuals act rationally in pursuing their self-interest, individuals will rarely contribute to a public good, especially if they can free-ride. Furthermore, collectives exist outside the purview of moral responsibility because there is no one person to whom blame might be attributed.

However, Olson’s approach is incomplete. It fails to consider other factors that motivate collective action. These might include, for example, the existence of a collective identity,
institutional structures that support collective action, and/or diverse incentives that may not be related to material gains. As importantly, Olson’s perspective does not consider the possibility that individuals might construct their own institutional arrangement in support of collective action. The incompleteness of this perspective indicates a discrepancy between theory and practice.

As research has shown, although collective action is contingent on individual choices, it has little to do with personal, individual goals. In fact, some scholars (Gilbert, 1989) have proposed that the collective act is something unique to the collective as an entity. The goal is no longer in the personal realm, but exists outside of individuals and has become “their” goal. Following this line of reasoning, “collective goals exist at a different level from personal goals...at the same time, what occurs at the collective level is enough to motivate the individuals who make up the collective” (Gilbert, 1989, p. 123). This is clear in the phenomena that when considering environmental degradation, “no one in isolation is responsible” (Latour, 2011, p. 123). However, in any cooperating community “there is a tension between competing and yet complementary imperatives—that of the self-preservation of individuals on one side and that of the survival of the collectivity on the other” (Habermas, 2011).

For this reason, collective action can be understood better at a practical level. Though the theory of collective action (Olson, 1965) may conclude that individuals will be unlikely to cooperate when there are opportunities to free-ride, cooperation among people does occur, in everyday activities such as driving, paying taxes, waiting in line, participating in voluntary associations and so forth. To explain such events, Ostrom (2000) describes a number of variables that affect the ability to act collectively. One of the most consistent variables (Ostrom, 2000;
Beirele & Konisky, 2000; Dietz, Ostrom, & Stern, 2003; Baber & Bartlett, 2005) is locally generated participation—that is, when users of common-pool resources “organize themselves to devise and enforce some of their own basic rules, they tend to manage local resources more sustainably than when rules are externally imposed” (Ostrom, 2000, p. 148).

Institutions that influence public participation and create spaces for local monitoring are a form of social capital. As Ostrom (1994) explains, people have been locally organizing institutions to manage and monitor natural resources for thousands of years dating all the way back to the Valencian irrigation system in Spain. These institutions are the result of the “time and effort invested by their creators in improving their productivity” (Ostrom, 1994, p. 4).

Monitoring can provide citizens with a method of participation by providing an opportunity for citizens to participate in knowledge production. This type of activity allows for “local self-organization by providing accurate information about natural resource systems, providing arenas in which participants can engage in discovery and conflict-resolution processes, and providing mechanisms to back up local monitoring and sanctioning efforts” (Ostrom, 2003, p. 257). Ostrom’s point is that when governance comes from the local generation of rulemaking, problems are better adapted to the local reality rather than subject to a top-down prescription from a central authority.

For this reason, it is critical that monitoring projects are in the hands of citizens because they are less legitimate when conducted by outsiders. This is a departure from the traditional view that monitoring and sanctions should be the responsibility of the State. By monitoring, community members can “become potential enforcers of environmental laws—a role, in fact, made available to them in the Clean Air Act, which for citizen enforcement suits” (Ottinger,
2013, p. 230). Beyond simply focusing on the individual incentives for participation, this approach illustrates that collective engagement in the management of shared goods is possible.

Furthermore, the emergence of web-based technologies offers a platform for enabling citizens to participate at a deeper level than traditional methods. Accordingly, citizens’ use of ICTs to generate bottom-up and local-level information is changing the way government interacts with citizens. The OECD (2005) review points out:

Governments are moving away from the direct provision of services towards a greater role for private and non-profit entities and increased regulation of markets…As government face more new and complex problems that cannot be dealt with easily by direct public service provision, more ambitious policies require more complex interventions and collaboration with non-governmental parties.

Another explanation for the discrepancy between theory and practice is that people do not act individually with regard to the collective; rather, they interact based on individual interests. Accordingly, monitoring may provide a way for visualizing oneself in the broader context of the collective. In addition, monitoring is essential “for the correction of information asymmetries pervasive among participants in collective action. In addition, systematic policing and enforcement are ways in which organizational leaders commit to their members that they are solving the problems of free-riding or overconsumption” (Corduneanu-Huci et al., 2013, p. 257).

An important factor accounting for participation, cooperation and self-organization is trust. Recent studies (Bourdieu, 1986; Putnam, 1993; Fukuyama, 1995; Coleman, 1988) have shown that social capital is an important determinant of trust. Referring to the ability of people to cooperate (Coleman 1990), social capital is defined as the “shared knowledge, understandings,
norms, rules, and expectations about patterns of interactions that groups of individuals bring to a recurrent activity” (Coleman, 1988; Ostrom, 1990, 1992; Putnam, Leonardi, & Nanetti, 1993). The trust, generated through social capital, allows individuals to make credible commitments and rely on generalized forms of reciprocity” (Ostrom, 1994, p. 20). When people believe that others will cooperate, they are more likely to cooperate as well. This trust in others’ willingness to participate brings net benefits and feedback. On the other hand, without the existence of social capital, communities will be unable to monitor and prevent damage to the common wellbeing (Shutkin, 2001).

When social capital forms within homogeneous groups it is considered bonding social capital, which is critical to cooperation among citizens for consensus-building as a local level (Arnstein, 1969; Goodchild, 2007; Kingston, 2007; Tang, 2006). In contrast, bridging social capital, or cross-cutting ties, are interactions that are formed with outside groups opening up “opportunities to those belonging to less powerful or excluded groups” (Narayan, 1999, p. 1). Narayan (1999) points out that horizontal ties to those within a community, or bonding capital, can help communities organize to protect themselves.

When problems are felt locally, greater participation occurs due to the synergistic relationship between social capital, physical experiences, and environmental degradation. One reason physical experiences influence social capital at the local level is due to the fact that members of a community share in the effects of environmental degradation, which erode social capital and disempower citizens by inhibiting people from coming together (Shutkin, 2001). In the same way that social capital results in a positive feedback loop of trust and cooperation,
physical barriers such as poor air quality or high-speed roadways “reinforce the conditions of powerlessness and anomie that led to the degradation in the first place” (Shutkin, 2001, p. 77).

Though it is important to build strong relationships within a community, it is not sufficient for collectively managing publicly shared goods. More recently greater attention has been given to the need for vertical ties, or bridging social capital (Putnam, 2007; Shutkin, 2001). By forming relationships with outsiders, communities are better equipped to collectively manage natural resources.

One way of forming relationships with outsiders is to have citizens involved in scientific research. Not only can participants strengthen horizontal ties by cooperating together, but they can also foster vertical ties by contributing to scientific research.

Conventional methods of public participation in the environmental policy-process have proved ineffective, but participation in scientific research offers a possibility for more active and locally specific ways of being involved. Citizen input is important to scientific research not solely because it should lead to better decisions, but also because it will “produce more genuinely democratic decision making” (Baber & Bartlett, 2005, p. 97) and contribute to a more trusting society. Not only can involvement in data collection and documentation provide a horizontal link bonding those within the community; it can also function as a vertical, or bridging, tie connecting local citizens to others interested in the issue.

**Public participation in science-related research.** Given the exponential growth of energy demand and development, it is no surprise that there are powerful stakeholders involved in deliberation about how to manage common pool resources such as air quality. The existence
of varied interest groups leads to conflicting communication about the effects of energy
development on public goods such as air, water, and land such as the conflicting Cornell studies
with regard to the positive and negative impacts of natural gas extraction (Hogwarth et al., 2011).
Because poor or conflicting information can make decision-making more unreliable, it is
important to address how information about environmental problems is collected and
communicated. Furthermore, public participation is “overlaid on science: scientific knowledge
serves as the common foundation on which democratic debate can be built” (Ottinger, 2013,
p.16).

Notwithstanding increasingly complex technological problems, there have been sharp
decreases over the past 100 years in how involved ordinary citizens are with science (Irwin, 1995;
Chopyak, Rahi, & Sher, 2005). In part, this is due to increasing specialization and division of
labor. It is also due to a decrease in federal funding in the 70s and an increase in research and
development being funded by commercial interests, which make the private sector the driver of
scientific and technological developments (Chopyak et al., 2005). The potential gains each
interest group stands to make has led to an increasingly politicization of science in the modern
era.

Contributing to this problem, the standards and regulatory restraints of government
agencies make decision-making and allocation of resources particularly difficult. Since 1970,
federal environmental programs have implemented stricter standards for mitigation procedures
(Fischer, 2000). This has forced environmental protection agencies to develop “extensive
mechanisms for generating scientific information, from internal expertise to external advisory
boards” (Fischer, 2000, p. 91).
The politicization of science has led to distrust in experts who produce information. Producing more suspect information will not likely reduce this mistrust but having the public involved in the production of information through a process of “discursive will-formation” very well may (Baber & Bartlett, 2005, p. 97). If involved in the production of information, the public can take greater ownership of the information as they have injected their own labor into the result. When science is seen as a product of “voluntary, decentralized interaction among peers, not as a product of a centralized, hierarchical enterprise” (Ezrahi, 1990, p. 222) it becomes more acceptable. Thus, to build public trust in the finding, science must be seen as a “decentralized collegial enterprise” (Ezrahi, 1990, p. 222).

One of the goals of citizen science and community-based research is to depoliticize science by engaging citizens in scientific research. Citizen science, also referred to as Public Participation in Scientific Research (PPSR) or crowd-sourced science, is defined as an informal science in which the public is directly involved in the process of research. This includes the collection, documentation and communication of information characteristic to local-level knowledge.

Citizen science is not new; the two world wars and the cold war “revealed the power of science to do harm in the wrong hands. Scientists joined and in many cases led the debate about the use of technology” (Stilgoe, 2009, p. 11). In an attempt to democratize science, citizen science incorporates “principles of accessibility, transparency, and accountability” (Guston, 2004, p. 25). For science to be accessible and transparent there is a need for institutions that support scientific literacy and research (Nielsen, 2012).
There are several initiatives that have illustrated the important role citizens can play in research. Some examples of successful citizen science projects include but are not limited to the Audubon Society’s Christmas bird count for charting the migration of birds, local associations of astronomy enthusiasts who note variations in galaxies, and natural historians such as farmers and anglers contributing to knowledge production.

Another example of a successful citizen science project, which utilizes Google Earth, is the mapping to fight illegal logging by the Surui tribe in Rondonia, Brazil. Tribe members have created an interactive cultural map “that highlights the biodiversity and history of the Surui territory” (Forero, 2013). The idea behind the project was to “equip the Surui with technology in the form of Android smartphones that help them immediately report illegal logging as well as monitor biodiversity and the forest’s health” (Forero, 2013). This was accomplished, in part, from the introduction of Google Maps and its Applications Programming Interface (API) in 2005. The Surui Chief Almir said that the intent was to “communicate and create a dialogue with the world” (Forero, 2013).

These advances in public participation in scientific research and communication is due in part to advances in technology providing citizens the opportunities to contribute time and energy to collective projects. The OECD reports that higher levels of education, new forms of mass communication, availability of goods and services, and the increasing controversy involved in 21st century science-related issues (GMOs, genetic testing, climate change, nanotechnologies, etc) has led to greater public involvement in science-related issues. However, engaging through

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6 Citizen science and collaborative open data projects have been exponentially increasing throughout the past decade. Due to the brevity of this thesis, it is not feasible for me to go into all of the exciting projects that are being conducted; however, I encourage the reader to visit citizenscience.org to see examples of other ongoing projects.
these technological advancement requires changes in expectations in citizens as well as government and industry.

Though citizen science is often lauded as a way to give power back to the citizens and depoliticize science, it also potentially places a much heavier responsibility of participation on the citizen. Likewise, as the government’s role becomes smaller and problems become more complex, it is likely that there will be a need for more collaboration with “non-governmental actors” especially as we move into an era “in which the provision of public services is oriented towards the creation of effective public value and user empowerment” (Charalabidis et al., 2012, p. 264).

Engagement through technological advancements. As literature on public participation and collective action has illustrated, traditional modes of participation no longer apply to 21st century problems, and the involvement of citizens in knowledge production is an opportunity to build a more trusting relationship between citizens, government and the private sector. As information and communication technologies (ICTs) advance, “new participation methods based around these technologies have been developed making online participation possible” (Tang, 2006, p. 24). Traditional methods of participation such as voting, comment forums, and attending public hearings are usually held in a “fixed place and at a fixed time” (Kingston, 2007, p. 139) and also tend to be dominated by a vocal minority or obfuscated in technical and legal ‘jargon’ (Kingston, 2007).

However, the use of technologies such as web-based mapping tools and mobile sensors has been helpful in engaging citizens in the decision-making process. On a technical side, the
conjunction of Web 2.0, mobile sensors, online communication, open source software, volunteered geographic information, and increasingly sophisticated Geographic Information Systems\(^7\) has added to the depth of information citizens can contribute. The growth of Web 2.0 has allowed citizens to contribute more data over the web—this data is unique in that it is generated from within a community based on a local perspective (Estima, 2012).

Success in these projects is contingent on citizens volunteering time and energy. Estima points out that a key difference in citizen volunteered projects today is that the Google Map/Web 2.0 revolution has provided a platform in which several Volunteered Geographic Information (VGI) projects have prospered; in 2009, 70 percent of the VGI initiatives had started in “2005 or later, such as Wikimapia, Flickr, OpenStreetMap (OSM), Panoramico and Degrees Confluence Project” (Estima, 2012).

