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# Renewable Energy: Prospects, Politics, the Public, and Proximity

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RENEWABLE ENERGY: PROSPECTS, POLITICS, THE PUBLIC,

AND PROXIMITY

by

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# ABSTRACT

Renewable Energy: Prospects, Politics, the Public, and Proximity

by

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This dissertation reviews the drivers of recent growth and development of renewable energy and the barriers to continued growth, and explores the public's attitudes about technological changes to the electrical generation system. In detail we examined the roles of political orientation, community context, and proximity to development as factors influencing attitudes about renewable energy development.

We found that renewable energy attitudes are influenced by political orientation but behave differently than other politically divisive issues such as environmental concern. We also found that community context is an important variable that influences how residents of certain communities tend to react to wind energy development. And when comparing communities facing similar wind energy development situations, we found that independent of socio-demographic composition differences, communities weigh impacts and benefits of wind power development differently. Finally, results indicated that household proximity to wind energy developments played no significant role in influencing support or opposition to wind energy development.

(276 pages)

# PUBLIC ABSTRACT


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Peter G. Robertson

The way our electricity is generated is in a period of rapid change; in the United States and many other countries the system is becoming less reliant on coal based power systems, while natural gas and solar and wind power are becoming more and more important. Technological advances have made solar and wind power more efficient and increasingly cost-effective. While these changes to the electrical system come with great benefits, such as less pollution, these technologies are not free of impacts. The electrical system is inseparable from our modern lifestyle, and because the system is so large this transition will affect society in many ways.

This dissertation analyzes one aspect of the social side of these changes in the electrical system by asking, what does the public think about renewable energy? In particular we examined how political beliefs, community differences, and residential distance from wind turbines might influence attitudes about renewable energy. We find that political belief is an important factor in predicting levels of support for renewable energy, with conservatives less likely to prefer renewable energy and liberals more supportive of its development. We also find distinct differences in how residents of particular communities tend to react to renewable energy and local wind power development. In addition, we find that living closer to wind turbines is not a good way to predict attitudes about wind energy. These results should help policy makers and developers to make better decisions about how and where we build utility-scale solar and

wind electric power facilities by taking into consideration the nuances of personal and political beliefs as well as community differences.

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# CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# CHAPTER I

# INTRODUCTION

Solar and wind energy have been the fastest-growing sources of electric generation in the United States, with wind energy expanding from producing less than 4 billion kilowatt-hours in 1990 to over 182 billion kilowatt-hours by 2014 (EIA 2015b), and utility-scale solar energy growing from 543 thousand kilowatt- hours in 2001 to 26,473 thousand kilowatt-hours in 2015 (EIA 2016). Wind is the second-largest source of renewable electrical generation (following hydropower), and in 2015 of the 20 gigawatts (GW) of installed utility-scale electrical generation installations solar (2.2 GW) and wind (9.8 GW) accounted for more than half of all new capacity additions (EIA 2015a). While recent forecasts have predicted continued growth for wind and solar power, that expected growth was contingent on the status of expiring federal subsidies important for renewable energy, i.e., the production tax credit. The recently enacted Consolidated Appropriations Act of 2016 continues U.S. government subsidies for renewable energy (DSIRE 2016), and adds near certainty that the forecasts for rapid growth of renewable energy will continue. The need to radically decarbonize our energy use as a response to climate change will also continue to provide an impetus for increased renewable energy development, as massive changes in our energy system require major shifts to low-carbon energy technologies and increased reliance on solar and wind for electricity generation (Hoffert et al. 2002; Pacala and Socolow 2004).

Renewable energy offers many advantages over fossil-fueled electric generation, including lower environmental impact, such as emitting no air or water pollution (Cullen

2013), and it often also boasts the lowest cost of new electric production (Wiser and Bolinger 2015). Yet even with these notable advantages, renewable energy development is still constrained by technical, economic, social and political barriers (Sovacool 2009b).

Technical barriers, including managing the variability of electricity production and developing systems of electricity storage, pose significant challenges to continued growth. However, the biggest barriers to further implementation are not necessarily these intermittency and technical issues, and managing the non-technical issues that result from the widespread adoption of this technology may be a bigger challenge (Sovacool 2009c). For instance, economic barriers include the increased costs of linking areas with strong wind or solar resources to areas that need electricity, the cost of storing electricity to match consumer demand, and competing with sources of electrical generation that do not pay the actual costs of the pollution they create (Sundqvist 2004). Political barriers include inconsistent subsidies (Barradale 2010) and active attempts to stop development of the technology by both competing industries that see the technology as a threat (Painuly 2001) and constituents who are opposed to development. Social barriers include opponents who do not accept development because of aesthetics, impacts to wildlife, or fears of property value declines, among other reasons (Warren and Birnie 2009).

The research presented in this dissertation focuses on the social barriers to renewable energy development by examining the factors that correlate with support or opposition to renewable energy in general, and to utility-scale wind energy developments in particular. The research explores how socio-demographic determinants, like political partisanship, influence attitudes towards renewable energy, and how local contexts and household proximity to wind power developments are related to different levels of local support for wind energy. The goal of this dissertation in general is to explore the factors that have been left unresolved and/or found to play an inconsistent role in other research examining public attitudes toward renewable energy and the local development of wind energy facilities.

The analyses are intended to address issues identified in the body of research on public opinions about wind and solar energy, with the hope that these results will be useful in informing policy decisions about siting questions, as well as offering renewable energy developers, supporters and opponents information about factors that may influence the acceptability of renewable energy development.

**Why Study Renewable Energy Using Social Science?**

The Department of Energy's report of the first quadrennial technology review states that an improved understanding of how the public and society choose and influence renewable technologies is needed because "the aggregated actions of individuals and organizations determine many aspects of the energy system, with demands on the system and the balance of supply and demand affected as much by individual choice, preference, and behavior, as by technical performance" (2011:125). Further, a switch to renewable energy is no longer a matter of technical feasibility, but a choice for society (Sovacool and Watts 2009), as renewable energy has been found to be effective, with more than enough resources to provide adequate electrical production (Jacobson and Delucchi 2011).

But the scale of this change will be enormous (Grubler 2012), as the electrical grid is one of the largest and most complicated systems ever built (Overbye 2000), and the addition of a source of electric production that is dependent on the vagaries of nature increases the level of complexity. Further increasing the difficulty of this change is the fact that the electrical system is not only a technical system designed to send electrons to power our economy, but is also enmeshed in a social world, a bureaucratic world, and an economic world. Thus, large-scale changes to this system (as are required as a response to climate change) will have ramifications that reach throughout society. Electrical generation is complex and deeply interconnected to the modern consumerist world; a system where the expert opinions of engineers connect profit-seeking businesses and bureaucratic regulators, vote-seeking politicians, and the public who protest, support, and ultimately vote for or against the use of their tax dollars to influence large, visible technological shifts.

The switch to renewable energy represents a social-technical choice that confronts long-entrenched power structures, large capital investments, multiple layers of bureaucracy and bureaucrats, and various publics who are or will become neighbors to new industrial-scale development and altered landscapes. These future developments are not just technical problems to be solved; they also interact with and alter social conditions that can either allow for or impede said development. This research will hopefully contribute additional understanding of the social dimensions of this transition.

A large reason for the need to study the social dimensions of the transition to greater reliance on renewable energy systems is due to the fact that an expansion of both solar and wind energy is changing the geography of energy production (Bridge et al. 2013). These changes are a result of technical necessities of solar and wind technology. Three technical requirements are currently influencing the development of solar and wind power and are changing the places that produce electricity. The first is that the low energy density of solar and wind requires hundreds of turbines or thousands of photovoltaic panels to replace a single fossil-based generation station. Secondly, solar and wind require steady and predictable resources (consistent wind and sunny skies). Finally, renewable energy installations, because of the large numbers required to produce utility-scale amounts of electricity, are usually highly visible. This is especially true for wind turbines because they need to be very tall to access steady winds, and for solar thermal plants because of the large area needed for solar collectors and the tall height of focusing towers. These three requirements mean that energy production is expanding geographically and developing in places other than the traditional regions of energy production. Add to this is the fact that renewable energy is a relatively new technology, so even in places traditionally used for energy production this new expansion creates an unfamiliar development situation for individuals, local governments, and communities.

Wind and solar energy development can represent a disruption to long-established industries and communities that may be accustomed to established patterns and certain ways of life, as all social change can be viewed both positively and negatively. For communities and people long dependent on fossil fuel-produced electricity, renewable energy may be an unwanted change and perhaps a perceived threat that portends a future of diminished fortunes, as these old forms of energy are forecast to lose relevance. For economically depressed areas, the possibility of new economic growth means that these new energy sources may be an economic lifeline, even if modest. And as geographies of energy production change, it becomes more important to understand the ways in which the public will respond, remaining cognizant that not every person will weigh the threats or opportunities in the same way.

While wind and solar energy are much less impactful than other sources of electrical production (Sovacool 2009a; Turney and Fthenakis 2011) they are not benign and each has its own environmental footprint, including impacts on wildlife and land use changes, and also other consequences like large wind and solar energy installations causing localized climatic changes ( Millstein and Menon 2011; Zhou et al. 2012; Armstrong et al. 2016; Xia et al. 2016), and environmental impacts linked to the use of materials such as rare earth metals required for turbine construction (Alonso et al. 2012). Continued growth of renewable energy, the concomitant environmental and social changes combined with the relative novelty of the technology and the variety of reactions by individuals and communities, are justification for the need to study public responses to this technology, in order to help identify impact mitigation or avoidance strategies as this technology continues its geographic expansion.

Most of the previous research on public responses to renewable energy has focused on utility-scale wind energy. There are two main reasons for the focus on attitudes and wind energy. For one, solar energy has not been developed as widely as wind energy, and currently wind energy has much more installed capacity. This wider deployment of wind energy is a result of wind energy emerging earlier than solar energy as a cost-effective source of electrical generation. The second reason is that visual impact is often a chief concern of opponents to wind energy development and most solar energy installations have a smaller visual impact than wind energy. While a utility-scale installation with hundreds or thousands of acres covered in panels can be visually impactful (and transformative for the land that it is sited on), solar installations usually have a lower profile than the hundred meter turbines common in wind energy development and cannot be seen as far away. These two reasons have meant that the majority of studies investigating public reaction to renewable energy development have focused solely on wind energy. The limited development of solar was especially true for the state of Utah, Idaho and Wyoming at the time we conducted our surveys. But the electrical production landscape is rapidly changing, and even in the short time following our surveys, solar development has seen rapid growth in these three states. Given these trends it will be increasingly important for future research to consider both of these technologies. Nevertheless, the earlier trajectory and the often-contentious nature of wind energy development has meant that much of the research exploring public opinion and renewable energy has largely focused on wind energy, and wind energy receives more focus in this research as well.