Additionally, digital compatibility of various forms of media has provided a platform that “allows the user to add fresh personal information to the bank, thus transforming the user of the map into one of its myriad amateur contributors” (November, V. Camacho-Huber, E., & Latour, B., 2009, p. 583). This capability has the effect of making the information not only more particular to local and spatial realities, but also to its place in time. In addition to this, being able to visualize individual contributions in a larger collection of actions helps in understanding an individuals’ role in a collective conscience.

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\(^7\) It is important to mention that these advancements have not always been looked to positively. Criticism abounds over privacy concerns. For instance, the use of remote sensing systems on orbital satellites, “together with an unprecedented ability to search, store, and process large amounts of information on individuals may give rise to new concerns over the ongoing conflict between privacy and freedom of the press” (U.S. Congress, Office of Technology Assessment, 1988, p. 8).
Although advancements to ICTs have been made to provide citizens with ways of contributing to knowledge production, there are criticisms to viewing technology as a panacea to global problems. On one side of the argument, there is the view that implementing distributed, personalized technologies will empower communities to dialogue with one another and interact in collectively-shared, democratic spaces. The underlying implication of this perspective is that individuals are the source of change as they learn to self-regulate once they understand their own data. In this way, the individual’s use of an “empowering” tool becomes politicized as a method for achieving desire outcomes either determined by designer or implementer.

The criticism of increasingly personalized and connected (yet disconnected) polis is rooted in a criticism on the effects of individuals. To clarify, these criticisms are still focused on the individual and what individuals can do to mitigate collective problems. However, damage does not cease at the individual level, as each individual is connected to each other in a greater whole. Morozov (2013) takes up this argument in criticizing the approach of personalizing technologies for individual participation as an approach that is too focused on a ‘consumerism’ rather than addressing the ethical and political issues underlying these problems. Similarly, the use of cost-benefit analyses and other economic calculations (such as the EPA’s statistical life measure) to assess the value of a life only contributes to obfuscating or prolonging discussion around important matters such as moral responsibility.

Understanding human-environment systems is increasingly complex as we deal with the ill-structured and ambiguous problems of living in a globally connected world (Webber & Rittel, 1973; Tang, 2006). Our 21st century, globalized, borderless problems such as economic volatility and climate change are moving much more quickly than the solutions put in place.
As boundaries blur between audience and journalist, citizen and scientist, teacher and student, computer and human, and so forth, emerging technologies enhance the possibilities for citizen engagement in scientific research. This engagement offers a potential solution to problems of collectively managing publicly shared goods such as air, water, and land. Collaborating with one another, individuals have the potential to contribute to greater knowledge capital and visualize themselves within a community. In lieu of public meetings, which are typically mired with arguments over scientific legitimacy, information and communication technologies might provide ways to circumvent bureaucratic barriers and fix 21st century problems.

Have the use of tools such as open-source GIS, distributed communication technologies, mobile sensors, and increasingly personalized communication and information technologies culminated in a more engaged polis and responsive government? With the introduction of participatory solutions to problem-solving such as PPGIS and VGI, will citizens report a greater level of engagement and sense of autonomy in the decision-making process? Presently, it is unclear whether or not these tools have been useful for the co-construction of knowledge and co-ownership of information.

**Conclusion.** As literature on public participation and collective action has illustrated, traditional modes of participation no longer apply to 21st century problems. By involving citizens in knowledge production, more trusting relationship between citizens, government, and the private sector may result. As information and communication technologies (ICTs) advance, new participation methods may offer a platform for citizen engagement that is richer than
conventional methods. Though advancements to ICTs may provide distributed, personalized access, which can empower communities to dialogue with one another and interact in collectively-shared, democratic spaces, will individuals come to use the tool in empowering ways? Accordingly, this research is focused on the citizen engagement in decision-making both with traditional forms of participation and with newer methods of citizen engagement.
Chapter III: Background and Methods

To address the question of how citizens are involved in environmental decision-making with respect to energy development, I use a grounded theory approach for analyzing the case study presented. In this case, I explore the following questions:

- How do citizens engage in environmental decision-making in the context of rapid energy development? What accounts for failure and success in participatory measures?
- How can technology be used to contribute to scientific discussion about environmental issues? Subsequently, what are some of the barriers and biases of the uses of such tools?
- To what extent are information and communication technologies (ICTs) being used to mitigate uncertainty in environment issues? How is or can technological innovations be used for research? Are there opportunities for greater participation?

To answer these questions, I provide the following sections in this chapter—Backgrounds and Methods:

- A history of energy development in Sublette County related to energy development in the region and the reasons why Sublette County serves as a good case study.
- National regulatory framework within which the state of Wyoming, and subsequently, Sublette County, must operate.
• Ethnographic field research and the reasons why this approach is most appropriate for investigating the research questions.

• Methods for selecting interview subjects and questions.

The case study provides an opportunity to explore how scientists, citizens, government, and industry can become more involved in the process of environmental decision-making. It seeks to answer the question: to what extent can citizens use digital technology to collectively contribute to greater knowledge about their environment?

**Background: Hydraulic fracturing and regulatory framework.** Hydraulic fracturing, the most common form of industrial activity in Sublette County, is developing more rapidly than the regulatory environment. There has been a great deal of contention surrounding this form of extraction, warranting a brief discussion about the regulatory approaches to this industrial activity. Thus far, fracturing has been loosely regulated at the federal level, raising questions about how to protect communities from development. This ambiguous situation is most clearly illustrated in the Federal Energy Policy Act of 2005, and its inclusion of the notorious ‘Halliburton Loophole’ that exempted companies from the Safe Drinking Water Act. Accordingly, companies are allowed to keep information about their chemicals a secret based on ‘trade secret’ exemptions, which allow for even greater opacity. Given the lack of federal regulations with regard to hydraulic fracturing and the lack of information available to citizens, this thesis will look at how citizens manage to interact in the policy-making process despite the constraints that they face.
Public engagement in energy policy suffers because the people in Wyoming are critically dependent on the land for revenue. The major source of revenue is related to the oil and gas industry. Although other avenues for development include grazing and outdoor recreation, such uses are contentious because they compete with energy companies for land-use.

One question that needs to be addressed in regards to the national approach to regulation is the management of public goods, specifically how the misuse of common pool resources can result in negative spillover effects to local communities. The most common problems affiliated with hydraulic fracturing are water supply contamination, groundwater contamination, seismic disruption, disruption of local character, and fugitive methane and VOC emissions. Of these effects, fugitive methane and VOC emissions are the most likely to incur negative spillover effects, because they cannot be contained to one specific location.

The negative spillover effects of air pollution caused by VOC and methane emissions should incentivize federal action in regulating the polluters. However, as illustrated through research, federal action around this issue has been minimal at best, and often more has been done at a state and local level. Despite the fact that 94% of VOC emissions and 60% of NOx emissions in the UGRB [Sublette County] were attributable to oil and gas production and development (DEQ, 2009), there has been very little federal attention given to the area. For this reason, I will look at a case study of air quality monitoring in Sublette County.

**Background: Setting: Sublette, County, Wyoming.** Sublette County is a suitable case study for a number of reasons. Most importantly, Sublette County is home to some of the largest natural gas reserves in the nation. The Pinedale Anticline and the Jonah fields near Pinedale, the
largest town in Sublette County, cover approximately 228,000 acres and contain an estimated 25 trillion cubic feet of natural gas. Although the town of Pinedale historically derived its revenue by raising cattle, in keeping with Wyoming’s identity as the “Cowboy State”, today it receives most of its revenue from the oil and gas industry. This growth in the energy sector has led to a growing population as well as a strain on the infrastructure in Sublette County.

Initially, local and state government as well as citizens viewed energy development positively, as a source of economic growth. However, some community members now believe that the growth is too fast for the county to keep pace. For instance, “community members note that Sublette County has a smaller and less diverse array of small businesses than it did before the gas boom” (Jacquet, 2007, p. 2). These community concerns illustrate the growing contention that surrounds the issue of energy development.

Furthermore, the American West is well suited for a case study of public participation in issues related to rapid energy development. Most importantly, it is a region that has historically relied on extractive industries dating back to the 1862 drilling of an oil well in Canon City, Colorado.

Because of its historical dependence on energy development, Wyoming Governor Matt Mead (2012) writes that Wyoming is more capable than the federal government to regulate this industry. Rulemaking, according to the Governor, should be left in the hands of the State (Mead, 2012). Thus, Governor Mead has pressured local communities and state governmental agencies

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8 It is notable that the other two towns in Sublette County—Big Piney and Marbleton—perceived the growth more positively than residents of Pinedale. This discrepancy might be due to the fact that “Big Piney and Marbleton have a long history of boom/bust growth associated with the energy industry, while Pinedale has had little to no direct experience with boom/bust or the energy industry” (Jacquet 2009).
to become leaders in managing environmental initiatives. However, not all citizens in Wyoming have been as sanguine about the State taking care of its public lands. Some citizen groups, such as the Citizens United for Responsible Energy Development (CURED) and Citizens for the Wyoming Range in Sublette County, lament the irresponsible actions of industry and the lax or bureaucratic approach government has taken to addressing these actions (Hatch, 2010). This contention is characteristic of common-pool resource management, specifically land development issues, which include conflicts such as developing for growth or preserving open spaces, using public lands in a private way or using private lands in a public way, and private property versus the free market (Kear, 2011).

Wyoming’s population size has also served to limit public participation in energy related issues. Apart from Alaska, Wyoming is the least populous state in the United States, with an average population density of 5.8 human inhabitants per mile and a total population of 576,412. In contrast, the most densely populated state—New Jersey—contains 1,205 inhabitants per square mile (“List of U.S. states...,” 2013). Given its sparse population, over a physically large terrain of 97,814 square miles, its citizens have little opportunity to develop the social capital required for collective political action. Contributing to this problem is the lack of access to information and communication technologies, which limits the potential to increase proximity and consequently the empowerment that follows from building social capital. Because proximity

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9 District of Columbia is home to 10,357 inhabitants per square mile, but is not technically considered a state.

10 Despite the relative isolation of Wyoming, it has advanced in various ways in regards to equality and citizen engagement. For instance, Wyoming was the first state to grant women the right to vote; it is home to the nation’s first national park—Yellowstone. It was also the first state to implement measures to require industries to disclose chemical information.
to others as well as to the land is important to building social capital, shifts in economic, ethnic and cultural networks (Debertin, 1996) tend to have a greater influence in rural communities than in urban areas. Thus we cannot assume that citizens in Western towns will actively participate in issues related to the natural gas industry.

Compounding this problem of collective action is the fact that many of the areas in Wyoming do not qualify for federal action, given their small populations. For example, the EPA can “regulate individual small oil and gas facilities like wells and pits if they are within a metropolitan area with a population greater than one million people” (Mall, Buccino, & Nichols, 2007, p.10-11). However, the majority of land out West does not satisfy this requirement. Hence, this region is exempted from provisions of the Clean Air Act.

The discovery of Benzene\(^{11}\) in 88 water wells\(^{12}\) in Sublette County (Lustgarden, ProPublica, 2008) exacerbated these concerns, raising questions about contamination due to the presence of natural gas extraction. These findings are significant because they were documented by a federal agency, the U.S. Bureau of Land Management (Lustgarden, 2008). The findings were also shocking because “the area is so rural that, until a few years ago, cattle would still run down Main Street in Pinedale, the nearest town to the gas field. The county is roughly the size of the state of Connecticut but has fewer people than many New York City blocks” (Lustgarten, 2008).

In addition to these considerations, which make Sublette County ripe for debate over energy development, are the citizens and grassroots organizations have advocated for funding for

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\(^{11}\) A chemical that has been linked to Leukemia

\(^{12}\) The water wells were not private wells but owned by the energy companies.
scientific research on air quality. This form of citizen engagement indicates that citizens share in viewing the environment as an important good for which to protect. Because there is an engaged populace in Sublette County, the case should provide an understanding of how scientists, citizens, government, and industry are involved in the process of environmental decision-making. As well, it will provide insights into to how environmental decision-making occurs in the rural West amidst rapid energy development.

Hydraulic fracturing is a contentious issue for citizens and decision-makers, which may lead one to think it is a new phenomenon. On the contrary, this resource as well as public skepticism about its extraction has existed in Sublette County for decades, beginning with California Oil Company, now Chevron—the first company to drill in the area in search of oil. Although Chevron found no oil, it did find natural gas. But at the time, there was no market for gas, so it abandoned the site (Noble, 2005).

Nonetheless, Sublette County was far from being abandoned as a possible site of energy extraction and experimentation. In the late 1960s-early 1970s, Sublette County explored the use of nuclear explosions to extract natural gas from tight formations. El Paso Gas Company chose Pinedale as a location for experimenting with nuclear detonations to study the effectiveness of nuclear power to mine natural gas (Noble, 2005). This project was called Project Wagon Wheel.

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13 Tight formations are one of six unconventional gas formations in which natural gas reservoirs are trapped underneath impermeable rock, due to irregular or badly connected pores in the rock formation. It now uses the same hydraulic fracturing technology used in shale gas.

14 This project was proposed and accepted in three places prior to Project Wagon Wheel: Project Gasbuggy in Northwestern New Mexico, Project Rulison and Project Rio Blanco in Western Colorado.
As the Federal Government passed stricter rules governing energy development, Project Wagon Wheel came under the purview of the National Environmental Protection Act (NEPA). According to NEPA, environmental impact statements (EIS) had to be finished before any other exploration could be conducted. The Draft EIS for Project Wagon Wheel was completed and issued by El Paso in January 1972; however, it did not address local concerns such as the impact on domestic animals, on wildlife, or on animal feed.

The government’s neglect of these local concerns incited Sublette County residents to protest “the likely effects of the explosions and fallout on vegetation, wildlife and livestock, and on bridges, roads, reservoirs and concrete irrigation canals” (Participant B, personal communication, May 2013). Focusing on these issues, residents including local ranchers, housewives, business and professional men and women, teachers and student formed the Wagon Wheel Information Committee (WWIC) as a way to gain knowledge about the proposal to do atomic testing in Sublette County” (Noble, 2005). To achieve their common goals of keeping the community safe and healthy, these individuals put aside their differences to work together on this issue. In addition to the lack of government concern, the region’s heavy reliance on oil and gas industries makes this type of citizen engagement a surprising occurrence.

Though the example of the WWIC set an historical precedent of civic engagement in common-pool resource management, citizen disengagement is also evident in the devolution of initial citizen advisory boards in the region. These advisory boards began in the 1940s and progressed through the 1970s when the BLM sought advice from grazing advisory boards. However, because the advisory boards were skewed in favor of the citizen, they were terminated in the 1970s under the pretense that the citizens’ power in the advisory boards was an abdication
of responsibility because citizens could not tell the BLM what to do. Although the idea of citizen advisory boards was revitalized in the 1990s and trumpeted by environmentalists as a way of engaging citizens, it had lost its effectiveness due to the disempowerment of the past (Participant N, personal communication, May 2013).

Since 2000, natural gas production in Sublette County has grown exponentially\textsuperscript{15}, causing ramifications such as air pollution, community disruption and stress on existing infrastructure. Some of these effects are anticipated by the literature that builds on Olson’s logic of collective action (1965). Though Olson concludes that individuals act with regard to individual incentives, scholars such as Gilbert and Ostrom illustrate that contrary to Olson’s view, there are other factors that influence action such as collective identity and community solidarity. But as Putnam (1993) demonstrates with his theories on social capital, social capital can be either positive or negative. In this way, collectives seem to have a dynamic of their own, which is influenced by factors other than individual incentives.

Today, energy development continues to be a controversial topic. Despite Sublette County’s reliance on oil and gas revenue, some citizen groups, such as those in Sublette, Fremont and Teton Counties,\textsuperscript{16} have petitioned against industrial development. For example, in Teton County ‘Citizens Protecting the Wyoming Range’ has advocated against hydraulic fracturing. This group has not only petitioned industry, but also environmentalists, insisting that they listen to the voices of those who have cared for the land.

\textsuperscript{15} As of 2012, there are approximately 6000 producing oil and gas wells and in the Upper Green River Basin (UGRB).

\textsuperscript{16} It is worth mentioning that in comparison to Teton County, Sublette County lacks the financial resources to choose the luxury of a clean environment.
In the past, energy development has largely been associated with progress for the community, with little attention from decision-makers to the potential negative effects of growth\textsuperscript{17}. Many of the negative effects of growth, such as air pollution, community disruption, and stress on existing infrastructure, are experienced most severely by the local population\textsuperscript{18}.

In coordinating together to voice local issues, citizens in Sublette and Teton Counties have helped pass the Wyoming Range Legacy Act, “which permanently protected 1.2 million acres in the Wyoming Range from future development” (Participant U, personal communication, May 2013). Success in passing the protective acts such as the Wyoming Range and the Snake Headwaters Legacy Act was not the product of a government-implemented solution, but rather the result of a “long campaign born in Wyoming's small communities--in Bondurant, Pinedale, Jackson, Rock Springs and elsewhere” (Koshmrl, 2012) to reduce the possible ill effects of a natural gas boom.

Despite progress made by local citizens to protect public goods, environmental discussions at the policy-making level are still contentious. Although environmental debates were once grounded in philosophical approaches to environmental protection, such as whether to

\textsuperscript{17} Since the 70s, there has been some research conducted in this area to explore the negative impact of a boom, sometimes referred to as “Gillette Syndrome” after the town of Gillette, Wyoming. Jeff Jacquet’s case study in Sublette County provides an interesting application of this problem for understanding the natural gas boom in the area. He finds that despite having received over $20 million in Oil and Gas revenues, Pinedale “has spent all of this revenue on water, sewer, and roadway infrastructure, and had identified over $30 million dollars of additionally need infrastructure projects…most projects are either directly needed to accommodate new capacity or were existing problems that became exacerbated due to increased usage” (Jacquet, 2009, p. 41).

\textsuperscript{18} Another interesting dynamic to this region is that the majority of the land is in the public domain, which makes decision-making largely in the realm of federal and state government; however, citizens often feel that their proximity to public land should be able to make decisions regarding land-use given the fact that they may be subject to spillover effects more than those who live further away from the land.

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preserve land for aesthetic or cultural reasons or to conserve land for sustainable use, debates now focus on legitimating scientific arguments. To provide clarity to environmental decision-making, my research investigates how the community of Pinedale, Wyoming has engaged in discussions regarding environmental decision-making. It also seeks to answer: to what extent can citizens use digital technology to collectively contribute to local knowledge about their environment?

**Methodology.** The study of human behavior and social interactions entails a great deal of complexity, given the unpredictability of human nature. To capture this complexity, I have selected a grounded theory methodology. Grounded theory is a qualitative research method first conceptualized by Glaser and Strauss (1967) as a way of studying data without preconceived assumptions. Glaser and Straus’ (1967) strategies develop theory from research data instead of from existing theories. It allows the researcher to engage in simultaneous collection and analyses of data, constantly refining and building upon the findings.

Charmaz’s (2006) contribution to the grounded theory literature explains that any study is an interpretive portrayal rather than a precise explication of the studied world. Informed by a social constructivist perspective, Charmaz points out that not only do we interpret the meanings and actions of participants; they also interpret ours (Charmaz 2006). Accordingly, this approach is appropriate for studying public engagement in environmental decision-making because it allows for the flexibility to encourage the interviewees’ perspective to emerge out of the data, rather than prescribing prior assumptions to the interaction with informants.
Memo-writing, which entails reflecting on how the data are informing the research question and creating meaning out of initial codes, is fundamental to the grounded theory methodology (Charmaz, 2006; Glaser & Strauss, 1967). By transcribing and reflecting interviews immediately after they occur, researchers following the grounded theory approach keep the dialogue between researcher and subject alive.

With the grounded theory approach in mind, described below are the procedures for conducting this research:

• Subjects contacted via email or phone to obtain approval and set up times for interviews. A sample list of questions included in the first contact email.

• Specific questions employed to elucidate an understanding of my primary research questions regarding citizen involvement in scientific research, particularly in a mobile air quality-sensing project. Listed below are examples of the questions I intend to ask.
  
  o How did people respond to the facilitation provided by Ruckelshaus?
  o Was there disempowerment involved with the PAWG task force? Do you think citizens want better or more direct forms of participation?
  o Has the environmental story changed in your experience in Wyoming—in terms of who participates and why?
  o How did the boom, and then subsequent bust, affect public participation in the region?
  o Do those who work out in the fields feel they are a part of the community?
  o Were any alternative forms of communication used to better facilitate dialogue and relationship building?
• What kind of partnerships do you think would help include multiple stakeholders in future deliberations?

• Site visit will be made to Sublette County, Wyoming. Interviews will be conducted in person while others will be administered over the phone.

• Upon collecting data, interviews will be coded using Nvivo. This includes coding interview data and memos.

• In addition to the interviews and site visit, a small survey will be administered to obtain a better sense of the national perspective on community engagement with regard to environmental problems. This survey will be conducted using Survey Monkey and Amazon’s Mechanical Turk, and running an SPSS analysis to test the hypothesis that the more people are concerned with federal land preservation, the more likely they are to be engaged in resolving local problems through non-traditional means (defined as participating in online searches and online versions of public meetings). This survey will investigate the relationship between environmental issues, economic development, and use of non-traditional forms of participation.

Informant selection and interview questions. To gather an understanding of how citizens engage in this issue, I rely on interpretive inquiry through interviews using a snowball sample. A snowball sample is a sampling technique in which the researcher relies on a few members of the studied group, and then has those individuals provide information about which other members to locate to answer questions. Thus, snowball sampling is appropriate for this type of research as it is an exploratory study of the region, and does not attempt to extrapolate findings to society as a
whole. For this reason, the first phase of the research entailed contacting key informants such as county commissioners, citizens, and members of government-organized citizens’ advisory boards and grassroots organizations.

As part of the interpretive approach, I employed questions designed to understand the perspective of my subjects. These questions were informed by my expectations based on the literature of public participation, collective action, and social capital. Because the goal of questioning informants was to bring forth their own stories and perspectives, questions were often open-ended such as “Tell me about your experience engaging in environmental decision-making.” “How has the public been involved in the decision-making process?” “Is there a role for web-based communication technologies in dealing with this issue?” “Are there barriers to participating with technology?”

Based on my findings from initial interviews, I employed more specific questions, which sought to elucidate an understanding of my primary research questions regarding citizen involvement in scientific research, particularly in a mobile air quality-sensing project. With respect to understanding citizen participation, I sought to investigate not only how citizens participate, but also how they understand their role and the effect they have in public policy-making. Therefore, the chosen method of interviewing involved bringing forth the interviewee’s interpretation of the experience. In addition to allowing informants to express their own perspectives, this interpretive approach is intended to keep the researcher “alert to possibilities for moving the analysis beyond the definitive evidence” (Charmaz, 2006, p. 148) which is why the “subsequent entering and reentering the experience is crucial” (Charmaz, 2006, p.148).

I found that this was unexpected, as most of my subjects had been interviewed by journalists who had particular stories they tried to elicit.
Accordingly, I returned to my interviews throughout the process for continual analysis of my findings.

To organize and analyze data, discourse is coded in Nvivo 10. Nvivo is a qualitative and mixed methods analysis software by QSR International. For a full list of thematic categories and interview excerpts, refer to Appendix C. Given the qualitative nature of my research methodology, Nvivo is the most appropriate tool for this type of analysis. Allowing the researcher to record, code, and edit data, this tool is designed to simplify the complexity of analyzing embedded themes in the data, and providing a location for the researcher to return to and reflect on the data.

This ethnography of a Wyoming oil and gas town documents how community members engage with government and industry over environmental concerns related to health and safety. The history of Sublette County provided a contextual understanding of past public participatory measures as well as an understanding of the collective identity. In addition, because energy development plays such a prevalent role in shaping the identity of the community; this chapter characterized the national regulatory approach to hydraulic fracturing. This research provides an opportunity to investigate how scientists, citizens, government, and industry can become more involved in the process of environmental decision-making. Through the juxtaposition of interviews such as those that provided a comprehensive understanding of collective identity, social dynamics, and public participation with those that provided more specific examples of citizen engagement, this research is a story woven together by a myriad of perspectives on the presence of industrial activity and possible methods of citizen engagement regarding it. Finally,
this research seeks to answer the question: to what extent can citizens use digital technology to collectively contribute to greater knowledge about their environment?
Chapter IV: Case Study, Sublette County WY: Results and Discussion

**Introduction.** This case study illustrates how local citizens interact within the policy-making process with respect to collective goods, and provides insights about how citizens use information and communication technologies (ICTs) to manage common-pool resources, specifically air quality. Though, it is clear that through the use of technological advancements such as discussion-enabled websites or applications for filing complaints, citizens are able to gain the attention of federal governmental agencies to mitigate pollution, it is unclear whether these technologies are used to advocate for specific causes. With increasing technological advancements, citizens can work together to generate ground-level collective action geared toward policy-change at the national policies. However, the adoption of ICTs is not necessarily about the technology, but about the people who use them.

Working from the literature review, I looked for common themes such as collective action problems and community disruption, citizen participation in scientific research, and social capital. After reviewing the interviews and allowing for other themes to emerge from the data, I established the following common core codes: community disruption and collective action, dissatisfaction with the conventional methods of public engagement or disempowering public engagement, physical space and participation, economic development, scientific engagement by non-experts, social capital and participation also referred to as citizens groups or grassroots organizations, barriers to participation, workers’ safety and inclusion, and empowering community engagement.
**National environmental priorities.** The analysis of my survey explores what accounts for richer community engagement with regard to environmental problems. The issue of economic development or energy extraction tends to take precedence to environmental issues on the pretense that economic development is critical to producing revenue for the community. As the responses to my survey showed, the majority (42.5%) of those polled ranked economic development as the highest priority under the seven community issues listed (economic development/job growth, environmental conservation, preserving biodiversity, protecting public health, mitigating the effects of climate change, property value, and energy development/energy security). Prioritizing economic development based on short-term cost-benefit analyses is problematic because it tends to overlook the long-term effects of pollution, a boom in population in small communities, lack of trust in neighbors, and so forth. Public land preservation is a special case because though local citizens typically see land-use issues as a local concern, it is actually a concern for the entire nation. For this reason, it is my hypothesis that those concerned with federal land preservation might be more likely to use web-based technologies for engaging in public participation. Rather than survey people on their opinions of web-based technologies, I chose to poll participants on actual use of these tools. Please find a full set of survey questions in the Appendix. The procedure is listed below.

Hypothesis: The more people are concerned with federal land preservation, the more likely they are to be engaged in resolving local problems through non-traditional means.

Null: The more people are concerned with federal land preservation, the less likely they are to be engaged in resolving local problems through non-traditional means.
Dependent variable: (Question 7): How likely are you to participate in an online version of town hall?

Independent variable: (Question 13): Concern for federal land preservation defined with the variable: Agreement that hydraulic fracturing should be banned on federal lands such as Yellowstone, the Wind River Mountain Ranges, and so forth.

Control variables:

Question 19: How long have you lived in your community?

Hypothesis: Those who have lived in their community longer are more likely to participate in resolving local problems through non-traditional means.

Null: Those who have lived in their community longer are less likely to participate in resolving local problems through non-traditional means.

Age:

Hypothesis: Younger people are more likely to resolve local problems through non-traditional means.

Null: Older people are more likely to resolve local problems through non-traditional means.

Community size:

Hypothesis: Those living in smaller populated communities (defined as 50,000 or less) will be less likely to participate in an online version of town hall.