**Research Questions**

In examining public opinions toward renewable energy in general and especially wind energy in the Intermountain West, the central research questions are: What are the key components of the public's support or opposition? And do these components confirm or confound factors identified in earlier research? The other research questions are subsets of these larger, overarching questions and examine certain factors in detail: (1) Is political orientation a determining factor of support or opposition to renewables in general, and to wind energy in particular? (2) How do the unique characteristics of a local community affect support or opposition to local wind energy development? (3) Does household distance from wind turbines influence support or opposition for wind energy development?

The current research on public opinions about renewable energy suffers from three gaps that this research will attempt to address. The first research question is the role that political orientation plays with regard to views about renewable energy. Renewable energy, in comparison to fossil-fueled systems, is often promoted for its lessened environmental impacts. Because attitudes about the environment and climate change are strongly correlated with political orientation, we examine the effect of political orientation as it may influence attitudes toward renewable energy.

The second research question examines the factors leading to support and opposition of wind power, as they are often found to play an inconsistent or even conflicted role. One of the hypotheses of this research is that some of this conflict can be explained because of the varied contexts in which wind energy development is set. Exploring the effect of local community context (independent of socio-demographic correlates) is an attempt to reconcile the wide variety of findings regarding factors influencing attitudes toward wind energy.

The third research question addresses the issue of the role of "not in my backyard" (NIMBY) attitudes as a factor that may explain opposition to wind energy. NIMBY has been a widely and hotly debated topic in the literature addressing wind energy attitudes. But much of this literature is rife with conceptualization errors and frequently uses proximity to wind turbines to measure NIMBY. This third research question will examine the role of proximity and how proximity at a fairly localized scale may relate to attitudes about wind energy.

**Overview of Study and Methods**

Four separate analyses are used to address the gaps in our current understanding of factors influencing public opinion about solar and wind energy, and more specifically, to understand the factors that lead to support and opposition at both a broad scale (the state of Utah) and a narrower scale (communities near the sites of proposed or active wind energy facilities).

The first paper reviews the trends of renewable energy development in the United States, considers factors contributing to (or slowing) growth, and addresses the implications that these changes in the electrical production system are expected to have on rural areas. The next three papers examine the statistical relationships between attitudes about renewable and wind energy and various factors identified in earlier research as potentially important determinants of those attitudes. The data for these chapters come from two separate surveys. The first is a mail-based statewide survey of Utah residents asking about energy preferences and environmental attitudes. The second survey was conducted in five communities scattered across three states in the Intermountain West (Idaho, Wyoming, Utah) to assess attitudes toward local wind development that has recently occurred or is about to be developed. The five-community survey was administered using a drop-off/pick-up methodology.

The first analytic paper (chapter III) reviews the patterns of development of both solar and wind generated electricity, the key drivers that are contributing to high rates of growth, and the barriers to further development. Technological advances have increased production capabilities as well as lowered costs, but because the electrical production system is highly regulated, supportive policies have been a key driver, as well as a major barrier. This paper's main foci include the complex ways that policy influences the growth of renewable energy systems, and the implications that continued expansion of these technologies will have on rural areas. It also offers policy recommendations to minimize impacts while supporting renewable development.

The second analytic paper (chapter IV) looks at the current politically polarized climate in the US and considers how and why varied political orientations may relate to public opinion about renewable energy. The chapter examines how political orientation may influence attitudes about renewable energy in general, using data from the Utah statewide survey.

The third analytic paper (chapter V) addresses the context in which a particular wind development takes place to see if community-level differences might help to account for the variety of responses to wind energy facilities. This chapter uses survey data from the five-community survey to examine how responses to wind power developments vary from place to place, and to determine whether observed variations are better explained by compositional differences reflected in survey respondent's socio-demographic characteristics or by other "contextual" conditions.

NIMBY has been a widely discussed subject in the exploration of factors influencing public opinion about wind energy. The fourth analytic paper (chapter VI) discusses this topic in-depth and explores the common methodology for testing the role NIMBYism plays, i.e., the proximity hypothesis, which suggests that attitudes are influenced by distance from turbines. The paper uses spatial data on the locations of survey respondents' residences in the eastern Idaho Falls survey area and examines the correlation between attitudes and distance from wind turbines.

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# CHAPTER II

# REVIEW OF LITERATURE

## Background: Wind Energy

Wind energy has been exploited for thousands of years for drying crops, and in more recent history for moving boats, grinding grain, and pumping water. The first successful attempt to convert wind into electrical power occurred in the late 1880s, and it was promoted as a response to the energy crisis in the 1980s. Advances in material technology in the 1990s led to turbine designs that were large enough to produce electricity at a reasonable cost and scale (Kaldellis and Zafirakis 2011). Following these design advances, governments responding to air pollution concerns like acid rain promoted wind energy as a replacement for coal. However, it wasn't until the mid-1990s that wind energy began to take hold, and growth rates have been strong since. Between 2004 and 2014, wind energy capacity worldwide expanded nearly 8-fold, from 48 GW to 370 GW. While hydropower is still the dominant source of renewable electrical generation in the US, wind has been steadily gaining and is forecast to be the largest source of renewable electrical generation by the year 2040 (EIA 2015).

Wind power is usually installed at the utility scale, with clusters of many large turbines. Utility-scale installations often involve hundreds of turbines, mounted on towers that stand two to three hundred feet tall. Advances in technology have fueled this growth in wind power that has both lowered production and construction costs and allowed for increased turbine sizes and increased electrical production capacities. While an individual turbine in the mid-1990s had, on average, a rotor 40 meters in diameter and a name-plate capacity of less than a megawatt, by 2009 turbines on average had a rotor diameter of over 120 meters and a 2-3 megawatt capacity, with much larger prototypes (140 meter rotor diameter, 7.5 MW capacity) currently being tested (Kaldellis and Zafirakis 2011). Recent years have seen increased emphasis on offshore siting, along with a continuation of the trend toward larger-capacity turbines (REN21 2013). The trend toward larger turbines and offshore installations is expected to offer additional economies of scale and lower price per kilowatt, while taking advantage of more consistent offshore winds (REN21 2013).

Despite these significant technological increases, a wind turbine's annual capacity factor, due to wind variability, is on average only around 30-35% (meaning that only 30% of the time will a turbine actually be producing power). In comparison, a nuclear power plant has a capacity factor of 90%, and a coal-fired power plant has an 85% capacity (Borenstein 2012). Lower capacity factors, the large size of turbines, the low energy density of wind, and the need for turbines to be adequately spaced in order to avoid the wind turbulence created by the other turbines means that wind energy necessarily has a large spatial footprint when compared to other electrical generation methods. While turbines do not necessarily preclude other uses of land once sited, they still have a vast footprint. On average a wind energy installation has a capacity of about 3 $MW/KM^2$ (Denholm et al. 2009), while coal or natural gas power plants usually have a capacity of 500-1000 MW (Glennon and Reeves 2010). Consequently, for a wind energy facility to replace 500 MW of more conventional power production systems would require an area of 166 square kilometers.

### *Growth of Wind Power Capacity*

Of the 370 GW of the worldwide total-installed capacity of wind power, 51 GW was added in 2014 alone. This continues a trend of recent growth—for instance, between 2007 and 2012, wind energy averaged 25% annual increases worldwide. The US accounts for a large portion of that development, with capacity expanding from 2.5 GW in 2000 to nearly 66 GW by 2014. Another 49 GW is forecast to be added by 2040 if existing tax credit and pollution policies remain in place (EIA 2015a). Wind energy currently provides the US with 4.4% of its total electric generation, with the US ranked second in the world for highest installed wind power capacity, trailing China's 115 GW of capacity (Sawin et al. 2015). Wind power is considered a more mature technology than solar power, and this is reflected in the share that wind plays in total US electric power capacity. As of 2014, wind power contributed 34% of total renewable energy production (including hydropower) in the US, compared to just 3% derived from solar energy sources (EIA 2015).

As wind technology has matured, wind power has become less and less dependent on the government subsidies designed to stimulate growth of renewable energy. The 2014 Wind Technologies Report reads, "Wind additions are also being driven by recent improvements in the cost and performance of wind power technologies, which have resulted in the lowest power sales prices ever seen in the US wind sector" (Wiser and Bolinger 2015:iv). And recent power purchase agreements are competitive with coal-fired electrical production. Despite these cost declines for wind power, very low-priced shale gas is currently offering competition not only to coal, but also to wind power (REN21 2013). But while low-priced natural gas is lowering the wholesale price for electricity, wind power can still be an important investment as a hedge against future fuel price increases, as it is not subject to future fluctuations (Bolinger 2013).

***Benefits of Wind***

Competitive production prices and price stability are not the only benefits of wind energy. It also has a much lower environmental impact than most other forms of utility-scale electrical production, as it does not emit carbon, air pollutants, or water pollution, is powered by an endless and renewable fuel, and requires no fossil fuels to be mined, drilled, or burned (Cullen 2013). Wind energy is even cleaner than the 'cleanest' fossil fuel-based electrical production, natural gas-powered generation plants. While burning natural gas emits fewer pollutants than coal or oil per BTU, the impacts of the pollutants released as a result of the combustion adds an additional 1.5 cents to 11.8 cents/kWh of external costs in the form of costs to health, and climate change impacts are also added to the cost of electricity produced by using natural gas instead of wind energy (McCubbin and Sovacool 2013).

***Impacts of Wind***

While wind has one of the smallest environmental footprints of electrical generation sources, wind energy is certainly not without ecological, social and climatic impacts. Among the drawbacks of wind energy are bird and bat mortality, habitat fragmentation, noise, visual pollution, electromagnetic interference, and local climate change (Dai et al. 2015). Bird and bat deaths from wind power have been a source of considerable controversy, as was the recent application to the US Department of Fish and Wildlife granting a wind energy facility the right to kill eagles (US Fish and Wildlife

Service 2015). Wind turbines have blades that rotate at speeds over 80 meters per second (Dykes et al. 2014), and avian species are often killed by these fast spinning blades (Kunz et al. 2007; Smallwood 2007). While wind power is a real threat to avian species and requires conscientious siting, the impacts on birds and bats from current fossil-fuel electrical generation is estimated to kill 5.2 birds per GWh compared to 0.4 fatalities per GWh for wind power (Sovacool 2009). But impacts to wildlife are not limited to death by turbine, as development can impact habitat when wind facilities are sited in previously undeveloped areas, and by fragmenting habitats as a result of building service roads and power lines connecting the turbines to the electrical grid (Kuvlesky et al. 2007).

**The Public and Renewable Energy**

Wind energy offers significant environmental benefits over fossil-fueled sources of electrical production, but it is not without some significant impacts. And while the public is generally supportive of the idea of renewable energy, the impacts noted above can create concern that leads to opposition for some local projects.

The substantial environmental benefits of renewable energy are one reason that large majorities are in favor of it (Wolsink 2007; Ansolabehere and Konisky 2012), and nationally representative opinion polls consistently rank wind and solar as the two most preferred sources of power (Jacobe 2013). Further, majorities in the US support the subsidies and governmental mandates stimulating growth of wind energy (Mills, Rabe, and Borick 2015). However, an interesting shift often occurs when wind energy is proposed for actual development in a specific location, in which case local opposition to the wind project is common (Warren et al. 2005; Phadke 2011). This local opposition/general support pattern has been described as a 'social gap' (Bell, Gray, and Haggett 2005; Bell et al. 2013).