Null: Those living in smaller populated communities (defined as 50,000 or less) will be more likely to participate in an online version of town hall.

To analyze the findings, I ran an SPSS analysis using Ordinary Least Squares (OLS) Regression. Before analyzing the regression model, I ran correlations with Pearson’s R,
illustrated in Table 1, for all the variables to examine the bivariate relationship between each of
the independent variables and the dependent variable. The results show that there appears to be a
moderate relationship between how long participants have lived in their community and their
participation in an online version of town hall.

Table 1

Correlation Between Measures

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<tr>
<th></th>
<th>onlinetown</th>
<th>fracking</th>
<th>livcom</th>
<th>compop</th>
<th>age</th>
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<td>-0.313**</td>
<td>0.128</td>
<td>0.048</td>
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<td>72</td>
<td>72</td>
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<td>-0.078</td>
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</table>

When I ran the Ordinary Lease Squares Regression on the variables, the adjusted R square
accounted for only 7.8 percent of the change when I controlled for age, size of community, and
length of time spent in community. I chose to examine the ANOVA means comparison because
it compares the difference between two or more groups on a single dependent variable. Results are listed in Table 2. Because F is so low (2.502) the analysis is not statistically significant. However, I did find that had the results been statistically significant, the hypothesis would have been supported in that as concern for federal land preservation decreased, so did participation in non-traditional means of communicating political and local issues.

Table 2

One-way ANOVA Means Comparison

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.776</td>
<td>4</td>
<td>1.444</td>
<td>2.502</td>
<td>.051*</td>
</tr>
<tr>
<td>Residual</td>
<td>38.669</td>
<td>67</td>
<td>.577</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>44.444</td>
<td>71</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Dependent Variable: onlinetown  
b. Predictors: (Constant), age, compop, fracking, livcom

Furthermore, an extraordinary majority (75.3%) reported to be more likely to participate in an online version of town hall rather than a traditional public hearing. As might be expected, older people were less likely to engage in non-traditional forms of participation, and those who had lived in their community longer\textsuperscript{20} were less likely to engage in an online version of a town hall meeting.

\textsuperscript{20} It is hard to speculate as to why this is the case. Perhaps citizens who have lived in a community longer are satisfied with their location, and have very little need to participate in public forums. However, it could also be that there are other interactive opportunities for citizens, which provide more face-to-face engagement than web-based forms of participation.
Thematic Codes

Given the results of massive development in Sublette County throughout the past decade, it is increasingly crucial to understand how citizens influence decision-making. This requires not only understanding the way in which citizens participate in knowledge generation, communication, and deliberation regarding environmental issues, but also understanding the way in which citizens report their perceptions of what participation means. Throughout this research, one of the main ways informants reported influencing decision-making about their environment was participation in government-organized citizens’ advisory boards (95%). Other methods included volunteering for research in air quality monitoring in conjunction with academic researchers and participation in grassroots organizations such as the Citizens United for Responsible Energy Development (C.U.R.E.D.), an organization “dedicated to ensuring that energy development in and around Sublette County, Wyoming does not compromise human health or environmental quality” (www.cured.ws). In addition to these participatory measures, citizens participated by requesting more academically rigorous research, engaging with local government, meeting together to discuss community needs and educate themselves, and relying on existing social structures to organize themselves to reach out to outsiders. Informants consistently compared the Pinedale Anticline Working Group (PAWG) and the Upper Green River Basin (UGRB) Ozone Task Force, both of which were government-organized citizen advisory groups, as a method of public participation. Discussing the successes and failures of each group provided an understanding of political and institutional barriers to participation. Although informants commonly reported government-led advisory boards as an example of
public participation, they also described these venues as minimally effective for empowering participants or making desired changes in policy.

In addition, and sometimes as an alternative, to the government-organized advisory boards, citizens participated in grassroots organizations. Informants involved in grassroots organizations, but also those who were disenfranchised by the government-led advisory boards, directed me to more innovative methods of participation, such as a volunteer citizen science project in which citizens of all ages wore mobile sensors to measure Ozone levels. Accordingly, information on these projects informed my follow-up questions. In the proceeding sections of this chapter I will explain in detail the most common codes I found. Table 3 illustrates the frequency of codes across informants. Codes were marked when a participant communicated the theme; however, each individual mention is not accounted for.

Table 3

*Frequency of Variables in Coded Interviews*

| Themes                        | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V |
| Community Disruption         | X | X | X |   |   |   | X | X | X | X | X | X | X | O | X | X | X |   |   | X | X | X | X |   |   |
| Change in Collective Identity| X | X | X |   |   |   | X | X | X | X | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Economic Development         | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Physical Space & Participation| X | X | X |   |   |   | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Social Capital & Participation| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Disempowering engagement     | X | X | X |   |   |   | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Dissatisfaction w/ traditional engagement| X | X | X |   |   |   | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
**Table:**

| Problem with lack of citizen involvement | X | X | X | X | X | X | X |
| Scientific engagement by non-experts | X | X | X | X | X | X | X | X | X |
| Government-organized advisory boards | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Grassroots organizations | X | X | X | X | X | X | X | X |
| Citizen science projects/need for better monitoring | X | X | X | X | X | X | X | X | X | X | X |
| Barriers to participation | X | X | X | X | X | X | X | X |
| Workers’ safety & inclusion | X | X | X | X | X | X | X | X |
| Empowering engagement | X | X | X | X | X | X | X | X | X |
| Lack of trust in citizen engagement | X | X | X | X | X | X | X | X | X |
| Public goods | X | X | X | X | X | X | X | X | X | X | X | X | X |

**Community disruption and collective action.** This was the initial code I looked for due to expectations informed by the literature. Because rapid energy development has disrupted communities in the past, I expected to find reports on community disruption as a result of the energy boom in Sublette County. Although residents of Sublette County have a history of extractive industrial development, which dates back to 1939, residents of Pinedale experienced a disruption in their community by the natural gas boom in a way that the other two towns in Sublette County, Big Piney and Marbleton, did not. Jeff Jacquet (2009) examined the economic effects of the boom in Pinedale and found that though revenue from energy projects brought on
the construction of new infrastructure projects, those investments were needed to respond to the rapid growth. In his research on the social impacts of energy development, Jacquet (2009) found that the majority of long-term residents surveyed rated their overall community satisfaction as having decreased since the boom began and viewed social relations within the community to have declined….When asked to list the positives and negatives of living in their community, respondents almost exclusively filled the negative column with gas industry and growth related factors, while filling the majority of the positive column with long-standing community attributes not related to industry or growth (p. 43).

While recognizing the benefits of the development, many (77%) voiced concerns about community disruption. For example, a member of the Citizens United for Responsible Energy Development (C.U.R.E.D.), remarked that the boom polarized the community in that it incited an entitlement attitude, which caused a great deal of discontent in the “whole community from the local government on up to our state” (Participant I, personal communication, May 2013).

I coded for community disruption and collective action when the specific terms was listed, but also when the idea of community disruption was communicated. Often there are overlaps in themes. For instance, when discussing disempowering citizen engagement, Participant I reported, that the “entitlement attitude has caused tremendous amount of discontent or lack of transparency with our whole community from the local government on up to our state and of course the EPA because we wound up suing the EPA but only because we couldn’t sue the DEQ” (Participant I, personal communication, May 2013). Because this also addresses community disruption, it is coded under this theme as well. An area of research that offers potential for greater study is analyzing the overlaps and potential relationship between different themes.
As literature on social capital and collective action illustrates, community disruption effects participation by poorly affecting the collective identity. Accordingly, the community of Pinedale responded collectively to the increased development “with absolute greed. We had money and we just couldn’t get it fast enough. I looked at my neighbors and didn’t recognize them. The money corked them, because the greed escalates in a collective” (Participant A, personal communication, May 2013). I included the theme ‘change in collective identity’ in the code ‘community disruption & collective action’ because the majority of informants who commented on the negative aspects of changes in the collective identity included this as a form of community disruption. There were other ways that the community was disrupted; however, the dominant way was the shift in collective identity.

Although initial action to advocate for stricter approaches to industrial activity may have taken the form of concern for community solidarity; people began to converge together as “discussion moved to what it [development] is doing to us as humans” (Participant I, personal communication, May 2013). As citizens began to raise local health concerns, they began to act based on their individual health and safety concerns. Therefore, it has become increasingly important for citizens to act collectively in an effort to mitigate the negative impact on individuals.

**Physical space and participation.** This was a particularly difficult theme to define. I initially looked for themes that communicated change in the environment such as Participant N’s comment that “Pinedale doesn’t lean one way or another. I think it’s too hard to measure majority opinion because that’s constantly shifting. How does the community identify? Is it a
natural gas town? Is it a cow town? You could quantify it but it’s not interesting. With a fluidity between people at times, there’s different ideas of what Pinedale is” (Participant N, personal communication, June 2013). This observation was based on Participant N’s research on the changing physical appearance of Pinedale. Overlaps in this theme are most common between ‘change in collective identity’ and ‘public goods.’

Although industrial activity is lauded for providing local jobs to family members as well as its restoring infrastructure, the activity’s negative impacts are largely hidden from residents or visitors of Pinedale. While it is true that services and jobs provided by industry gave people a tangible benefit from industry’s presence, these benefits have obscured the appearance of negative effects. Accordingly, this invisibility of the industry has allowed many people to cling to the ‘cow town’ identity amidst incredibly rapacious industrial development only a few miles away. Additionally, though Sublette County may not get its identity from being an oil and gas town, it receives much of its revenue from the industry.

Illustrating the theme of invisibility and physical space, Participant N remarked that the town itself is not marked by typical signs of an industry town such as a place like Rock Springs, WY—90 miles south of Pinedale. Instead, wagon wheels and spokes—relics of the past—decorate Main Street where you’ll find old stores such as Fandek’s Saddle Shop, Stockman’s and the Log Cabin Motel. Participant N commented that Pinedale “is not a cow town anymore, but people still have ideas that if they have lived there their whole lives it’s always going to be this way (Participant N, personal communication, June 2013.).”

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21 The well-sites are not immediately visible upon entering town; rather, they are distanced from public view.
How much does collective identity and physical space affect participation? It is evident that people are deeply concerned about the environment as well as economic growth. Nearly everyone to whom I spoke mentioned that they lived or moved to Pinedale for its aesthetics—either because of the natural beauty it has to offer or because it was a place they could call home. Furthermore, the ties to the land are explicit in some of the actions taken to protect the environment. To demonstrate environmental concern, Participant I remarked that the haze obfuscating the Wind River Mountain Range was enough to spur action for it was “visibly shocking because the Winds [Wind River Mountain Range] were getting dimmer and dimmer” (Participant I, personal communication, May 2013).

**Economic development.** Juxtaposing concerns of community disruption and collective identity with the benefits of economic development, informants illustrate the complexity of decision-making with regard to this issue. Economic development is an increasing concern for residents as other major industries, such as the grazing and cattle industry, decline. Significantly, not only did my survey show that economic development is among the top priorities of those polled, but also 16 of my 22 interviews highlighted the importance of economic development in some way.

Discussions after a Planning and Zoning meeting in Sublette County focused on the importance of economic development. Participant H lauded the effects of energy development for making it possible for the younger generation to stay closer to home rather than leave in search of jobs. In this way, the collective identity of the younger population has changed because those in their 20s and 30s are reliant on oil and gas industry for revenue thus are more likely to
feel warmer toward natural gas development. As a consequence, there is only a “minimal amount of participation around the issue with the younger folks” (Participant G, personal communication, May 2013).

In some ways, “environmentalism has become an elite sort of luxury” (Participant I, personal communication, May 2013), “but it needs to be redefined within our regular economy” to keep people from following economic development at all costs. To illustrate the need for reducing economic incentives to exploit common-pool resources, Participant I remarked, “development can be done correctly. And part of that formula is credible monitoring at the source so that you can focus on where the problem is and fix it.”

How do citizens engage about these issues? Addressing this question, informants reported participating with government as well as with one another. The most common method citizens reported being involved in is government-organized advisory groups, set up for participants to make non-binding recommendations to the government. Other methods involve participating in grassroots organized citizen groups, connecting to resources outside of the community. And lastly, citizens have reported engaging in citizen science projects to educate themselves and connect with others around these issues.

Present in each of these participatory measures is an element of technological engagement. Use of technologies ranged from using traditional email communication and accessing documents online to relying on local citizens’ expertise in conjunction with academic researchers to build and implement sophisticated and innovative technological solutions. Regardless of how sophisticated the technology, it was used primarily as a research and communication tool, rather than a tool for reducing pollution. Though there is mention of
technologies for reducing emissions in the DEQ Ozone Strategy Plan and the recommendations from the Ozone Task Force, this is largely separate from the citizens’ involvement outside of requesting the technological implementation.

**Disempowering public involvement: Dissatisfaction with traditional forms of engagement and lack of citizen engagement.** 12 of the 22 interviewees reported some form of disempowerment regarding traditional forms of citizen engagement. Other codes that overlap with this theme are ‘dissatisfaction in government advisory boards’ and ‘problem with lack of citizen involvement’. I found multiple overlaps in lack of citizen involvement and dissatisfaction in government advisory boards – both of which were communicated as disempowering forms of public involvement. One of the major sources of dissent is the lack of support for the mobile monitoring air quality project through the University of Wyoming, which was widely supported by citizens.

The two cases most prominently highlighted in discussions regarding public participation were the Pinedale Anticline Working Group and the Upper Green River Basin Ozone Task Force. The first case illustrating public participation in Sublette County is the Pinedale Anticline Working Group (PAWG), which was an adaptive management group sponsored by the Bureau of Land Management (BLM) under Federal Advisory Committee Act (FACA). It aimed to get more citizen input into the land use decisions. However, in October of 2012 participants resigned in protest due to citizens’ disempowerment in the process.