To account for the social gap, a variety of factors have been identified as influencing public attitudes towards wind energy. However, it appears that such factors have inconsistent effects, in that they can be important in one study but not in another, or play conflicting roles—linked to increased support in one study and lower support in another. An example of an inconsistent factor is the influence of environmental impact. Expectations of lower environmental impacts from renewable energy have been found to increase public support (Smith and Klick 2007; Ansolabehere and Konisky 2012; Jacquet and Stedman 2013). At the same time fear of environmental harm has also been found to influence attitudes, with wind energy's impacts on wildlife a common concern among opponents (Rose 2014).

The economic effect of wind energy is another factor that appears to exert mixed influence. In particular, fear of negative impacts on residential property values has been shown to influence attitudes towards wind (Gulden 2012). Economic effects have also been found in the belief that support for wind energy development will bring local economic development (Brannstrom, Jepson, and Persons 2011; Slattery et al. 2012). The importance of potential economic effects is influenced by localized economic conditions, with residents of economically-depressed areas more likely to view wind development positively (van der Horst 2007; Toke, Breukers, and Wolsink 2008) and those living in areas reliant on tourism-based economies less accepting of wind energy (Fast and Mabee 2015).

Fairness in the development process has also been identified as an important factor in explaining the social gap and influencing support or opposition to wind energy (Haggett 2011). Specifically this includes whether or not the economic effects (benefits and impacts) are shared fairly (Bolinger et al. 2004), or if promised economic benefits are seen as bribes to accept other potentially adverse impacts caused by wind energy (Cass, Walker, and Devine-Wright 2010). Fairness during the planning process is another factor identified as influencing support or opposition to wind (Wolsink 2007), with an opportunity for the public to voice concerns and feel that they are offered adequate information about the development also influencing attitudes toward wind energy (Gross 2007).

However, the issue that commonly causes the most concern is wind energy's visual impact, and this factor is shown to exert a substantial influence on attitudes toward wind energy (Wüstenhagen, Wolsink, and Bürer 2007). In fact, being able to see wind turbines can apparently influence other impacts, as views of turbines (or having wind turbines visible from a home) appear to increase negative response to noise from the turbines (Pedersen and Persson Waye 2004). Besides siting wind energy facilities in places far from habitation, not much can be done to reduce visual impacts, as larger turbines are required for economical electric production, and turbines need to be in places that offer unobstructed access to wind. This means turbines are typically visible from long distances—on clear days as far as 30 km (Bishop 2002).

When wind turbines are visible, they can be viewed positively or negatively. Some people view wind energy as beautiful and a symbol of progress (Johansson and Laike 2007; Slattery et al. 2012), while others see wind development as ugly and disruptive of the local environment (Thayer and Freeman 1987). Others may see wind turbines as unwanted industrialization and commoditizing of nature (Gulden 2012). Such perspective is intensified if a landscape is valued for natural benefit or as a place viewed suitable for economic development (Devine-Wright and Howes 2010) . The subjective nature of visual impact is highly variable, due in part to the wide variety of landscapes in which development occurs, along with variations in the level of importance placed on a landscape and the level of attachment to a place. These factors are also expected to influence the perception of whether or not wind energy is a visual intrusion (Devine-Wright 2009; Jacquet and Stedman 2013).

**Political Orientation and Renewable Energy Attitudes**

A lesser-explored factor that hypothetically could be playing an important role influencing attitudes towards renewable energy—and is a possible explanatory factor for the social gap—is the role of political beliefs. In the current era of intense political polarization (Abramowitz and Saunders 2008), and the strong correlation between political partisanship and environmental attitudes, as well as the environmental justifications that have led to policies designed to encourage wind energy development, political beliefs could be an important factor when it comes to attitudes towards renewable energy. Such connections could mean views about renewable energy are connected to political orientation, but these ideas have not been explored in depth, and currently no research has explicitly examined the link between political beliefs or orientations and wind energy attitudes.

A large body of research has examined how political belief correlates with environmental attitudes. This research generally indicates that there exists a modest but consistent relationship between the two factors (Jones and Dunlap 1992; Van Liere and Dunlap 1980). Moreover, the relationship appears to have grown more substantial in recent years, with findings that the current political climate is highly polarized and that "today, political ideology and partisan identification are important determinants of a general environmental concern and are not exclusive to global warming" (Guber 2012). Political orientation is a strong predictor of attitudes and beliefs regarding a range of environmental issues, including climate change, beliefs on air pollution, and the loss of tropical rainforests.

Fewer studies have explored how political partisanship might be related to energy preferences. One study that examines political orientation and pro-energy saving behavior found conservatives less willing to buy energy-efficient products when the environmental benefits are highlighted (Gromet, Kunreuther, and Larrick 2013). Another study examined the idea of a National Clean Energy Standard that would require clean power generation—the study concluded that Republicans are more likely to vote against such a standard, when compared to Democrats (Aldy, Kotchen, and Leiserowitz 2012). Further study is needed to know if the current state of polarized politics is influencing public attitudes toward renewable energy and whether or not political orientation can help account for the variety of responses to wind energy development.

**Local Contexts and Wind Energy Attitudes**

Another factor that has the potential to help account for the social gap and explain the inconsistent roles of the many factors influencing attitudes toward wind energy is the role that particular community contexts might play in shaping attitudes at the local community level.

While a number of studies have explored how attitudes are connected to the opportunities and threats wind power development brings (Ansolabehere and Konisky 2012; Slattery et al. 2012; Bidwell 2013; Groth and Vogt 2014; Van Rijnsoever and Farla 2014), fewer studies have considered how the community context in which wind development occurs might influence attitudes toward wind power. This is an under-examined factor that may influence beliefs, and testing community context may help to determine why some studies show certain factors are important and less so in others.

An exploration of the similarities and differences in attitudes and beliefs about wind power development using community context as a variable would help to show the extent to which differing levels of support for wind energy are linked to community-level phenomena, or if community differences in attitudes are more linked with local socio-demographic composition differences. While the earlier research has shown that attitudes toward wind energy are highly variable between individuals, this research will help to show how localized contexts in which development takes place might also influence the public's response to wind energy.

**NIMBY, Proximity, and Wind Energy Attitudes**

The NIMBY reaction has been suggested as one possible means of accounting for the social gap, though many have called for abolishing the use of this term, in part because NIMBY is too simplistic to account for the many factors that influence wind energy attitudes (Burningham 2000; Devine-Wright 2009; Swofford and Slattery 2010; Wolsink 2006). And while there are many good reasons to limit use of the term NIMBY to explain opposition to wind energy, we need to be sure that NIMBYism is actually measured before the term is abolished.

Studies exploring possible relationships between NIMBYism and attitudes about wind energy have generally done little to clarify its definition or conceptualization, and have done a poor job at measuring it (Bell, Gray, and Haggett 2005; Devine-Wright 2005; Warren et al. 2005). Some studies of NIMBYism with regard to wind energy have measured distance from turbines as a stand in for "backyard" (Braunholtz and McWhannell 2003; Warren et al. 2005; Swofford and Slattery 2010). Unfortunately, distance is not an appropriate operationalization of backyard, because backyard is not an actual linear measure but a metaphor for place. And in the case of wind energy production, distance is relative to what is proposed for development.

This is not to suggest that proximity to wind turbines is not likely an important factor in explaining attitudes towards wind energy, but the studies of distance from turbines and attitudes towards wind power attitudes have been inconsistent. Proximity to wind facilities has been found to increase opposition, decrease opposition or play an insignificant role ( Thayer and Freeman 1987; Krohn and Damborg 1999; Braunholtz and

McWhannell 2003; Warren et al. 2005; Johansson and Laike 2007; Swofford and Slattery 2010). Further study is needed to explain the conflicting role proximity to wind turbines plays when paired with attitudes towards wind energy, and, as in the debate over NIMBY, to determine whether proximity from wind turbines is or is not a poor conceptualization of the actual impacts from wind power installations. Finally, further study is also required to ascertain whether and in what manner local contextual factors (such as topography) might interact with proximity to influence attitudes.

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# CHAPTER III

# RENEWABLE ENERGY IN THE UNITED STATES: TRENDS, PROSPECTS, AND IMPLICATIONS FOR RURAL DEVELOPMENT—2016 UPDATE

## Introduction

Renewable energy sources, including, in particular, wind and solar technologies, have within the past few years shifted from being novel, relatively experimental, and seemingly futuristic options for electric power production to a major force that is altering landscapes and future development prospects of rural areas across much of the United States. Rapid progress in developing more practical and efficient wind and solar generating technologies for both utility-scale and local or residential-scale applications is one key factor contributing to the recent surge in renewable energy production. That technological progress has converged with growing public and political concerns about the effects of conventional electric power facilities, especially coal-fired power plants, on air quality, greenhouse gas emissions, and global climate change to create a major push toward increased renewable energy production worldwide and in the US. Indeed, a report by the International Energy Agency suggests that through 2020 renewable energy systems will be the largest source of net additions to power capacity and will account for two-thirds of installed generation worldwide (IEA 2013a; 2015).

As the shift toward increased reliance on renewable energy sources continues to unfold, it will have many socio-economic as well as environmental consequences for rural America. For example, rural areas with economies tied to the legacies of coal mining and past siting patterns for major electric generating stations could experience a substantial economic downturn as growing numbers of coal-fired power plants are decommissioned in response to more stringent emissions standards and the high costs of retrofitting or replacing facilities that are in many cases already approaching the end of their anticipated useful lifespan. The increasingly cost-competitive nature of some renewable energy sources – residential-scale solar power is already at retail grid parity in 46 of the 50 largest cities in the US and projected to attain full parity by 2017 (Farrell 2013; Kennerly and Proudlove 2015; Shahan 2013)—will undoubtedly hasten these transformations. At the same time, siting patterns for current as well as future utility-scale wind farms and solar arrays will undoubtedly lead to a concentration of such developments in rural areas—something that is all but inevitable given the large land areas required for these facilities and the greater availability and lower cost of land in rural settings. Such siting patterns have potential to produce both opportunities and liabilities for rural areas. Possible opportunities include reduced pollution, potential for employment growth, new sources of personal income, and increased revenues for local governments. Among the potential liabilities are negative effects on viewsheds, displacement of alternative land uses, possible effects on surrounding property values, damaging effects on wildlife, ecological disturbance and fragmentation effects, and public controversy and conflict.

In the remainder of this chapter we provide a brief overview of recent and anticipated trends in renewable energy development globally and in the US, and highlight various forces that are simultaneously fostering and constraining further expansion of renewable energy systems. We then turn to a discussion of policy issues and options pertaining to renewable energy, and provide several recommendations for new policy directions that could help to make renewable energy a more positive contributor to rural development opportunities and outcomes.