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22 Participant N pointed out that it is interesting that PAWG devolved to the point that inaction was the most empowering measure participants could take.
To address the reasons for PAWG’s failure, a prominent member of PAWG mentioned that although the goal of the initiative was to involve the public, “there wasn’t enough public participation” (Participant V, personal communication, May 2013). Lack of public participation was due in part to the fact that the PAWG did not have a lot of teeth when it came to making tangible policy changes. As an alternative to PAWG, the BLM established the Wyoming Resource Advisory Council, which is a “10-member statewide advisory council, which provides advice and recommendations to the BLM on resource and land management issues” (Kerstetter, 2012)\textsuperscript{23}.

Another reason given for PAWG’s failure was poor communication among governmental agencies and advisory board participants. To illustrate the communication problem, Participant N remarked that the miscommunication about what citizens could do in the PAWG caused a “community sense of confusion.” One reason for this sense of confusion is people thought they would make decisions rather than serve as an advisor. Participants had interpreted their position “on the PAWG as being able to tell the BLM what to do and to stop or change actions, which is illegal under NEPA. BLM cannot abdicate that responsibility in decision-making” (Participant N, personal communication, June 2013). However, in 2004, after the PAWG was re-chartered under FACA, it became clear that citizens could not tell the BLM what to do. Additionally, once it became apparent that citizen recommendations would not be taken seriously, the citizen...
position became less frequently occupied because “environmentalists and industry representatives were paid staffers whereas the citizens were not. And unless you’re getting paid it’s hard to put in this kind of work” (Participant N, personal communication, June 2013).

In addition to communication problems, another consistent complaint about PAWG was that it did not include ordinary citizens. Seven of the 22 interviews showed that people were dissatisfied and disempowered by the lack of ordinary citizens on the PAWG board. For instance, Participant K remarked that citizens resigned in protest because all of their recommendations were ignored. Furthermore, throughout the history of the PAWG, “the BLM had shown it wasn’t a meaningful opportunity because they rejected all of their recommendations. The rules of any public participatory process is that if your participation is meaningless (or if the agency doesn’t take it seriously) then people quickly see it as meaningless” (Participant K, personal communication, June 2013). Additionally, it is an essential part of success in these kinds of participatory efforts that the process be clear and structured with an end result in sight, because “the mired stagnation of bureaucracy is going to sap empowerment” (Participant N, personal communication, June 2013).

When asked why the PAWG failed, Participant M indicated that a major flaw was that ordinary citizens were never involved. Indicative of his view M said that it is “interesting to hear the stories of those working out in the field [because] they point out problems with industry” (Participant M, personal communication, June 2013). Additionally, in an interview about the citizen volunteer project for sensing air quality, Participant I mentioned that it “could be really great for workers to wear [these badges for air quality monitoring] to gauge worker exposure” (Participant I, personal communication, June 2013). However, in line with the dissatisfaction
Participant I indicates that no company would be willing to invest in a project like that. Initially I coded these comments as ‘lack of ordinary citizen involvement’ but expanded this to include all interviewees who expressed a need for local knowledge to build social capital and trust.

The previously mentioned data on the need for local input is indicative of the fact that the inclusion of local knowledge in decision-making not only fits in line with the ‘democratic right’ perspective, but also is important to knowledge production for building a more locally-specific understanding. Because positive social capital feeds into a community and contributes to a more trusting society, social capital is important for increasing levels of local citizen empowerment through more participation at the local level.

The other commonly mentioned government advisory board is the Upper Green River Basin (UGRB) Air Quality Citizens Advisory Task Force, which was put together in February of 2012 by the Wyoming Department of Environmental Quality (WDEQ) to form consensus about how to get Pinedale out of non-attainment. Due to the poor air quality in Sublette County, the purpose of the task force was “to advise and recommend to WDEQ approaches for resolving air quality issues and increase public engagement in the proposed Ozone Nonattainment Area of Sublette County and parts of Sweetwater and Lincoln counties.” Additionally, it was meant to improve communication between the public and the DEQ (WDEQ, 2009).

Despite initial satisfaction with the consensus of the UGRB, people are now beginning to feel disappointed by the fact that DEQ has done very little with their recommendations. This disappointment is due in part to the skepticism that the recommendations will not be taken seriously insofar as DEQ is not bound to use them. Though citizens were involved directly in the discussion and consensus-building process in a collaborative group, the lack of political will on
behalf of the DEQ is a deterrent to participation in this form of engagement. Reflecting on this
dissatisfaction, both Participant C and I remarked that it is inappropriate for DEQ to bring the
recommendations back to the Task Force for further discussion because the recommendations
were reached after a great deal of debate and discussion through a “formal and structured
process” (Participant C, personal communication, May 2013).

One of the major sources of dissent is the lack of support for the mobile monitoring air
quality project through the University of Wyoming, which was widely supported by citizens.
Illustrating dissatisfaction in DEQ’s approach to scientific research is an email conversation with
Participant C that showed that the Air Quality Division in the DEQ are “dragging their feet and
providing roadblocks to the UW Mobile Monitoring project much less any input from citizens.
They will not acknowledge that they need more data to assist with 1) identifying opportunities to
reduce emissions; 2) meeting air quality standards; and 3) getting their predictive ozone model to
work.” (Participant C, personal communication, May 2013).

Disempowerment begets lack of participation. Commenting on the disempowerment
caused by the PAWG, Participant B said that the whole process [of government-organized
advisory groups] is
totally disempowering. We felt we have absolutely no influence on the federal
government. They’re going to do what they’re going to do. We have some impact on
state government. Where we’ve got to take control is with our county and our towns. The
Sublette Group was set up to initiate citizen involvement with the county commissioners,
with planning and zoning, and with the town officials. I felt like we had a huge impact
because we stayed away from the federal agencies. Starting with grassroots is the only
way that works.

For this reason, Participant B has chosen not to participate in the government-organized
groups because she is “repulsed with how government functions” (Participant B, personal
communication, June 2013). To illustrate dissatisfaction, B compared government meetings and industry meetings, saying that at least in the industry meetings citizens were able to see their impact and felt “listened to by industry.” B commented, “They [industry] wanted to know what we had to say. They want to be good neighbors because they know that if the locals are pissed their jobs get a whole lot more difficult. Why do you think they give away such good candy?24”

Community members have criticized the DEQ for being stalwart and uncommunicative. Participant O, an employee with the Wyoming DEQ, remarked that he would have liked to have seen the group function with more two-way communication because they [citizens] have ties to the community. [He] would like for them to be part of DEQ’s voice to carry that message out there and explain in more detail what we’re tasking with doing, but [he] didn’t get much applause for that.” His statement regarding a desire to see better communication indicates that there is a miscommunication and misunderstanding occurring at all levels.

Throughout the process of these formal forms of engagement, the primary methods of communication were face-to-face meetings and email correspondence. Participants such as Participant C engaged in extensive email correspondence with local and state government officials, scientists, and other citizens. In fact, most of the coordination and communication regarding the funding of the mobile monitoring project as well as participation in the UGRB Task Force was done through email correspondence. An additional communication feature of the

24 It is perhaps a misnomer that industry and citizens are at odds with one another. The most criticism has come from citizens about their interaction with the DEQ. A common theme was that the industry is agreeable and amiable while government is bureaucratic, stalwart, and difficult to negotiate with. In many ways, citizens report bonding with industry over irritations with the bureaucratic roadblocks provided by the government.
task force was the presence of a ‘neutral facilitator’ in the meetings—one of the primary reasons participants attributed success to the Ozone Task Force.

Given the dissatisfaction participants voiced with regard to government-citizen interaction, what are some alternative ways of involving citizens? To mitigate collective action problems and respond to the request for more local knowledge, monitoring by employing new technologies could provide a way of engaging citizens, and responding to requests for better scientific research.

**Scientific engagement by non-experts.** Beyond forming consensus in the formal task force, citizens have requested more scientific research in the area of air pollution. On September 29, 2011, due to the pressure C.U.R.E.D. along with Earthjustice put on EPA Administrator Lisa Jackson, the EPA declared Sublette County in non-attainment, thus, triggering the need for additional research to satisfy the required protections of the Clean Air Act. Due to the action taken by citizens, government and industry are now faced with the regulatory hurdles of getting back into attainment. However, as indicated, before regulations can be implemented, there is a need for further research.

In an attempt to get Sublette County back to attainment levels, the Pinedale Anticline Project Office in conjunction with the University of Wyoming’s Department of Atmospheric Science on September 13, 2012\(^25\) proposed a project. The stated objectives of the project are to “(1) assess ozone precursor accumulation in the study area by mobile monitoring of methane and other precursors during different wintertime meteorological conditions and (2) characterize select

\(^{25}\)The project was estimated to cost $127, 985 and be conducted primarily by Dr. Robert Field for the year of 2013.
emission sources by stationary monitoring of methane and VOC (Volatile Organic Compounds)” (PAPO proposal, 2012). Prior to the project proposal, a project referred to as the Pinedale Anticline Spatial Air Quality Assessment (PASQUA) took place in which the “University of Wyoming conducted three spatial surveys of benzene, toluene, ethylbenzene, and xylenes (BTEX) and oxides of nitrogen at fifty measurement sites; UW conducted sixteen spatial surveys of thirty volatile organic compounds at ten measurement sites; UW conducted five mobile methane pilot exercises, which identified a variety of continuous and intermittent sources throughout the PAPA” (PAPO proposal, 2012).

However, despite discussion of funding these projects and the multitude of requests by citizens for more academically rigorous research, it has been a difficult to acquire funding for the previously mentioned mobile monitoring project—a project deemed of utmost importance to the participating citizens. Though it is hardly mentioned in interviews, it is worth noting that the Pinedale Anticline Project Office receives its mitigation funds from industry in the area. As mentioned on its website, the Supplemental Environmental Impact Statement (SEIS) “established a Monitoring and Mitigation Fund to mitigate potential impacts to wildlife, air, and other resources in the area. Ultra, Shell, and Questar contribute $7,500 to the Monitoring and Mitigation Fund for each well spudded in the Anticline, with a total contribution of $36 million during the life of the project.”

Participant C describes citizen dissatisfaction regarding funding for the project. To elucidate this dissatisfaction, C commented:

I feel my concern has been misinterpreted a bit and would like to clarify it. My concern is with the denial of a University of Wyoming Air Monitoring funding request by PAPO that had a lot of citizen support and, going in, was favorably considered by many of the
board members. It was denied based on input from DEQ” (Participant C, personal communication, May 2013).

C commented further that he has “seen the need for more and better information and data for a long time” (Participant C, personal communication, May 2013).

The effects of rapid energy development such as community disruption, stress on infrastructure, change in collective identity, and lack of adequate information and communication affects levels of trust and feeds into why and how people participate. As interviews have illustrated, government-organized citizen groups are not always effective, and often are disempowering due to miscommunication with the public and the fact that government is not bound to implement citizen recommendations. For this reason, it is critical to focus on locally generated knowledge not only as a method of public participation, but also as a way to understand the local complexities more intimately than top-down implemented methods. However, decision-makers do not always readily accept knowledge generated by non-experts.

In total, 14 of the 22 interviews highlight a need for locally generated knowledge. However, a consistent finding is that there is an opposition to non-experts, or ordinary citizens, and this can have an effect of deterring others from participating. For example, regarding the PAWG and the UGRB Ozone Task Force, people often did not participate because they felt they would not have much of an effect. This has lead to the pursuit of other methods of participation. To illustrate the problem with expertise and local knowledge, Participant B lamented the attempts of government officials to try to inform her and her husband about the best methods for raising cattle despite the fact that they have been in business for over a century. B remarked,

The government won’t even listen to us on something we have taken care of 60 years and that we know intimately because it’s just a rancher that’s telling them to do this. So I
would transfer that same model to DEQ. Unless they have the right degree with the right credentials it will hold no validity. You’re just a hick. The citizen is never an expert and the expert is so removed from the citizen that you get a huge schism between farmers and ranchers and academics…It’s potentially a problem created in the academic world because they have come up with so many sterile, simple answers that don’t necessarily fit with the real world. So those of us breathing this air and looking across the valley for 60 years will have no validity in comparison to somebody from Berkeley, CA who studied something and read a couple of articles and is an authority (Participant B, personal communication, June 2013).

B’s understanding of the complexities of the land demonstrates that the way that local residents can be more knowledgeable than formally defined ‘experts’.

As literature and interviews have shown, the tendency of ‘experts’ to disregard the validity of local knowledge has led to lack of trust in the science as it becomes more politicized and alienated from local realities. This politicization is indicative of a chasm between citizens and scientific research.

Currently, the most contentious environmental issue in Sublette County is the findings of ground-level Ozone and how it relates to the oil and gas industry. Participant I, along with C.U.R.E.D., released a press release on nonattainment26 that claims that before the oil-and-gas boom, “Sublette County’s residents enjoyed some of the best breathing in the country. Today, thousands of federally approved oil-and-gas wells pollute the region’s air with significant amounts of ozone’s ingredients—volatile organic compounds (VOCs) and nitrogen oxides (NOx). As a result, those living in Wyoming’s rural Upper Green River Basin have recently suffered some of the nation’s highest ozone levels” (C.U.R.E.D. Nonattainment Press Release).