## Recent and Anticipated Trends in Renewable Energy Development

Solar and wind energy technologies have seen a decade-long trajectory of very rapid growth worldwide. Electric power generation from both photovoltaic (directly converting the rays of the sun to electricity) and concentrated solar power (using the sun to heat water to power a generating turbine), wind power (using the wind to turn a turbine), and other non-hydropower renewable generation sources more than doubled between 1990 and 2012 in the US alone (EIA 2013a). Although these technologies have seen impressive rates of growth, current renewable energy production from sources other than hydropower only comprise 6% of total US electric power capacity. The existing organizational and physical infrastructure that has evolved over the past century around fossil fuel and hydropower electricity generation and transmission is very large and deeply entrenched in America's economic and political systems, making a transformation to primary reliance on renewable energy sources unlikely in the short term at least. Nevertheless, rapid recent growth in installed renewable energy capacity along with rapid technology advancements, innovative financing strategies, and broad-based public and political support suggest renewable energy development will continue to accelerate and contribute an increasingly larger share of electric power production into the foreseeable future.

While there are a number of new forms of non-hydro renewable energy production, such as geothermal and biomass, the two forms of renewable energy seeing the most growth and garnering the most attention are the technologies of wind power and solar power. While both of these technologies have seen a dramatic increase in capacity, they have had different trajectories in growth and costs. In addition, these technologies are being installed at two different scales; the residential and utility scale. The growth at these different scales is driven by related forces, but because growth at one scale potentially disrupts growth at the other, the discussion of these technologies will be divided between these two scales.

***Wind Power Systems***

Worldwide, wind-based power generation increased from just 17 GW (gigawatts) of capacity in 2001 to over 370 GW in 2014 (EIA 2015; REN21 2013). Most of that growth has occurred within just the past few years, with 2007-2012 seeing an average annual increase of 25% worldwide in installed wind power capacity, and with 51 GW installed in 2014 alone. The US has also experienced very rapid growth in wind power development, with capacity growing from 2.5 GW in 2000 to nearly 66 GW by 2014. Projections suggest another 49 GW will be added by 2040 if existing tax credit policies and pollution reduction policies remain in place (DOE 2013; EIA 2015). At present the US is the country with the second largest installed wind power capacity, trailing only China's 115 GW of wind power (Sawin et al. 2015).

*Utility-scale Wind Power*

Growth in wind power capacity has occurred almost exclusively at the utility-scale, involving the development of wind farms with clusters of large turbines. These installations often involve 100-200 or more turbines, mounted on towers that stand 200-

300 feet tall. Wind power is considered a more mature technology than solar power, and this is reflected in the share that wind plays in total US electric power capacity. As of 2014 wind power contributed 34 percent of total renewable energy production (including hydropower) in the US, compared to just 3 percent derived from solar energy sources (EIA 2015).

Growth in wind power capacity has occurred in part as a result of maturation of the technology, which has increased turbine capacity while also contributing to reduced turbine costs. Turbines prices did increase during 2004-2009, due in part to increased size and performance enhancements as well as rising production costs for labor, materials, and energy (Lantz, Wiser and Hand 2012). More recently turbine prices have dropped—2012 prices were 25% lower than in 2008, and some forecasts suggest a continued trend of declining costs over the long term. Recent years have seen increased emphasis on offshore siting, along with a continuation of the trend toward larger-capacity turbines (REN21 2013). Several massive turbines standing over 600 feet tall and with capacities of over 7 megawatts (MW) have been installed (Enercon n.d.). The trends toward larger turbines and offshore siting should contribute to further declines in price per kilowatt that accompany economies of scale and the greater consistency of offshore winds (REN21 2013). Even more massive turbines are in the works, with attempts to build a 50 MW wind turbine with blades over 650 feet long (2.5 times longer than standard turbine blades) currently in development (Sandia Labs 2016).

The maturation of wind technology has allowed wind power to become less and less dependent on government subsidies and other policies designed to encourage growth in renewable energy systems. REN21 (the renewable energy policy network) reports that "onshore wind-generated power is now cost-competitive with or cheaper than conventional power in some markets on a per kilowatt-hour basis (including some locations in Australia, India, and the United States), although a rapid expansion in the production of shale gas in some countries is making it more difficult for wind (and other renewables) to compete with natural gas" (REN21 2013: 51). Even as surpluses of natural gas have reduced the wholesale price for electricity, wind power may still offer important advantages as a hedge against the uncertainties of future natural gas prices (Bolinger 2013).

*Small-scale Wind Power*

While most installed wind power capacity involves large utility-scale facilities, power production based on small-capacity wind turbines (usually defined as less than 100 kilowatts, or kW, per turbine) is also expanding both on- and off-grid. Small-scale wind power generation, also called "distributed" wind generation, can occur at both residential and community scales. Growth at this scale has been spurred by technological advances lowering the costs of turbines and grid-connected inverters, the uncertainty of fossil fuel prices, and government incentives (REN21 2013). Growth in small-scale wind power has been rapid—as of 2012 world-wide capacity reached 678 MW, an increase of 18% from 2011. The bulk of small-scale wind capacity has been clustered in China with 39% and the US with 31% of global installed capacity (WWEA 2013).

Small-scale wind power is particularly well-suited for rural areas, as winds are not blocked by tall buildings and rural residents more often have access to the land area needed to install a wind turbine tower. At present investment in small-scale wind power is a longer-term strategy—as of 2011 the average cost was $6,040 per kW installed (AWEA 2012), with many systems (depending on the wind, incentives, and the size of the system) offering a payback period of about ten years. Despite high initial costs, small-scale wind power can offer long-term energy cost stability by reducing or avoiding utility charges and for some remote areas can offer electricity at a lower cost than connecting to the grid. For US farmers the USDA supports investing in small-scale wind by offering loan guarantees for small wind turbines through the Rural Energy for America Program (REAP).

Forecasts for small-scale wind suggest continued strong growth. WWEA (a global wind trade group) has predicted 20% annual increases through 2020 with continuation of supportive renewable energy policies along with continued technological development and increases in the generating capacity of small turbines, and predicts 3 GW of cumulative installed capacity by 2020 (WWEA 2013).

### *Solar Power Systems*

Solar power, like wind power, has been in a period of very rapid expansion due to substantial price drops, major technological advances and government supports. Global installed solar capacity increased from just 1.5GW in 2000 to 177 GW by the end of 2014, with 40 GW installed in 2014 alone and with 60% of all PV solar installed in the last three years (Sawin et al. 2015). Strong growth in solar power is expected to continue into the foreseeable future—the International Energy Agency (IEA) predicts 18% annual growth between 2014 and 2020 (IEA 2013c).

Solar power development has expanded at an extraordinarily rapid pace in the US as well. Photovoltaic solar power production grew from 138.8 MW in the year 2000 to a total of 25 GW (e.g., 25,000 MW) by the end of 2015. And, solar development trends appear to be very robust for the near future with an additional 14 GW of utility-scale solar projects in the pipeline scheduled for installation by the end of 2016 (GTM Research 2015; IEA 2010; 2013b; Sawin et al. 2015; SEIA 2012; SEIA 2013b).

*Utility-scale Solar Power*

Unlike wind power, the development of solar power systems involves a substantial mix of both smaller-scale and utility-scale systems. Utility-scale solar power facilities accounted for more than 50% of all solar power capacity installed in the U.S. in 2015. However, this recent period of extremely rapid growth in utility-scale solar energy development is expected to slow as the current 30% Federal Investment Tax credit ramps down to 10% by 2017 (GTM Research 2015). While growth rates are not expected to decline, rates of growth are not expected to continue to rise as they have in the recent past. One reason is that increasing numbers of utilities are approaching their Renewable Portfolio Standard (RPS) targets (EIA 2013b). There is no federal RPS, and variability in state-level RPS policies has contributed to a concentration of solar and other renewable energy development in states with policies requiring that a relatively large percentage of state electricity consumption be derived from renewable-source energy supplies, that provide strong incentives for renewable energy production, or both. For example, California has recently raised its unusually aggressive RPS that previously required 33% of the state's electric power to be derived from renewable sources by 2020 to a level that now requires 50% of electricity to be generated from renewable sources by 2030. This mandate provides considerable state-level incentives for renewable energy installations. As a consequence, California, has nearly 50% of the U.S. total installed solar capacity and leads all states with 8.7 GW of installed solar (EIA 2016; Sawin et al. 2015; SEIA 2013a).

Crystalline silicon photo-voltaic (PV) solar has been the most common form of solar energy for both utility-scale and small-scale applications, capturing 85-90% of the solar market (Hernández-Moro and Martínez-Duart 2013). However, numerous types of PV technologies (such as thin film, multi- and single-junction, concentrated photovoltaic and promising technologies such as organic, quantum dot, and dye-sensitized) are emerging and have the potential to increase the efficiency, applicability, or economy of solar power systems. In addition, concentrated solar power systems that use the heat of the sun to create steam and drive a turbine are now seeing strong growth. One distinct advantage of CSP technology is its ability to store energy for later use. Unlike PV systems that can be adapted to both utility-scale and smaller-scale applications, concentrated solar power is better suited for utility-scale production, and several large CSP projects in the desert areas of the American southwest have recently started to produce electricity, with total capacity increasing in 2014 to 1.6 GW from .9 GW the year previous (Sawin et al. 2015).

As is the case with wind power, PV solar technology has been in a period of strong price declines as a result of improved manufacturing processes and increased PV cell efficiencies. The average cost (both residential and utility scale) of a completed PV system declined by 30% a year from 2010 to 2015 (IEA 2015). These declines have not come without challenges to the solar power industry, as dropping prices have strained solar system manufacturers and caused some to go bankrupt.

*Small-scale Solar Power*

One key difference between wind power and solar power involves the fact that PV solar is well-suited to distributed-scale installations. Distributed-scale solar is most typically installed on residential and business rooftops, and recently the development of community-shared solar arrays (commonly called "solar gardens") has gained traction, serving anywhere from ten to fifty or more households. As a result, in the US and worldwide a significant amount of solar power is being generated by customer-sited solar panel installations. By the end of the first quarter of 2016, more than one million homes were expected to have solar systems installed (Honeyman 2016). And in 2015 residential solar represented 29% of the entire U.S. solar market, the largest share since 2009 (GTM Research 2015).

Unlike utility-scale installations, small-scale solar power has the advantage of not having to compete directly with fossil fuel-based electric power supplies, at least not at the wholesale price level. Rather, small-scale residential and community solar electricity has to compete only with the higher retail rates customers pay for power from the grid. With small-scale solar power rapidly approaching – and in some cases attaining parity with – the retail price of electricity in many markets (Bazilian et al. 2013), electric utilities are confronted by major changes as growing numbers of traditional power consumers become electricity producers. A report produced for the Edison Electric Institute called "Disruptive Challenges: Financial Implications and Strategic Responses to a Changing Retail Electric Business" (Kind 2013: 2) highlights utility industry concerns that rooftop solar technologies could threaten and fundamentally change their business model, saying:

> The combination of new technologies, increasing costs, and changing customer-usage trends allow us to consider alternative scenarios for how the future of the electric sector may develop. Without fundamental changes to regulatory rules and recovery paradigms, one can speculate as to the adverse impact of disruptive challenges on electric utilities, investors, and access to capital, as well as the resulting impact on customers from a price and service perspective. We have the benefit of lessons learned from other industries to shift the story and move the industry in a direction that will allow for customers, investors, and the U.S. economy to benefit and prosper.

These utility industry concerns result from the fact that production of grid-connected residential solar power by just a small percentage of customers has the potential to greatly reduce profits for utilities, since residential solar produces electricity during peak load periods that are also the times of highest profit for utilities. Additionally, utilities are concerned because grid-linked solar residences still use electricity during the times without sun (at night or on cloudy days), but may not consume any electricity at times when the utility can receive the greatest profit. At the same time, residential solar users are in effect receiving a subsidy because they still use the electrical infrastructure associated with the commercial power grid, even as their reduced power consumption limits their contributions to paying for the fixed capital costs of developing and maintaining the distribution system. Utilities worry that enough households switching to solar will create an amplification effect that will produce less capital to reinvest into maintenance of the grid, leading to lower system reliability and a possible need to raise rates to make up the difference in revenue lost to small-solar users

—both of which may create additional incentives for residents to switch to solar. As a response many electric utilities have lobbied public utility commissions to enact regulations less favorable to residential solar installations, like increasing demand charges (a fixed monthly fee) as in the case of the recent decision by the Nevada public utility commission to raise fees on solar customers (Whaley 2015). Utilities in 30 states pushed for changes in net metering policies such as higher fixed charges for solar customers in 2015 (Inskeep et al. 2016).

**Key Drivers of Renewable Energy Growth**

The macro issues of energy security, air pollution, and more recently carbon emissions have led to supportive policies in the US encouraging renewable energy development. These policies include production targets, creation of renewable markets, and tax credits. One of the first policies designed to support renewable energy was the *Public Utility Regulatory Policies Act, 1978* (PURPA) that required utilities to buy power from small producers (under 2 kW), fostering development of distributed renewable technologies. While access to the grid was an important key to initially opening the market for renewable energy systems, recent growth of both distributed- and utility-scale renewables has also been propelled by other supportive policies, government subsidies, evolving economics, technological innovation, and state-level mandates. A brief review of some of the most important drivers of renewable energy expansion follows.

One of the most significant trends in renewable energy has been rapid technological evolution, which has led in turn to increased efficiencies and major cost reductions. As was noted above, by 2012 wind turbine prices had declined 25% compared to 2008 (REN21 2013), while the costs of PV solar panels have dropped 60%

since 2011 (SEIA 2013c). Advances have come from technological innovations in designs, materials, and production techniques, as well as increased economies of scale, increased competition, and supply chain and installation efficiencies that come with experience. The speed at which costs have declined has meant many policy makers likely over-estimate the current costs and that "outdated numbers are still widely disseminated to governments, regulators and investors" (Bazilian et al. 2013: 332), obscuring the real economic viability of renewable energy.

However, despite very substantial cost declines, electricity produced via renewable energy remains more expensive than traditionally produced energy. To make up the difference, the US has offered the federal renewable energy production tax credit (PTC). This subsidy has been an especially important driver influencing the growth of wind power, offering utility-scale wind turbines 2.3 cents for each kilowatt-hour (kWh) produced. Uncertainties regarding renewal or expiration of this credit have contributed to dramatic fluctuations in wind power development, with many projects rushed to construction in advance of possible tax credit expiration dates (Barradale 2010). The PTC is only one of a myriad of incentive programs (all with different start and end dates and different technologies covered) available for utility-scale renewable energy. Incentives come in many forms, including corporate tax exemptions, tax credits, grants, low-interest loan programs, and favorable depreciation standards. For example, the *Modified Accelerated Cost-Recovery System* (MACRS) + Bonus Depreciation (2008-2013) modifies the depreciation schedule for certain renewable energy/energy efficiency investments, while the *Business Energy Investment Tax Credit* (ITC) offers 30% tax credit for solar, fuel cells, distributed-scale wind, and PTC-eligible technologies.

While the Federal government has been a major subsidizer of renewable energy expansion, supportive state-level policies have also played key roles. Most states have enacted mandates or targets for renewable energy utilization, called renewable portfolio standards (RPS) or renewable electricity standards (RES), encouraging or requiring that a certain percentage of electric power use be derived from non-hydro renewable sources. These renewable portfolio standards vary widely across the 29 states (along with the District of Columbia, Puerto Rico and the North Mariana Islands) that have enacted them—ranging from a mandated 50% renewable requirement by 2030 in California to a voluntary, unenforceable goal of 10% renewable power in North Dakota (DSIRE 2016). The wide-ranging nature of these standards is accompanied by considerable variation in the development of renewables—states with the strongest RPS standards have shown how quickly those mandates can spur development, while other states with high potential but without a strong RPS have seen much slower growth in renewables (EIA 2012a; Sarzynski, Larrieu and Shrimali 2012). Another supportive policy often linked to RPS is the creation of renewable energy credits (REC). REC policies allow producers of renewable energy to sell "credits" linked to renewable production, in addition to the sale of electric power. One consequence of these policies has been an increase in the extent to which renewable energy generated in states with lower or less binding RPS is purchased and imported into states with a high RPS. RECs have helped to create a market for renewable energy by giving customers who do not have access to locally produced renewable electricity (or utilities that need to meet a state's standard) a means to purchase it through RECs.

Another set of policies implemented by some states (or even individual utilities) that encourage renewable growth are those involving net metering and feed-in tariffs. Net metering allows small producers to be paid or credited for the electricity they produce—if their system produces excess electricity that can be fed into the grid during the day, that unused "surplus" is credited against their use of utility-produced power at night (or over some other time frame, as some net metering policies extend over the year so, for example, customers with solar systems can receive credit for increased electrical production in the summer to offset decreased production in the winter). The number of participants in net metering has increased rapidly in recent years, and states with favorable net metering policies that allow small-scale producers to sell excess power at retail rates have experienced higher levels of adoption of small-scale renewables (EIA 2012b). Net metering offers the advantage of having been approved by the Federal Energy Regulatory Commission (FERC) and is legally tenable after having survived judicial review (Powers 2012), but many utilities are attempting to impose restrictions on net-metering as residential solar power has expanded (Inskeep et al. 2016).

Feed-in tariffs (FITs) function similarly to net metering, but go a step further by guaranteeing a price for excess energy produced that is higher than retail rates. FITs function more like the production tax credit, and are designed to guarantee a return on investment to address the high initial costs of purchasing and installing renewable systems. Although FITs have been adopted less frequently than net metering in the US, where instituted they have fostered investment in renewable systems (EIA 2013c). Their effectiveness in increasing distributed energy use in places like Germany has stimulated increased interest in this policy alternative (Couture and Cory 2009). Although the

Federal Energy Regulatory Commission (FERC) has ruled that FITs are possible (FERC 2010), complex regulatory issues related to the levels at which “avoided costs” (the cost per kilowatt-hour the utility did not have to spend to produce the electricity, including capital costs of building increased capacity and transmission) remain unresolved, a situation that at least for the present is limiting increased use of FITs.

Federal regulations like the Clean Air Act have also encouraged development of renewable energy systems by requiring reductions in emissions from conventional energy production facilities, leading to increased costs associated with the need to implement more effective pollution controls. Further pressure to reduce pollution from fossil fuel-based power production seems likely following a recent ruling by the United States Court of Appeals (District of Columbia) that the Environmental Protection Agency (EPA) has legal authority to regulate carbon emissions because they pose a danger to public health. Although the EPA intends to regulate carbon emissions through the adoption of the Clean Power Plan, which would mandate reductions in carbon emissions from the electric sector, a recent Supreme Court ruling has stayed the implementation of that plan following a legal challenge (EPA 2016). Increasingly restrictive emissions standards and the EPA’s ability to impose new mandates and penalties on carbon emissions will likely lead to increased costs for conventionally produced electric power, helping to increase the cost competitiveness of renewable energy alternatives.

Given substantial capital equipment and installation costs, financing is also key to renewable energy development. Until very recently traditional lending sources have generally viewed renewables as risky investments and been reluctant to provide favorable lending terms, leaving foreign banks to provide much of the financing for renewable projects (Mintz et al. 2012). As renewable technologies have become less novel, lenders have become more willing to finance these projects, a trend that is likely to continue as renewables experience further price declines and tax credits remain stable. Large banks like Wells Fargo and JP Morgan have recently expanded their investments in distributed solar energy (Pentland 2013). In addition, some solar companies are raising money themselves by selling shares through public stock offerings (First Solar 2013), and a few traditional energy providers are also investing in renewables (Sweet 2013). New and improved financing options are likely to lower costs for renewable projects and serve as an even more important driver of renewable energy growth in the future (Mendelsohn and Feldman 2013).

While traditional financing opportunities are beginning to open up, there have also been many creative responses to the difficulty of financing the high costs of renewable systems, especially at the small scale. One example involves the formation of energy co-ops that work as a group to buy solar or wind systems, using a larger number of buyers to bargain for reduced small-scale system costs or to raise capital to purchase shares of a larger-scale renewable system, such as a solar garden. "Crowd-funding," an approach used by organizations such as the company Solar Mosaic, is another recent development. Crowd-funding involves loans provided by multiple small investors (investing as little as $25) to provide low-rate financing of solar projects for non-profits that cannot take advantage of corporate tax incentives. Another response has involved leasing renewable systems. Residential solar customers (usually in high incentive states) enter into a leasing arrangement where solar panels are installed at very low or no cost, and then pay a locked in rate for the electricity they use. The leasing company assumes that electricity prices will continue to increase, and expects to profit by selling excess power produced by the system at increasing rates while offering stable prices for the homeowner.

Another recent financing strategy has been the creation of Property Assessed Clean Energy (PACE). Designed to encourage residential and other distributed-scale renewable energy systems or energy efficiency upgrades, PACE financing is like a loan that spreads out the high initial cost of these systems over a longer time period. PACE allows governments to create financing districts that offer loans for the cost of renewable systems. The loan value is added as an increased assessment on the property of owners who install renewable energy, and the debt is repaid through increased property taxes. This increases yearly property tax but gives property owners the assurance they can recoup the investment even if they sell the property, because the value of the upgrade will be included in property taxes the next owner will pay.