Initially, the awareness of ground-level Ozone was initiated from the findings of a high school student. To demonstrate the importance of non-expert involvement in scientific research,

26 A nonattainment area is an area which has air quality worse than the National Ambient Air Quality Standards—a metric defined by the Clean Air Act.
Participant I described the story of the initial discovery of ground-level Ozone in the area, which began when a student expressed an interest in researching the pollution problem in Pinedale:

She [the student] wanted to do something on Ozone. And I suggested how about we try to find some ground level ozone because I had known a little about it just from my own research and she was excited about that because we already kind of knew about stratospheric ozone and what’s causing it. She did a wonderful project that won everything and had to explain it to the judges so they could understand. It was amazing….I always would bring projects that won at state to meetings like a display for the community. It’s a great thing for kids to have positive press. There happened to be a BLM public meeting coming up and Tracy was enthralled with her project so I said I think you should present it – it’s absolutely marvelous and it won first place at national and all this stuff. So bless her heart she brought her little stuff over and I told them we had some projects to present. She presented her project and the BLM just flipped out and tried to discredit her right there in the public meeting [saying things like] there’s no such thing at ground-level ozone, you’re just a little 8th grader. [She] was so poised and mature for her age; she just stood up, this was my project, this is how I did it, and these were my findings and I repeated it several times. It wasn’t even evening until KTV came and interviewed her.

Because the results were not the product of an “expert”, they were subject to incredible scrutiny.

The problem of need for more research is compounded by the fact that citizens have reached a point in which they feel they can no longer trust government to protect their air quality—a sentiment that is illustrated in the C.U.R.E.D. Nonattainment Press Release: “After years of unhealthy air and government delay, it is now up to the citizens who live, work, and recreate in Sublette County, Wyoming, to take a firm stance for the restoration of the region’s air to its prior, pristine state.” Not only did the government seem unconcerned with the quality of air in the region, but did not act until pressured by the public. For instance, the EPA did not declare Sublette County in nonattainment until the participants of C.U.R.E.D. pressured the federal government to take action, and even then it was not until the 60th day that the government acted, declaring Sublette County a nonattainment area. The need for federal classification of Pinedale
as a nonattainment area is indicative of the bureaucratic process, which requires EPA’s designation before the state government can develop a “State Implementation Plan to describe how the state will attain and maintain the ozone NAAQS” (PAPO proposal, 2012).

As part of the Pinedale Anticline Project Office (PAPO) proposal, there is a monitoring requirement to determine where to reduce emissions. As a result, citizens have petitioned PAPO to help fund a mobile monitoring project as an alternative to stationary monitoring, which does not offer information at the level of precision citizens have requested. One of the scientists working on the project attributed the support for his air quality research to the citizens of C.U.R.E.D. and other citizens’ groups in the area, who have interacted together to pressure local, state and federal governmental actions. Emphasizing this appreciation, he remarked, “Without a caring populace, there would be no discourse for change. And if it wasn’t for them [citizens], maybe I wouldn’t have the opportunity to do my research” (Participant T, personal communication, June 2013).

Although the typical framework for thinking about public participation includes actions such as voting, public forums and writing local government, the framework fails to consider ways that citizens may be indirectly involved. These interviews illustrate that public participation occurs in a myriad of ways, some of which are not specifically intended to directly impact the decision-making process.

**Citizen participation in air quality monitoring.** As we have seen, advocating in citizens groups to acquire funding for formal research projects, which work directly in conjunction with industry and government, is an additional way that citizens can engage in the
environmental policy-making process. However, these methods still leave the research in the realm of ‘experts’. For example, the student project on ground-level Ozone was only legitimated after the government recognized it as valid. Thus it is important to explore other avenues through which the public can engage with research regarding environmental issues. One such example is the Upper Green River Ozone Investigation Project (O3i) conducted by Dr. Field. This initiative utilized citizen volunteers for detecting air quality with mobile sensors.

A project such as this is feasible due to the proliferation of sensors such as the O3 ambient air passive samplers, made available by 2B Technologies. This particular technology was designed as a “UV-based ozone monitor by developing the Personal Ozone Monitor (POM). The POM has a built-in GPS so that ozone measurements may be logged continuously along with geographic location” (www.twobtech.com). Refer to Figure 2 for a map of the O3i project area.

27 It is worth noting that C.U.R.E.D. also worked on a citizen science project for monitoring air quality. Participant I remarked that having a local expert was helpful to the project. A resident of Sublette County put together a spectrometer and way of reading Ozone and “CURED all volunteered to put them by our houses and read them morning and night and report to him after a week. That had some very interesting results—very high results but DEQ would not accept them because it wasn’t their spectrometer” (Participant I. Personal Communication. May 2013.).
This project used samplers and trained citizen volunteers to allow both experts and the public to collect and understand environmental data. Although citizens and sensors do the scientific data collection, the analysis still takes place in the lab. To further illustrate that scientific research conducted by citizens has potential to satisfy the rigor required in academic scientific research, Participant T described how the participants were required to undergo a “training session before they took part in the sampler placement exercise.” T remarked, “It was important that participants were included in the process; [however], the other aspect was to
potentially meet people they wouldn’t meet usually” (Participant T, personal communication, June 2013). This was an earlier attempt of the citizen forum.

Despite the fact that the project was useful for education and outreach, there was also “a strong scientific need; we had to get those samplers out and so I had to have 12 teams. But I could have done it differently. I could have just employed people or could have just taken all governmental workers. And we didn’t do that because we wanted it to be parallel. So the primary motive in terms of the contract was the science but I was responsible for delivering the measurement so it would have this kind of outreach” (Participant T, personal communication, June 2013). This approach to relying on volunteers interacting with one another is indicative of the fact that these types of projects have the potential to be much more empowering than traditional ways of engaging in the policy-making process. In this way, the citizen science project is not entirely designed to manipulate individual incentives for knowledge; rather, the emphasis is primarily on the importance of citizens coming together and connecting to one another.

However, there is a great deal of planning that has to go into involving citizens in scientific research. How does this planning come about? Should citizen groups appoint leaders to organize and coordinate with scientists and decision-makers? Or should government introduce citizen science projects as part of a more centralized plan?

To involve citizens in scientific research it is important to both get citizens involved based on their own interests as well as use the generated data for broader research goals. Demonstrating these goals, Participant T explained The People Project, a project that was a one-day ‘snapshot’ of the city in which volunteers would travel on different modes of transit while
wearing air samplers for a day. This data could then be used to compare with the standard methods of monitoring. This satisfied two important goals: “1) to involve people and allay their fears about exposure levels and 2) to compare findings to the fixed site monitoring sessions to then determine if the monitors were doing their job of assessing exposure of a population” (Participant T, personal communication, June 2013).

Though the People Project and the mobile sensing project were focused on the use of sophisticated technological tools to measure air quality, the organizers were also attuned to the infrastructural and political barriers to this type of participation. For example, Participant E defined the failure of integrating citizens and technology into research in the Eastern Bloc as a design problem because of the political structure is such that “the only people who participated were the health authority” (Participant E, personal communication, May 2013). E also remarked that “there are different agendas depending on the city. Our thinking was to bring together health and environmental agencies on national and city-wide scale about air quality so the philosophy with O3i was that there is a lot of antagonistic ‘us vs. them’ rhetoric and the best way to break that down was to involve people” (Participant E, personal communication, May 2013).

Notwithstanding the institutional and political barriers to implementing this type of project, Participant K mentioned that citizen volunteers are useful to the extent that it gets people engaged, educated and invested in the project. However, if the science becomes politicized, it could have the opposite effect of disempowering people or of creating an atmosphere of doubt. Additionally, there is a possibility that public participation in research “is not be the best use of the limited volunteer time and capacity that regular citizens have” but that it could be a good way
to “get people who don’t know about the issue engaged as a kind of outreach and grassroots tool” (Participant K, personal communication, June 2013).

Despite barriers to participation, Participant T sees environmental science as a good interface for citizen participation in scientific research because it is tied to a geographic location. Additionally, “when it’s your health that’s potentially on the line, your ears should certainly prick up hopefully before your lungs do” (Participant T, personal communication, June 2013).

**Social capital and citizens groups.** In all three of these examples: government-organized advisory boards, grassroots organizations and citizen volunteer data monitoring, the social dynamics affect how and why citizens engage. Given the proliferation of technological tools available for public participation, it is increasingly important to consider the institutional, political, and social dynamics, which may inhibit or engender such participation.

The influence individuals have on one another can be seen in the process of reaching consensus in public meetings such as in the PAWG and UGRB. As noted by Participant K and others, much of the success in reaching consensus could be attributed to the fact that participants bonded outside of the meetings. Participant K and Participant C mentioned that they would go out to the brewpub with industry guys and gals; through this process of bonding, they found that they shared common concern\(^2^8\). In this way, the social capital could have either impeded or facilitated deliberation. Further illustrating the importance of positive social capital, Participant

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\(^2^8\) In fact, Participant K remarks that there is a “frustratingly false kind of conflict [between citizens and industry] in many cases. Industry is pretty straightforward. It’s the agencies who are more frustrating because they are pushed around more by political forces” (Participant K. Personal communication. June 2013). Furthermore, she points out that it the responsibility of the governmental agencies such as DEQ and BLM is to not violate the Clean Air Act and yet they are the agencies permitting these operations.
N remarked that if the relationships [in the UGRB Task Force] were not already in existence when the Task Force began, “they were building relationships while they were there and that is something PAWG never did. You have a better sense of you’re industry, I’m environmental, and we had a great meal last night and that can be a powerful tool in a consensus dynamic” (Participant N, personal communication, June 2013).

The interviews on government-organized advisory boards make it clear that the success of face-to-face meetings is contingent upon building relationships, or relying on existing relationships. But how and why do citizens participate in volunteer initiatives such as the ozone-sensing project?

To mitigate the aforementioned problems associated with rapid energy development, new technologies such as web-based tools for discussion and embedded sensors for mobile monitoring may offer citizens more distributed and collaborative ways of engaging with one another as well as with the environment. However, there is concern that the technology will not engage the citizen as much as face-to-face deliberation does. Furthermore, governmental representatives often voice concern that new technologies will ruin scientific integrity. Illustrating this skepticism, informants such as Participant G stressed that it is important with web-based technologies that the information offered on them “is based on sound science and not on popular view” (Participant G, personal communication, May 2013). In additional to concern, Participant B mentioned the salons she hosts in her home and how they have been successful in engaging citizens precisely because of the face-to-face aspect; this has led her to be skeptical about how effective web-based technologies would be at engaging citizens in this way.
One area in which participation in these measures can reduce the tension between individualism and collectivism characteristic to collective action problems, are the collaborative volunteer citizen science projects. To demonstrate the tension between individualism and collectivism, Participant I defined the personality of the West as fiercely individualistic yet very community conscious. Though individuals reported taking pride in their independence, they also noted being proud of community ethics and the ability to relate to one another despite differences. To clarify this statement, Participant I remarked that citizens have come to her to commend her on the work she has done for the community; however, they feel they cannot speak out against the oil and gas industry because they feed their children with industry money. In this way, individuals are kept from voicing concerns because they fear a loss of reputation with companies that provide important income.

Conversely, the proliferation of distributed technologies presents an opportunity to use technology in ways that are more specific to local realities. In the citizen science project explored, sensors were provided to participants to measure individual levels of exposure to air pollution.

However, leveraging this type of citizen engagement effectively requires more than the provision of technological tools. While this form of participation was designed with the idea of not only empowering citizens, but also contributing to a local knowledge base, formal decision-makers such as DEQ and BLM are still focused on using resources for larger-scale projects such as modeling and stationary monitoring. This is indicative of a problem at a higher level in the decision-making process.
Conclusion. My review of the literature influenced my expectations that integrating volunteer-based citizen science projects, which utilize technological tools such as mobile sensors, can reduce uncertainty regarding environmental decision-making. However, the data on the mobile monitoring project in the area illustrated that the problem is a political and institutional issue. Though the technical capabilities exist, the project is underrepresented as a valid method of scientific research. In accordance with this, the government has been stalwart in adopting new methods of monitoring.

Citizen involvement in environmental decision-making is important not only as a democratic right but also as a way of empowering citizens as producers of local knowledge and participants in policy-making outcomes. The key results are:

1. Although informants largely viewed the government-organized advisory boards as ineffective, citizens reported these interactions as the primary mode of engagement.

2. Although the technology provided in the citizen sensing projects offers opportunities for more distributed, collaborative, and empowering ways of engaging with one another, it was recalled less often as a means of participation.
Chapter V: Conclusion

The Icarian dream of flying on the wings of science and technology toward a more perfect society, toward a “knowledgeable society” in which ideology and politics are replaced by technically rational choices approved by an informed public, may have lost its earlier hold on the political imagination. –Ezrahi p. 240

The American West has been an obsession in North American Culture—characterized by sparse populations, vast spaces, large energy reserves, reliance on the land, and finally, a prevalence of an individualistic political perspective, which is dominated by distrust in government. With increasingly sophisticated communication, transport, and energy extraction technologies came wealth and prosperity for this isolated region. However, as might be expected when rapid growth occurs, the prosperity and influx of development that offered opportunities for growth also brought consequences such as community disruption, change in collective identity, and uncertainty regarding the management of public goods.

For the purposes of this research, Sublette County, Wyoming provided a case study for understanding the complexities of environmental decision-making. Ten years ago, Pinedale—the largest of the three towns comprising Sublette County—was transformed from a sleepy cow town of 1,200 people primarily reliant on the grazing industry to an energy boomtown, with all the common characteristics of such change including rapid growth, radically altered social dynamics within the community, and stress on existing infrastructure. To explore the uncertain and complex way in which the public resolves issues related to energy development and the environment, I explored this case study using a grounded theory methodology through interpretive interviews. The majority of informants responded that the development affected the local economy, caused community disruption, and brought change in collective identity.
The key results of this research in relation to my research questions are:

1. Although informants largely viewed the government-organized advisory boards as ineffective, citizens reported these interactions as the primary mode of engagement.

2. Although the technology provided in the citizen sensing projects offers opportunities for more distributed, collaborative, and empowering ways of engaging with one another, it was recalled less often as a means of participation.