In addition to technological changes, supportive public policies, and increased financing availability, broad-based public support has also been an important driver of renewable energy expansion. For example, a March 2013 Gallup poll asked “Do you think that as a country, the United States should put more emphasis, less emphasis, or about the same emphasis as it does now on producing domestic energy from each of the following sources?” Three out of four (76%) respondents indicated they wanted more solar and 71% wanted more wind power, compared to just 31% wanting more use of coal, 37% wanting more nuclear power, and 46% wanting more use of oil (Gallup Politics 2013). Such findings are consistent with those derived from many other national and regional opinion polls and surveys that have found high levels of public support for renewable technology since the technology was first commercialized in the late 1970s (Brunner and Vivian 1980). Even in states like Montana, Wyoming, and Utah that have long traditions of reliance on extractive economies, public support for renewable energy is high (Colorado College State of the Rockies Report 2013). Further, public recognition of adverse environmental consequences of existing technology (but not concern about carbon emissions or relationships to global warming) has been found to be more instrumental in shaping attitudes about renewable energy than the costs of shifting to these new technologies (Ansolabehere and Konisky 2012). And, even as the costs of renewable energy move closer to those associated with conventional sources, most consumers indicate they are willing to pay more for renewable energy; a 2011 study found the average US citizen is willing to pay an additional $162 annually for power from renewable systems (Aldy, Kotchen and Leiserowitz 2012).

Finally, it is important to note that public support for utility-scale renewable energy development often forms locally in response to expectations about economic benefits projects may bring to an area in the form of new tax revenues, new employment opportunities, and new sources of income or reduced electricity costs (Bidwell 2013; Slattery et al. 2012). Most revenue derived from utility-scale projects comes from taxes assessed on the value of installed facilities and equipment. Given the high cost of turbines and solar panels this can be a substantial source of revenue for a rural county, especially when large projects are sited in sparsely populated areas. And, unlike many other types of economic development in rural areas that tend to attract substantial workforce in-migration, these projects typically do not require significant public expenditures on services like additional roads, sewers, police, or schools. However, because of a rapid depreciation rate applied to taxable capital equipment at renewable energy facilities, what may be a large initial revenue increase for local governments is often relatively short-lived. Some states have implemented additional revenue-generating policies, which provide longer-lived economic benefits. For example, in 2010 the state of Wyoming implemented a Wind Energy Excise Tax, which in 2012 began collecting $1/megawatt-hour annually from developers for all wind electricity generated in the state—60% of this revenue goes directly to the county hosting the facility.

Utility-scale wind farms and solar arrays can create much-needed employment and income opportunities in areas where such facilities tend to be sited. In a study examining the economic effects of wind power development from 2000-2008, Brown et al. (2012) reported an aggregate increase in county-level personal income of approximately $11,000 and the addition of 0.5 new jobs for each megawatt of installed wind power capacity. Most project-induced jobs involve short-term construction-phase employment, as renewable projects typically require only a small number of employees during the operation phase. And, there is a tendency for relatively few of these newly created jobs to be filled by established local-area residents. Nevertheless, even a handful of new jobs can represent a substantial economic boost in many rural areas, as can short-term construction-related increases in sales for local-area materials providers and service-sector businesses.

In areas where development occurs exclusively or extensively on privately owned lands, utility-scale renewable energy facilities can also produce an economic windfall for landowners who lease their property for the siting of wind turbines or solar arrays. Lease payments can be very helpful for rural landowners as they provide a steady and predictable income, while often not displacing revenue generated through farming or other existing land uses. Additionally, some wind developers have begun offering "good neighbor payments" or "community benefit provisions" to households living adjacent to turbine-leased land, since those neighbors often feel impacted by the installation of turbines. In some counties, economic benefits from wind farms are distributed even more widely. For example, in Sherman County, Oregon a compensation program provides an annual royalty payment check to every household in the county, enabling all residents to share in the revenue stream from the wind farm (Druckenmiller 2012). Even in areas without utility-scale growth, distributed or small-scale projects can provide economic stability for business and residents that install systems as a buffer against rising prices and as a long-term investment. And for some rural residents in very remote areas, renewable systems can provide electricity much cheaper than connecting to the larger grid.

**Barriers and Liabilities**

Although a variety of forces are driving the growth of renewable energy capacity in the US, there are also multiple factors acting to constrain that expansion. Among the more important of these are pricing and cost issues. At present conventional electric power sources maintain a considerable price advantage over renewable energy in most markets, due in part to the fact that many of the negative externalities associated with conventional power systems are not reflected in the price of electricity. Rather, conventional energy production is partially subsidized because the human health and environmental quality effects of power plant emissions and fossil fuel extraction are not fully reflected in the price of electricity. And, while the costs of both utility-scale and distributed-scale renewable energy options are declining, most renewable power options remain more expensive than grid-supplied electricity due in part to the still-emergent nature of these technologies and limited availability of financing.

The complexities of the regulatory environment involving electric power production and distribution further exacerbate the cost disadvantages that constrain renewable energy expansion. The US electric utility industry is highly regulated, with multiple layers of regulation at federal, state, municipal, and utility-sector levels. The resulting complexity and variability of regulations across multiple layers of authority and from one geographic location to another can add considerably to the cost of renewable energy installations. Indeed, one analyst has asserted that "up to 40 percent of the cost of installing solar panels onto your home or business isn't related to hardware at all, but rather due to complications of 'soft costs,' like permitting, zoning, and hooking your system up to the power grid" (Simmons 2011). And, "inconsistencies in soft cost requirements—from town to town and utility to utility—make it difficult for solar installers to enter new markets" (Le 2013).

There are also important barriers associated with the difficulties involved in integrating renewable energy production into the existing electric power grid and transmission systems. Provision of a sufficient and reliable supply of electricity requires a perfect balancing of supply with demand. Renewable energy sources present a challenge to attaining that balance, since the amount of power produced can vary from one minute to the next as wind speed variations and changes in cloud cover alter output from wind turbines and solar panels. Substantial variations in output from renewable energy sources also occur from day to night and from season to season. This variability requires that utilities have back-up capacity available and ready at a moment's notice to fill in the troughs in power supply caused by shifts in renewable output or in power demand. Some have argued that as renewable energy production becomes more widespread these fluctuations will level out as a result of anticipated advances in power storage technologies and a greater geographic dispersion of renewable systems, allowing dips in output from one area to be counterbalanced by sustained or increased output from others (Grossman, Grossman and Steininger 2013). However, such "balancing" outcomes will require substantial changes to the national power grid, a highly-complex system that at present provides for only limited inter-regional interconnection and coordination (Kassakian et al. 2011).

Further complicating the situation are difficulties involving the ability to transmit power from remotely sited utility-scale renewable energy developments to distant power consumption markets. Siting requirements and the renewable resource conditions needed for utility-scale wind farms and solar arrays tend to concentrate such developments in remote rural areas, often at considerable distance from population centers that are the biggest users of electric power. The absence of or inadequacy of existing power transmission lines capable of moving this newly-generated electricity across long distances means that additional high-capacity transmission lines are needed. Adding the needed transmission capacity can be difficult to achieve given high construction costs and the challenges associated with permitting of transmission corridors that are often highly controversial due to public concerns about environmental and land use consequences (Brown and Rossi 2010). The need to address the requirements of multiple levels of regulatory authority makes transmission lines difficult to site, and the barriers associated with public opposition and reluctance to cooperate by what may be hundreds or thousands of individual landowners are daunting (Furby et al. 1988). Policy responses to these difficulties, such as the creation of National Interest Corridors that assign the Federal Energy Regulatory Commission final authority over interstate transmission decisions, could perhaps facilitate future siting efforts (McLaughlin 2008)—but the imposition of federal authority in locating and permitting transmission corridors is also likely to spawn considerable controversy. This highlights another advantage of distributed energy options. With power from such systems used primarily where it is produced, the need for new high-voltage transmission lines to deliver power to distant locations is reduced.

Policy inconsistencies also act to constrain the growth of renewable energy. In particular, the availability of federal funding programs in support of renewable research and development activities has fluctuated wildly as various renewable technologies gain or lose favor and as the politics of energy policy swing in various directions. For example, recurring Congressional threats to discontinue the production tax credit every few years have undoubtedly had a dampening effect on private-sector decisions about investment in new renewable energy projects. As Liang and Fiorino (2013: 111) have observed, "incremental, predictable, and credible expenditures appear to be more conducive to renewable energy development," while "a boom-bust cycle of resource support hardly translates policy goals into intended results."

The interests and concerns of the electric utilities industry may also serve to limit growth in renewable energy production. The prospect of increased utilization of residential-scale distributed renewable energy has spawned considerable concern within the utility industry due to the potential for declining revenues, increased costs, and lower profitability. The practice of net metering, which requires that utilities purchase excess power produced by individual small-scale and residential renewable installations, has increasingly been a focus of industry efforts to secure regulatory changes that would reduce compensation to or increase costs for the owners of those small-scale systems. Similarly, a number of utilities have pursued policy shifts that would allow them to restructure or limit their contractual obligations to purchase renewably-produced electricity from larger-scale commercial facilities. Utilities have substantial lobbying influence and legal resources, and their ongoing efforts to protect the industry from these "disruptive challenges" to the centralized utility services business model (see Kind 2013) may create new barriers to more widespread adoption of renewable energy options.

Finally, it is important to acknowledge that local-level public concerns about and opposition to the siting of large-scale renewable installations can be an important barrier to expanded production of renewably produced energy. Despite broad-based public support for renewable energy development generally, local-area residents, landowners and land users are often strongly opposed to the development of these facilities. Indeed, a recent study indicates that many proposed wind projects in the US have been blocked as a result of opposition and controversy at the local level (Pociask and Fuhr 2011). Public concerns about renewable projects vary widely, but most commonly include fears that they will spoil views, create unwanted noise, cause harm to wildlife and wildlife habitat, change and restrict land use patterns and options, or lower property values. In addition, concerns sometimes arise regarding the fact that local communities and rural areas bear the brunt of potentially adverse effects associated with these facilities, while most economic benefits as well as newly generated electricity are sent to other, often distant urban areas.

## Policy Options and Recommendations

Policies that promote development of renewable energy at both the utility scale and smaller scales seem necessary for the foreseeable future. At the same time, policies designed to promote distributed generation may offer longer-term opportunities and benefits to rural areas, particularly since forecasts point strongly toward a diminishing importance of utility-produced electricity. To best promote renewable energy in ways that will reinforce and enhance positive rural development outcomes, we offer the following policy recommendations:

### *Establish and Maintain Consistent and Predictable Policies*

Even as renewable technologies continue to mature, for the near term at least there is a need to continue supportive policies such as the production tax credit, the residential renewable energy tax credit, or feed-in tariffs. Such policies also need to be characterized by a higher degree of predictability, stability, and consistency than has occurred over the past several years. For example, recurring Congressional threats to discontinue the production tax credit every few years have undoubtedly had a dampening effect on private-sector decisions about investment in new renewable energy projects. Long-term policy commitments will help signal to investors and inventors that these technologies are worth pursuing. At the same time, to provide the correct incentives such policies should include a defined time horizon and a reduction schedule that will lower subsidy levels as renewable energy technologies mature and as new innovations and increased efficiencies lead to a declining need for subsidization and incentive programs.