While the majority of informants reported government-organized advisory boards as a form of public participation, few considered the volunteer projects until specifically asked. The implication of this omission is that while literature suggests that volunteer monitoring projects may provide more interactive, participatory ways of involvement, the literature does not indicate how these forms of interaction can be viewed as more legitimate modes of public engagement in the policy-making process. Additionally, though citizen-led active participation is in accordance with the highest level of public participation (OECD, 2001), initiatives often tend to be focused on participation as an end, resulting in a failure to account for participation in policy outcomes. Furthermore, citizens are often disempowered by governmental inaction with regard to citizen suggestions. In this case study, disempowerment was most clearly illustrated in the informants’ dissatisfaction with the government-organized advisory boards and the way in which citizen recommendations were incorporated, or more often, not incorporated.

In addition to reporting concerns about poor communication between the government and the public, citizens reported concerns about lack of local input. This indicates, as the literature
shows, that inclusion of local knowledge in decision-making not only fits in line with the 'democratic right’ perspective, but also is important to knowledge production for building a more locally specific understanding.

The importance of information cannot be understated. Because the information we consume builds our knowledge of the world, if citizens consume poor or inaccurate information, their evaluations will likewise be poor and inaccurate. Accordingly, one of the primary requests citizens made was for academic, unbiased research regarding air pollution, in part because the majority of informants were dissatisfied with the form of research provided by governmental agencies.

However, simply providing information to citizens is no guarantee for empowerment. And in fact, the provision of information can be disempowering at times. For example, to fulfill certain requirements of participatory efforts, governmental agencies and industry may decide to disclose chemicals used in industrial activity as a form of information sharing. Additionally, state and local governments may decide to publish pollution levels in local areas to inform citizens of their level of exposure. However, by providing this information, government agencies and industry may transfer the burden of action to citizens who may not have the luxury of responsive or corrective action to the concerns revealed.

Thus, after reviewing literature on collective action and public participation as well as preliminary interviews with informants in my case study, I concluded that while citizen engagement in scientific research can help contribute to greater transparency, citizen science projects may be most useful for educational and outreach purposes. This involvement has the
potential to create an environment of knowledge generation, facilitating greater levels of trust between citizens, scientists, government, and industry, making social coordination much easier.

**Design proposals for greater citizen engagement.** But what is the best way to involve citizens in the collection and documentation of scientific data? As the case study indicated, the possibility for mobile tracking of air pollution through the use of embedded sensors is a promising way to monitor and mitigate pollution by relying on local knowledge structures already in place. One example of this is the Visibility App for the Android Phone, which was created by University of Southern California’s Robotic Embedded Lab. It works by allowing the “user to take a photo of the sky which is then sent to a central computer that compares the luminance value of the sky to algorithmic models for time and coordinates of the photo” (Treacy, 2012). Another example is the Common Sense project, a mobile air quality-sensing project, which employs individuals with air quality sensors as an alternative to traditional stationary monitoring. This approach is focused on mobile participatory sensing, which “allows the community members impacted by poor air quality to engage in the process of locating pollution sources and exploring local variations in air quality” (Willett, Aoki, Kumar, Subramanian, and Woodruff, 2010).

Although tracking, monitoring, and modeling are features of more top-down centralized methods of gaining knowledge about the world, the personalization of technologies bring forth opportunities to rely on individual self-interest. This type of engagement leverages the individual’s desire to participate often for personal reasons. As observed in the literature (Gilbert, 1998), the actions of an individual can give rise to a collective that is wholly distinct.
Accordingly, I had hopes that these approaches could be applied to perhaps a form of collective measurement, which would focus on the individual as a distinct actor within the collective. However, for this type of measurement to be effective in the management of natural resources, incentives must be tied to a regulatory or governmental body as industry and government may lack the inherent self-regulation possessed by individuals. Additionally, emissions-tracking is a reading on the current state of air quality, so the sensors merely show the state of pollution, which means there is still a need for commitment from governmental regulators and industry to reduce emissions.

Given the findings in the case study in Sublette County, I formulated some design principles for future development of a mobile sensing citizen science project that may be more fruitfully employed in the decision-making process. As citizens, scientists, and government are all potential users of these tools, they informed the underpinnings of the design proposals.

The common form of communication citizens utilized was one of the most informative areas of the research. Accordingly, citizens reported relying heavily on email correspondence, and most informants accessed email on their mobile phones. For this reason, there is an opportunity to embed sensors into the cell phone device for continuous monitoring. To better facilitate multiple users in the mobile sensing project, future design should focus on a mobile platform. Typically apps embedded with mobile sensors for monitoring environmental issues are designed for individuals to observe their own activity and adjust accordingly. Because these apps are built on the pretense that individuals will self-regulate, they are empowering in the sense of providing information, which individuals can then base changes on. However, when tracking for the management of common-pool resources, visualization alone does not achieve the desired
outcome of lowering emissions. For this reason, it is critical that findings are binding and force regulators and industry to make changes to mitigation efforts for reducing emissions.

In addition, research indicated that funding was not only one of the biggest sources of dissatisfaction for participants, but also one of the biggest hurdles to successful monitoring. For this reason, it may be useful to engage in public-private partnerships with governmental agencies and grassroots organizations so that government might be better equipped to respond to citizen complaints, and citizens might be more willing to trust the decisions proposed by government officials.

Institutional and political barriers: A caution against relying on tools to solve complex problems. As research illustrated, although technological improvements, such as those proposed, can be made to the tools used in citizen science projects, it is likely not a problem that can be resolved by technology alone. The case in Wyoming showed that though it is important to involve citizens in the policy-making process as a way of empowering citizens as producers of local knowledge, it is critical to have all decision-making parties on board.

Assessing the outcomes of the three forms of citizen engagement have contributed to the understanding of public participation, and how it can be mutually beneficial to policy outcomes and solidarity among community members. Initially I hypothesized that a technological solution such as monitoring through the use of mobile sensors and citizen volunteers would be most effective for involving citizens in decision-making; however, it has become evident that technology is not necessarily the sole driver of participation, but rather, institutional structures can inhibit interaction from occurring. Accordingly, as this research has shown, it is not simply a
matter of coming up with technical solutions, but of fitting them within an existing institutional and political structure.

Citizen involvement in environmental decision-making is important not only as a democratic right but also as a way of empowering citizens as producers of local knowledge and participants in policy-making outcomes. Though engagement facilitated in citizen science projects offers opportunities for more distributed, collaborative, and empowering ways of engaging with one another, it is recalled less often as a method for participation.

Additionally, it has become clear that traditional ways of engaging the public in deliberation over complex environmental problems has led to poor policy outcomes, lack of political buy-in from citizens, and a general sense of disempowerment due to inability to affect change. The problems of traditional public engagement were primarily illustrated by the informants’ reported dissatisfaction with government-led advisory boards.

Contrary to the dissatisfaction experienced regarding government-organized groups, the projects that appeared to have the most citizen buy-in were volunteer projects and those related to education. Designed to provide a way for community members to bond while participating in scientific research, these projects were effective in providing a space for citizens to collaborate with one another. For this reason, it is critical that designs for more scientific contributions from citizens be implemented in the future.

There were a few limitations to my research that should be addressed. Of the four barriers to engagement with technology mentioned in the introduction: technological lock-in, barriers in terms of training, inaccessibility of web and mobile services, and privacy concerns, I did not address privacy concerns in my interviews. Additionally, though industry is a critical component
to participation in environmental decision-making, I did not speak with anyone representative of industry. It should be noted that in the process of contacting informants, I pursued a handful of industry representatives; however, I was never able to get an interview. This omission poses a limitation to the depth of this research, and should be addressed in future research.

**Conclusion.** As emerging technologies offer increasing opportunities for unconventional forms of participation, highlighting what non-experts, or amateurs\(^{29}\), can do out of their own interests, citizens are making more and more important contributions to knowledge that was once considered the purview experts. Today “it’s becoming more and more common for the most valuable analysis to be done by people outside the original laboratory” (Nielsen, 2012, p. 107-108) especially as more data is shared online. This participation takes on many forms from citizen journalism to citizen mapping to citizen science. The more traditional delineations between observer and analyst are changing and becoming blurred. As Clay Shirky remarks:

> *We are used to a world where little things happen for love and big things happen for money. Love motivates people to bake a cake and money motivates people to make an encyclopedia. Now, though, we can do big things for love.*

Initially I hypothesized that citizen engagement with technology would help citizens engage in more locally-specific data collection, both bonding them to outsiders as well as to one another. For this reason, I looked for ways to improve technological engagement on the presumption that the flaws resided in technological design. However, it became clear that the

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\(^{29}\) The word *Amateur* comes paired with negative connotations of being a novice or not enjoying the prestige of expertise. However, the word is rooted in the Latin *amatorem* meaning “lover” or the French *amateur*, which means “lover of”. It is precisely passion that drives many of our amateur endeavors.
problems extend from political, moral, and institutional structures. Because there is no simple solution, this presents challenges for both traditional and non-traditional means of engagement.

My research has raised quite a few areas for further research. Most importantly, it has raised the question of how technology can be better integrated into existing institutional structures. Are there specific social dynamics that could make the adoption of this type of solution more successful than others? Are there barriers to entry in terms of technology acceptance from participating citizens? Is the political structure such that vested interests are so powerful that they will not be willing to use the suggestions and contributions of citizens? Will this type of engagement potentially replace other solutions such as government-led advisory groups?

These are just a few examples of how this research could be extended in the future. In conclusion, I would like to emphasize that the innovations and implementation of digital technology has contributed massively to the distribution of knowledge production. Though this research has made me less sanguine about the possibility of using technology as a panacea for communication problems, I believe it opens the doors to an incredible area of research with regard to public policy. Further research should focus on possible partnerships that could reduce the disconnect between scientist, citizen, and government.
Appendix A
Questionnaire
What accounts for engagement in a community over an environmental problem?
H1: The more people participate in knowledge generation, the more likely they are to be engaged in resolving local problems.
What is the willingness to engage in the process of rulemaking?
IV: engagement
DV: participation in knowledge generation (defined as taking part in protests, voting, research, writing, posting, talking with community, leading initiatives, financially supporting groups), embeddedness in the community, proximity to a well-site, familiarity with the issue (defined as whether or not the community has experience with extractive industry)

1. How important is the environment to you?
   a. Very important
   b. Somewhat important
   c. Neutral
   d. Not very important
   e. Not important at all

2. How familiar are you with hydraulic fracturing?
   a. Very familiar
   b. Somewhat familiar
   c. Just a little familiar
   d. Know the name only
   e. Never heard of it

3. How often do you participate in community meetings (i.e. neighborhood watches or public hearings)?
   a. Frequently
   b. Sometimes
   c. Rarely
   d. Never

4. When you are deciding whether or not to participate in a local decision-making process, how important are the following factors? (participants asked to rank level of importance from very important to not at all)
   a. Time
   b. Money
   c. Convenience
   d. Recognition from community members
   e. Ability to be anonymous
   f. Knowledge of the issue
   g. Helping others

5. There are different ways to participate in the resolution of local problems. How likely are you to take each of the following actions:
   a. Perform an online search
   b. Go to a library
c. Talk with a neighbor
d. Talk with a local representative
e. Read the local newspaper
f. Read a national newspaper
g. Call a government official
h. Send emails to local officials
i. Join causes on social network sites
j. Participate in a public hearing
k. Organize protests or campaigns

6. Please rank the following 7 community issues based on their importance to you. Please use each number once, with 1 being MOST important and 7 being LEAST important
   a. Economic development/job growth
   b. Environmental conservation
   c. Preserving biodiversity
   d. Protecting public health
   e. Mitigating the effects of climate change
   f. Property value
   g. Energy development/energy security

7. How likely are you to participate in an online version of town hall?
   a. Very likely
   b. Somewhat likely
   c. Not very likely
   d. Not at all likely

8. Would you be more likely to participate in an online version of town hall or a traditional public hearing?
   a. Online version of town hall
   b. Traditional public hearing
   c. Either one (makes no difference to me)
   d. Neither

9. What factors make it less likely for you to participate in an online version of town hall? Check all that apply.
   a. I feel well represented by my local government.
   b. I do not have access to the Internet.
   c. I do not feel comfortable with the technology.
   d. I do not want to put my information out to the public.
   e. N/A – I do not participate in the political process.
   f. None of the above.

10. What factors make it less likely for you to participate in public hearings? Check all that apply.
    a. It is out of the way.
    b. I don’t have the time.
    c. I feel like I wouldn’t have anything to contribute.
    d. I’m not interested
e. I think others can make better decisions about topics being discussed.
f. I do not know when the hearings take place or where to find information on them.
g. N/A I do not participate in the political process.
h. None of the above

11. When you want to learn more about science and environmental issues (such as natural gas extraction), how important are the following sources of information?
   a. Local or national newspaper
   b. International news source
   c. Online search
   d. Government official
   e. Industry leader
   f. Local resident/neighbor
   g. Social network websites (i.e. Facebook, Twitter)
   h. Academic science journals
   i. Talk shows (tv or radio)

12. I will now ask you some questions about your attitude toward hydraulic fracturing and regulation. To what extent do you agree with the following statements:
   a. Management of public lands show emphasize the extraction of natural gas.
   b. Hydraulic fracturing should be banned on federal lands such as Yellowstone, the Wind River Mountain Range, and the Finger Lakes in New York State.
   c. Greater protection should be given to fish and wildlife habitats.
   d. The government can be trusted to safely regulate fracking.
   e. Endangered species laws should be relaxed to make room for the oil & gas industry.
   f. Issues of public health should take precedence to industry and oil & gas development.