### *Coordinated Planning at the Federal, Regional, State, Utility, and Local Levels*

The electric power grid is vast and complex, and the intermittent nature of power production from renewable sources poses serious challenges to the existing grid system. To be stable and reliable the grid will require the interconnection of backup capacity and increased integration across multiple scales of generating systems. Further deployment of smart-grids and deeper interconnection of the national grid will help smooth the intermittencies of renewable energy supplies and increase the total amount of renewable capacity the grid can use. But successful deployment of these systems needs careful planning, with emphasis on more effectively connecting the many levels of bureaucracy involved in regulating the electrical system.

### *Low-interest Loan Programs for Small-scale Renewable Systems*

The high initial cost of a residential-scale solar or wind system prevents many would-be buyers from installing renewable energy. Although banking practices are changing, traditionally banks have not offered favorable loans for renewable energy projects even if they can be shown to offer consistent returns of reduced energy costs. Because of this we recommend continuation of programs like the Rural Energy for America Program (REAP) that offer low-interest loans for renewable and energy efficiency projects. Given the potential for substantial energy cost savings, and because residential-scale energy systems are usually covered by homeowners insurance, such investments tend to be among the safest available to individual property owners and to lending institutions.

### *Local-level Revenue Generation Standards*

Most of the public revenue derived from utility-scale wind and solar energy developments comes in the form of taxes on capital equipment installed at these facilities. Because a rapid depreciation schedule is typically applied to such equipment, it is important that counties and municipalities hosting developments plan carefully around the timing and uses of these funds. Renewable energy projects have potential to provide much-needed tax revenues for rural areas, but the relatively short-term and declining nature of revenue flows can create challenges in anticipating the extent and duration of revenue increases and in determining how funds should be used. Given the relatively short-term and declining nature of these revenue flows, the benefits derived from such funds might be enhanced by creating investment accounts or endowments that can help to address public expenditure needs over a much longer term. State- and county-level governments could also consider implementing policies that produce a steadier income stream, such as Wyoming's Wind Excise Tax, as well as compensation programs that distribute economic benefits to a wider number of recipients, as has occurred in Sherman County, Oregon. However, it is important to weigh such options carefully since increased taxes and economic disbursements required of renewable energy developers could constrain an industry that already faces a number of vulnerabilities.

Local governments would also benefit from the creation and use of standardized agreements that clearly establish the amount of tax revenue they will receive, and how revenue levels will change over time. Standardized agreements could help local governments avoid being "bargained out of" revenues by energy companies that may negotiate for reduced taxes on the basis of job creation promises that may not materialize. In addition, a modest energy production tax allocated to local governments in areas affected by the siting of utility-scale renewable energy facilities would help to insure that some revenues remain available over the lifespan of these projects to offset longer-term externalities imposed on the locality.

### *Local Job Creation and Hiring Policies*

Although large-scale renewable energy projects are often promoted as providing significant new job opportunities for host areas, those expectations and promises frequently give way to disappointment in the face of limited job creation and a tendency for many positions to be filled by non-local and in-migrating workers. Policies and programs that help to increase employment opportunities for existing local-area residents are needed if renewable energy projects are to contribute more effectively to rural economic development outcomes. Such policies might include minimum requirements for a percentage of employees to be hired from the surrounding area during project construction and operation periods, as well as requirements for local purchase of some specified portion of construction materials and services. In addition, establishment of training programs to enhance preparedness of local-area residents for employment at renewable facilities should be considered.

### *"Best Practice" Siting and Interconnection Standards*

We also suggest the creation of new siting standards focused on reducing the negative externalities that are likely to accompany development of utility-scale renewable energy facilities. Besides the requisite environmental impact assessment and mitigation considerations, we suggest that standards include recognition of the visual impacts these developments can create. While the visual impact of wind turbines or other large renewable energy structures may appear unimportant compared to the environmental damage associated with some extractive industries, the visual and environmental effects of renewable technologies are not benign. Utility-scale projects require careful planning, with siting standards that include well-defined setback and distance requirements that protect cultural and natural landscapes. A careful planning process that considers and includes public views and concerns as part of the site evaluation and decision process will help avoid or reduce the controversy and opposition that often arises in response to large-scale project proposals.

For residential and small-scale systems, we recommend adoption of interconnection and permit standards that facilitate and encourage connection of these systems to the grid. Policies are needed that prevent the imposition of unnecessary permitting and connection requirements or expenses. These standards should also fully consider how residential-scale renewable energy systems offer benefits grid-wide, such as reduced utility power production and transmission costs and environmental benefits, and should insure that owners will receive a fair price for the excess electric power they produce.

**Conclusions**

Although the future trajectory for renewable energy remains uncertain, both the need for an energy system with a smaller environmental footprint and current trends in the creation and use of renewable technologies strongly suggest that our future world will use more and more renewably produced electricity. As that future unfolds, rural areas will experience potentially profound changes linked to increased reliance on both utility- and residential-scale renewable energy systems. Through careful planning and policy development those changes can contribute positively to economic, environmental, and social well-being, and help to foster positive rural development outcomes.

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# CHAPTER IV

# POLITICAL ORIENTATION AND ENERGY PREFERENCES IN UTAH

## Introduction

Renewable electric generation sources like wind and solar energy are in a period of rapid growth. This growth has been fueled by a number of factors, including technological innovations that have lowered costs and increased efficiencies, and because of supportive policies that have offered subsidies and tax breaks for renewable energy development.

Besides not requiring finite fossil fuels, solar and wind energy have environmental benefits of lowered air pollution and reduced carbon emissions. Policies supportive of renewable energy technologies have been justified because of the smaller environmental footprint of these technologies compared to the fossil fueled systems they are replacing. The recognition of the need to lower carbon emissions as a response to climate change is a major justification for supportive subsidies and mandates used to promote development of renewable energy technologies.

While these technologies have become more cost-effective, and in many situations can be cost competitive with traditional sources, because of the intermittent nature of production renewable sources have lower capacity factors compared to other generation methods and consequently cost more to integrate into the electrical system. Unless technological improvements further lower costs of production and storage (to smooth intermittencies), renewable energy technologies will continue to require supportive policies to continue to grow.

This technological change in our electrical system is occurring at a time of intense political polarization in US politics, and at a time when the American public is "more polarized on the environment than at any other point in time or on any other topic of political relevance included within Gallup's surveys" (Guber 2012: 95). And, at the same time, political belief correlates with clashing beliefs as to whether or not climate change is occurring (McCright and Dunlap 2011). If renewable energy technologies are promoted for their environmental benefits and as a response to climate change, we would expect attitudes toward renewable energy technologies to vary by political orientation. We will test if this assumption is correct and if renewable energy has become an issue like many others that have divided the American public. If support for renewable energy varies substantially in relation to political orientation, we could expect additional challenges to the continued growth of these technologies, especially since potential sites suitable for development are mostly found in rural areas which tend overall to be politically conservative.

**Polarization in Politics**

Polarization in politics refers to an increasingly bimodal distribution of core political attitudes, with views diverging from moderate political attitudes and clustering on the extremes of the distribution. DiMaggio et al., describe it this way, "Polarization is both a state and a process. Polarization as a state refers to the extent to which opinions on an issue are opposed in relation to some theoretical maximum. Polarization as a process refers to the increase in such opposition over time"(DiMaggio, Evans, and Bryson 1996). This process according to Baldassarri and Gelman creates a problem for democratic institutions that rely on consensus, as it "induces alignment along multiple lines of potential conflict and organizes individuals and groups around exclusive identities, thus crystallizing interests into opposite factions" (2008). The Pew research organization released a report on political polarization in 2014, showing that the American public has become more ideologically encamped, and having less overlap of political beliefs than before. Fewer people report having moderate political views, and fewer get their news from many different sources. More surround themselves with like-minded people who share their political views, and more have greater antipathy toward the opposing party. In addition, there are indications that this level of political polarization is a recent phenomenon:

> A decade ago, the public was less ideologically consistent than it is today. In 2004, only about one-in-ten Americans were uniformly liberal or conservative across most values. Today, the share who are ideologically consistent has doubled: 21% express either consistently liberal or conservative opinions across a range of issues – the size and scope of government, the environment, foreign policy and many others. (Pew Research Center 2014)

Polarization means that our nation is characterized by a public divided into political factions that largely exist in separate worlds, and they use completely different sets of information (Iyengar and Hahn 2009). Polarization has an impact on the political process by diminishing opportunities for compromise (Layman, Carsey, and Horowitz 2006), with both Republican and Democratic identifiers more apt to dislike their opponents and increasingly rate each other lower on the classic thermometer scale (Iyengar, Sood, and Lelkes 2012), and to identify co-partisans more positively (Iyengar and Westwood 2015). In a polarized political environment the public is likely to follow party cues, even if their party justifies its position with a weak argument (Bachner and

Hill 2014). While there is an argument about whether or not political polarization is in fact occurring in the populace or if it is just a divide of the political elites (Fiorina and Abrams 2008), other studies (Abramowitz and Saunders 2008; Druckman, Peterson, and Slothuus 2013) and recent polling data suggest that on a host of issues, such as gun control and abortion, members of the American public are highly politically polarized, and that issues of climate change and the environment are now among the most polarized topics (McCright and Dunlap 2011).

**Political Orientation and Climate Change and Environmental Beliefs**

As political polarization has intensified since the 1970s (Abramowitz and Saunders 2008), so has the correlation between political partisanship and environmental attitudes. Earlier research explored how political identity correlated with environmental attitudes, and while the connection was consistently statistically significant most studies found only a modest correlation between political views and environmental attitudes (Van Liere and Dunlap 1980). Follow up studies also found this relationship to be consistent (Jones and Dunlap 1992), but the importance of the relationship was questioned because although the correlation was significant statistically, the divide between political parties found in polls on environmental topics was negligible when variance from wording and survey design was controlled for (Guber 2003). However, it appears this relationship has significantly changed in recent years. Critics have revisited the political partisanship and environmental attitudes relationship, and found that in the more polarized current political climate "political ideology and partisan identification are important determinants of a general environmental concern and are not exclusive to global warming" (Guber 2012). Similar patterns divide Democrats, Independents, and Republicans on a range of issues, including air pollution and the loss of tropical rainforests, as well as partisan polarization regarding support or opposition for governmental spending on environmental protection (McCright, Xiao, and Dunlap 2014).

In addition to distrust of climate science, political conservatives have voiced a disregard for science in general and exhibit a declining confidence in the authority of scientists (Gauchat 2012) for many topics considered largely settled in the sciences such as evolution, the age of the earth, or health impacts of industrial pollution (Hamilton, Hartter, and Saito 2015). The conservative movement has been criticized as attacking environmental protection by spreading misinformation (Jacques, Dunlap, and Freeman 2008) and conservative politicians have been accused of waging a "war on science" by restricting or attempting to restrict funding to federal agencies that do scientific research viewed as a threat to the conservative political agenda (Mooney 2012).