13. How close do you live to a well-site? A well-site is an area where the ground is injected with fracturing fluids to break up shale underneath the surface to release natural gas.
   a. Less than 25 miles
   b. 25-100 miles
   c. 100-200 miles
   d. more than 200 miles
   e. don’t know

14. How long have you live in your community?
   a. Less than a year
   b. 1-5 years
   c. 6-10 years
   d. over 10 years
   e. most of my life

15. What is the average population of your community?
   a. Less than 1000
   b. 1000-15000
   c. 15000-50000
16. How would you characterize your community?
   a. Urban
   b. Suburban
   c. Rural
   d. Don’t know
17. How often do you feel people in your community listen to what you have to say?
   a. Frequently
   b. Sometimes
   c. Rarely
   d. Not at all
18. Demographics
Appendix B
Survey Procedure

Hypothesis: The more people are concerned with federal land preservation, the more likely they are to be engaged in resolving local problems through non-traditional means.
Null: The more people are concerned with federal land preservation, the less likely they are to be engaged in resolving local problems through non-traditional means.

Dependent variable: (Question 7) How likely are you to participate in an online version of town hall?
Independent variable: (Question 13) Concern for federal land preservation defined with the variable: Agreement that hydraulic fracturing should be banned on federal lands such as Yellowstone, the Wind River Mountain Ranges, and so forth.
Control variables:
Question 19: How long have you lived in your community?
Hypothesis: Those who have lived in their community longer are more likely to participate in resolving local problems through non-traditional means.
Null: Those who have lived in their community longer are less likely to participate in resolving local problems through non-traditional means.
Age:
Hypothesis: Younger people are more likely to resolve local problems through non-traditional means.
Null: Older people are more likely to resolve local problems through non-traditional means.
Community size:
Hypothesis: Those living in smaller populated communities (defined as 50,000 or less) will be less likely to participate in an online version of town hall.
Null: Those living in smaller populated communities (defined as 50,000 or less) will be more likely to participate in an online version of town hall.
Initial Questions (with follow-up interviews the questions changed a bit to reflect the incorporation of new information). As questions were informed by a review of the literature and a contextual understanding of energy development in Sublette County, so too were initial codes.

1. What were the social aspects of both PAWG and Task Force?

2. Was there disempowerment involved with the PAWG task force? Do you think citizens want different forms of participation?

3. How did people respond to the facilitation provided by the Ruckelshaus Institute?

4. In your experience working on environmental projects, have you ever come across any citizen–generated science studies? This is commonly referred to as citizen science or community-based research.

5. Has the environmental story changed in your experience in Wyoming? In terms of who participates and why?

6. Can you think of any specific failures in the past to provide citizens with adequate information?

7. Where do you think the greatest need is for better information/data?

8. Where does the information go after it is collected—DEQ? Citizens advisory boards? Local government? Universities?

9. How involved were outside environmental groups in the task force meetings? Such as Cured or Wyoming Outdoor Council? Do you think these kind of groups can be more effective as they represent mostly one interest group or is the collaborative approach the most effective?

10. Did people seem more trusting after these meetings?

11. How did the boom, and then the subsequent bust, affect public participation in the region?

12. Where have citizens been able to make the biggest impact with regard to the environment?

13. What are some other solutions you would have liked to have seen supported?

14. Is it a possibility that this task force could be disempowering?

15. How did the group formed and how can consensus be reached?
Some emergent questions:

1. Do those who work out in the fields feel a part of the community?

2. Did you notice specific leaders each time or did the power seem to shift?

3. Were any alternative forms of communication used to better facilitate dialogue and relationship building?

4. What was one of the toughest challenges with regard to scientific discussions?

5. What kind of partnerships do you think would help include multiple stakeholders in future deliberations?
<table>
<thead>
<tr>
<th>Codes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community Disruption &amp; Collective Action</td>
<td>This was an initial code I looked for due to expectations informed by the literature. Because rapid energy development has disrupted communities in the past, I expected to find reports on community disruption as a result of the energy boom in Sublette County. As research has shown, the traditional view of collective action problems (Olson) fails to consider other factors that motivate collective action. These might include, for example, the existence of a collective identity, institutional structures that support collective action, and/or diverse incentives that may not be related to material gains. Furthermore, Olson’s perspective does not consider the possibility that individuals might construct their own institutional arrangement in support of collective action. I coded for community disruption and collective action when the specific terms was listed, but also when the idea of community disruption was communicated. Often there are overlaps in themes. For instance, when discussing disempowering citizen engagement, Participant I reported, that the “entitlement attitude has caused tremendous amount of discontent or lack of transparency with our whole community from the local government on up to our state and of course the EPA because we wound up suing the EPA but only because we couldn’t sue the DEQ.” Because this also addresses community disruption, I have coded it under this theme as well. An area of research that offers potential for greater study is analyzing the overlaps and potential relationship between different themes.</td>
</tr>
<tr>
<td>Change in Collective Identity</td>
<td>I included ‘change in collective identity’ under the code ‘community disruption &amp; collective action’ because the majority of informants who commented on the negative aspects of changes in the collective identity included this as a form of community disruption. There were other ways that the community was disrupted; however, the dominant way was the shift in collective identity.</td>
</tr>
<tr>
<td>Economic Development</td>
<td>When coding for economic development, there were many overlapping themes with issues such as ‘community disruption,’ ‘workers’ safety and inclusion,’ and</td>
</tr>
</tbody>
</table>
This was a particularly difficult theme to define. I initially looked for themes that communicated change in the environment such as Participant N’s comment that “Pinedale doesn’t lean one way or another. I think it’s too hard to measure majority opinion because that’s constantly shifting. How does the community identify? Is it a natural gas town? Is it a cow town? You could quantify it but it’s not interesting. With a fluidity between people at times, there’s different ideas of what Pinedale is.” This observation was based on Participant N’s research on the changing physical appearance of Pinedale. Overlaps in this theme are most common between ‘change in collective identity’ and ‘public goods.’

This code emerged from mentions of publicly shared goods mostly with regard to air quality. However, a sensitivity to this code extends from questions raised in the literature such as: What is problematic about collective action and public goods? Is the root of the problem the individual in the context of a collective? Or perhaps a collective entity is entirely distinct from the individuals who comprise it?

Other codes that overlap with this theme are ‘dissatisfaction in government advisory boards’ and ‘problem with lack of citizen involvement’. I found multiple overlaps in lack of citizen involvement and dissatisfaction in government advisory boards – both of which were communicated as disempowering forms of public involvement. One of the major sources of dissent is the lack of support for the mobile monitoring air quality project through the University of Wyoming, which was widely supported by citizens.

The data on the government organized advisory boards indicated that most of the dissatisfaction came from poor communication and lack of ordinary citizen involvement. The previously mentioned data on the need for local input is indicative of the fact that the inclusion of local knowledge in decision-making not only fits in line with the ‘democratic right’ perspective, but also is important to knowledge production for building a more locally-specific understanding. Because positive social capital feeds into a community and contributes to a more trusting society, social capital is important for increasing levels of local citizen empowerment through more participation at the local level. An emergent code was ‘lack of coordination.’ I ended up
<table>
<thead>
<tr>
<th>Problem with lack of citizen involvement</th>
<th>including this underneath ‘dissatisfaction with traditional forms of engagement.’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Capital &amp; Participation</td>
<td>I included this code in ‘dismounting engagement’</td>
</tr>
<tr>
<td>Scientific engagement by non-experts</td>
<td>This theme was influenced by the literature that high social capital leads to higher instances of public participation. In all three reports of participation: government-organized advisory boards, grassroots organizations, and citizen volunteer projects, the social dynamics affected how &amp; why citizens engage.</td>
</tr>
<tr>
<td>Traditional government advisory boards</td>
<td>Based on the literature regarding citizen science projects and environmental policy-making, I asked questions about citizens engaging in scientific discoveries. For this reason, this is a code I expected to find mention of.</td>
</tr>
<tr>
<td>Grassroots organizations</td>
<td>This was the most commonly reported form of public participation</td>
</tr>
<tr>
<td>Citizen participation in air quality monitoring/need for better monitoring</td>
<td>This was one of the three forms of participation that was mentioned. I also coded for this when informants expressed a need for greater citizen engagement or a need for better monitoring/mitigation efforts with regard to increasing air quality.</td>
</tr>
<tr>
<td>Barriers to participation</td>
<td>‘Barriers to participation’ was a newer category, which I created after receiving multiple reports on possible barriers. Some overlaps are in changes in collective identity, community disruption, and physical space and public participation; these codes also denote many reasons people give that deter participation. For example, a barrier is the way industry is hidden from the town of Pinedale allowing residents and visitors to cling to false conceptions about town identity. Just as it is difficult to study the absence of something, it is difficult to study the presence of something when it is not blatantly obvious. In this way, a citizen science project in which volunteers wear mobile sensors brings the possibility of visualizing and making tangible the effects of industrial activity.</td>
</tr>
<tr>
<td>Workers’ safety and inclusion</td>
<td>This is a code I didn’t expect to find; however, multiple subjects reported a concern with not only worker safety in terms of physical injury but also that workers experience a sense of community within the town of Pinedale.</td>
</tr>
<tr>
<td>Empowering engagement</td>
<td>This code emerged from the data as a contrast to reports on disempowering citizen engagement. As participants reported feelings of disempowerment in traditional methods of</td>
</tr>
</tbody>
</table>
participation, they also reported ways that they were able to feel more empowered. The empowering community engagement code has many overlaps with social capital and public participation.

<table>
<thead>
<tr>
<th>Lack of trust in citizen involvement</th>
<th>This code emerged from the number of interviewees who reported feelings of disempowerment or lack of trust in findings when conducted by ordinary citizens or “non-experts”</th>
</tr>
</thead>
</table>
Appendix D
Table 1 Correlations Between Means

<table>
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<tr>
<th></th>
<th>onlinetown</th>
<th>fracking</th>
<th>livcom</th>
<th>compop</th>
<th>age</th>
</tr>
</thead>
<tbody>
<tr>
<td>onlinetown</td>
<td>Pearson</td>
<td>-.313**</td>
<td>.128</td>
<td>.048</td>
<td>.087</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.007</td>
<td>.283</td>
<td>.688</td>
<td>.469</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>73</td>
<td>73</td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td>fracking</td>
<td>Pearson</td>
<td>.128</td>
<td>-.078</td>
<td>-.151</td>
<td>.144</td>
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<tr>
<td></td>
<td>Sig. (2-tailed)</td>
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<td>.515</td>
<td>.206</td>
<td>.226</td>
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<tr>
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<tr>
<td>livcom</td>
<td>Pearson</td>
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<td>-.151</td>
<td>.203</td>
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<td>Sig. (2-tailed)</td>
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<td>.206</td>
<td>.087</td>
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<td>N</td>
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<td>72</td>
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<td>72</td>
</tr>
<tr>
<td>compop</td>
<td>Pearson</td>
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<td>.144</td>
<td>.185</td>
<td>-.094</td>
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<td>Sig. (2-tailed)</td>
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<td>.120</td>
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<td>72</td>
<td>72</td>
<td>72</td>
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</tbody>
</table>

** indicates significance at the .01 level.
Appendix E
Table 2 One-way ANOVA Means Comparison

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
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</thead>
<tbody>
<tr>
<td>Regression</td>
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<td>1.444</td>
<td>2.502</td>
<td>.051</td>
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<tr>
<td>Residual</td>
<td>38.669</td>
<td>67</td>
<td>0.577</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>44.444</td>
<td>71</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Dependent Variable: onlinetown
b. Predictors: (Constant), age, compop, fracking, livcom
| Themes                                      | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V |
| Community Disruption                       | X | X | X |   | X | X | X | X | X |   | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Change in Collective Identity              | X | X | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Economic Development                       | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Physical Space & Participation             | X | X | X |   |   |   |   |   |   |   |   | X | X | X | X | X | X | X | X | X | X | X | X |
| Social Capital & Participation             | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Disempowering engagement                   | X | X | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Dissatisfaction w/ traditional engagement  | X | X | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Problem with lack of citizen involvement   | X | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Scientific engagement by non-experts       | X | X | X | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Government-organized advisory boards       | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Grassroots organizations                   | X | X | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Citizen science projects/need for better monitoring | X | X | X | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Barriers to participation                  | X | X | X | X | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Workers’ safety & inclusion                | X | X | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Empowering engagement                      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Lack of trust in                           | X | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Appendix F
Table 3 Frequency of Variables in Coded Interviews
| citizen engagement | | | | | | | | | | | Public goods | X | X | X | X | X | X | X | X | X |
Appendix G
Figure 1 Tang’s Model of Public Participation

<table>
<thead>
<tr>
<th>Rung</th>
<th>Objective of Participation</th>
<th>Flow of Information and share of power in decision-making</th>
<th>Type of interaction</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rung 6</td>
<td>Public participation in final decision</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rung 5</td>
<td>Public participation in assessing risks and recommending solutions</td>
<td></td>
<td>Many-to-many interaction</td>
<td>Participative model</td>
</tr>
<tr>
<td>Rung 4</td>
<td>Public participation in defining interests, actors, and determining agenda</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rung 3</td>
<td>Public right to object</td>
<td></td>
<td>One-to-many interaction</td>
<td>Broadcast model</td>
</tr>
<tr>
<td>Rung 2</td>
<td>Informing the public</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rung 1</td>
<td>Public right to know</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Key

- **Participants**
  - Public
  - Planning authority
  - One-way
  - Two-way

- **Flow of Information/Ideas**
  - One-way
  - Two-way

- **Share of power in decision-making**
  - Minor
  - Dominant

- **Possible communication**

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Figure 2 Map of the study area from the 2009 O3i Report
References


Bamberger, B., Downs, M., Jorgenson, J., Galginaitis, M., Schug, D., Scollon, R., and


Tang, M. Y. (2006). Design and implementation of a GIS-enabled online discussion