The connection between political orientation and environmental concern shows that this issue is not just a discrepancy between the uninformed versus informed; studies have shown that as the level of knowledge of environmental issues like climate change increases, level of concern does not necessarily increase but instead opinion splits into opposing groups (Guber 2012; McCright and Dunlap 2011). For liberals, a positive relationship between education and environmental concern is found, but political partisanship moderates this relationship for conservatives. On a range of conservation issues, including urban sprawl, natural resource conservation and regulations supporting conservation, for conservatives education has no effect or is negatively correlated (Hamilton, Colocousis, and Duncan 2010; Hamilton 2011; Hamilton, Hartter, and Saito

2015). This has been explained not as a result of incomprehension of science but as a result of a conflict of interest "between the *personal* interest individuals have in forming beliefs in line with those held by others with whom they share close ties and the *collective* one they all share in making use of the best available science to promote common welfare"(Braman et al. 2012: 732). Because a person's beliefs are strongly influenced by those who they share ties with, it should be no surprise that polarization is occurring, because as the Pew report made clear Republicans and Democrats have little interaction with each other, and their views are reinforced by separate sources of information (Iyengar and Hahn 2009).

Fewer studies have explored how political orientation correlates with energy attitudes. In one recent study political identity was found to be a statistically insignificant predictor, but patterns in the analysis revealed beta values suggesting Democrats tend to be less likely to support coal or natural gas power development near their homes (Ansolabehere and Konisky 2009). Another study found Democrats are significantly more skeptical of horizontal drilling and hydraulic fracturing for oil and natural gas, and more likely to favor increased regulation of drilling and the need to disclose information about drilling practices (Davis and Fisk 2014).

Research has also revealed relationships between political orientation and certain energy and environmental behaviors. Liberals are more likely than conservatives to have a smaller carbon footprint, more willing to purchase less environmentally damaging products such as a hybrid cars (Kahn 2007), and more likely to engage in energy efficient practices than conservatives (Costa and Kahn 2010). Liberals are also 2 to 4 times more likely than conservatives to lower electrical use after receiving feedback about household energy use, whereas conservatives are more likely to use more electricity if they are told they use less than their neighbors (Costa and Kahn 2013).

In addition to having higher energy use and more environmentally impactful buying habits, conservatives have been found to be so dismissive of environmental messages that their willingness to buy energy efficient products decreases when the environmental benefits are highlighted (Gromet, Kunreuther, and Larrick 2013). But the divide is not as strong for other environmentally beneficial issues like a National Clean Energy Standard mandating clean power generation, which a substantial majority of the American public is willing to vote for. However, here too Republicans are more likely to indicate they would vote against such a standard (Aldy, Kotchen, and Leiserowitz 2012). The apparently substantial divide between liberals and conservatives on environmentally friendly behaviors appears to be a relatively recent occurrence, as in the 1970s and 1980s there was only a modest divide on environmental issues in the general public (McCright, Xiao, and Dunlap 2014).

A large body of literature has examined socio-demographic correlates of pro-environmental attitudes, and because of the assumed connection between energy and the environment they are expected to be relevant to attitudes about energy as well. Persons of younger age and those with higher incomes and increased education have been found to have higher environmental concern than older, poorer and less educated persons (Finucane et al. 2000; Xiao and Dunlap 2007; Konisky, Milyo, and Richardson 2008; Semenza et al. 2008). Education has also been connected with attitudes about energy and the ability to understand the issue (Southwell et al. 2012), though it should be noted that the U.S. population has a very low working knowledge of energy in general (The National Environmental Education and Training Foundation 2002).

**Rural-Urban Political Orientation**

Political orientation is also influenced strongly by geography, as residents in rural areas are much more likely to be conservative than residents of metropolitan areas (McKee 2008). This could have additional ramifications for renewable energy development if political polarization is found to exert a strong influence on attitudes toward renewable energy.

Following the 2012 presidential race another round of media coverage highlighted the ‘red state-blue state divide’; the maps show that the more rural states in the center of the country all voted Republican while the predominantly urban coastal edges voted Democratic. That pattern became even more dramatically evident following the 2016 Presidential election (Greenblatt 2017). The urban-rural divide is more complex than the duality the red state-blue state maps suggest, as it is modified by socio-demographic factors such as age distribution, race, and income, making the divide more nuanced as voting preference varies within each state. Even so, metropolitan areas are much more likely to vote Democrat and rural areas are more likely to vote Republican (Gimpel and Karnes 2006; McKee 2007; Greenblatt 2017).

Like polarization between the political parties the rural-urban pattern has become increasingly entrenched in recent decades, and by the 2004 presidential election “never before ha[d] the gap in the presidential vote choice of rural and urban voters been so wide” (McKee 2008, 106). The rural-urban patterns appear to be connected to the economic base of some rural areas, as voters in areas with economies relying on farming are more likely to vote Republican (Scala, Johnson, and Rogers 2015). But changes to an economic base can have ramifications for rural voting behavior, because when rural areas transition to recreation dependent economies they often become less likely to vote Republican (Scala, Johnson, and Rogers 2015). Along with a political divide, rural and urban areas are divided by inequalities as rural areas are more likely to be dealing with population loss, higher poverty rates, and lower educational attainment than urban areas (Economic Research Service 2016); and rural area residents, on average, have a 3 year shorter lifespan (Singh and Siahpush 2014).

**Renewables Justified by Environmental Benefits**

At the same time we are seeing increased political polarization, the electrical generation system is in a period of rapid change. Coal is being displaced by natural gas and wind and solar energy. Coal power is among the most polluting sources of electrical production and although it is still the largest source of production in the US, its share has been rapidly declining as pressures to lessen reliance on coal combine with increased cost competitiveness from other sources of electrical generation such as natural gas and wind and solar energy (EIA 2015b). Technological innovations in drilling techniques such as hydraulic fracturing and directional drilling have created a boom in natural gas production and lowered prices for natural gas power plants (EIA 2015c). Technical innovations and supportive polices and subsides that have rapidly lowered costs have also created a boom in wind and solar energy. Indeed, in recent years most newly installed electrical capacity in the US was in the form of wind and solar power (EIA 2015c); 2015 was the first year during which more solar was installed than natural gas power plants (Munsell 2015). These technological changes to the electrical system are potentially disruptive to the existing utility business model and renewable energy could create a completely new electrical system as increased numbers of consumers may become producers (Schleicher-Tappeser 2012).

While wind and solar sources will create challenges for the electrical grid and the electric-utility business model, these renewable sources have a much smaller environmental impact than traditional fossil fuel sources. They are powered by an endless source of fuel, do not require fossil fuels to be mined, drilled or burned, and as a result do not emit carbon or air pollutants or water pollution (Cullen 2013). Fossil fueled sources do not typically pay the costs of the external impacts of the pollution they produce. Even the 'cleanest' fossil fuel based electrical production systems, natural gas-powered generation plants, cost society an additional 1.5 cents to 11.8 cents/kWh in the form of health and climate change effects associated with using natural gas instead of wind energy (McCubbin and Sovacool 2013).

Renewable energy sources are not without environmental impacts such as wildlife and habitat loss, and possible local climate effects (Alsema, Wild-Scholten, and Fthenakis 2006; Turney and Fthenakis 2011; Dai et al. 2015). However, polices supporting their development have been justified based on the recognition of the need to lower carbon emissions and because renewable energy sources offer considerable reductions (Ciocirlan 2008). Renewable energy plays a large role in most plans designed to reduce carbon emissions as a response to climate change (Pacala and Socolow 2004).

**Public Support for Renewables**

Polling data show that renewable energy is the preferred source of electrical generation for the American public. This sentiment has been consistent and long lasting, with high public support for renewable energy since the earliest introduction of the technologies (Brunner and Vivian 1980); recent polls have found large majorities are supportive of renewable energy (Ansolabehere and Konisky 2012). A 2013 nationally representative opinion poll from Gallup found solar and wind to be the most preferred sources of electricity, with 76% of respondents agreeing that the US should place more emphasis on solar, and 71% on wind. However, while a majority of Americans support renewable energy, Republicans are less enthusiastic than Independents or Democrats, with 68% of Republicans agreeing that more emphasis should be placed on solar compared with 74% of Independents and 87% of Democrats. Republicans are less likely to desire more wind energy with 59% wanting more emphasis compared with 68% of Independents and 83% of Democrats. Whereas the top two preferred sources for Independents and Democrats are solar and wind, Republicans' top two most preferred sources of energy are an increased emphasis on natural gas (78%) and oil (71%). Republicans also express a very different level of support for coal, with 51% wanting more emphasis compared to 26% of Independents and 21% of Democrats (Jacobe 2013).

Large majorities of Americans also support government subsidies and tax breaks designed to encourage renewable technologies (Bolsen and Cook 2008; Mills, Rabe, and Borick 2015). Support for renewables is strong even in states whose economies are heavily dependent on fossil fuels like Wyoming and Utah. Majorities in Republican-leaning Western states like Arizona, Montana, New Mexico, Utah, and Wyoming who are typically opposed to government subsidy tend nevertheless to express a desire for additional funds to support renewable energy development (Colorado College State of the Rockies Project 2015).

Despite favorable public opinion and significant environmental advantages renewable energy projects are not often built without public controversy. Opponents express concerns about a host of issues, ranging from wildlife and habitat impacts to fears of property value declines, aesthetic concerns about the visual impact from these developments (Dai et al. 2015), and complaints about government subsides. While in general majorities of the public view these technologies favorably, there is often opposition to a proposed specific development that reflects significant differences between attitudes about renewable energy in general and reactions to local development, as local opposition to development is a frequent occurrence ( Warren et al. 2005; Phadke 2011; Larson and Krannich 2016). This disconnect between support in general and opposition at the local level has been called the "social gap"( Bell, Gray, and Haggett 2005; Bell et al. 2013).

A variety of factors have been identified to account for this "social gap" between general support and local opposition. The factors that have been examined most often as influences on attitudes about renewable energy (usually asking questions about wind energy specifically[1]) include renewable energy's benefit and impact on the environment, economic development, impact on wildlife, private property value impacts, and diminishing scenic views.

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[1] This is a result of the relatively low percentage of installed solar and because wind energy has a larger visual impact than most photovoltaic solar installations.

These factors are expected to have specific and different influences on attitudes toward renewable energy among those on the edges of the political spectrum. Given the earlier discussion of the decreased likelihood that Republicans are concerned about climate change and the environment, we expect conservatives to be less supportive of renewable energy. And while earlier research has shown that the lessened environmental impact increases support for renewable energy (Smith and Klick 2007; Ansolabehere and Konisky 2012; Jacquet and Stedman 2013), we also expect conservatives to be less interested in renewable energy's positive environmental benefit. But, because all development has both positives and negatives, supportive attitudes toward renewable energy will depend in part on whether or not these technologies are viewed as having more benefits than costs. In addition to lowered importance of environmental concern, another reason to expect lowered supportive attitudes toward renewable energy among conservatives is opposition to the use of subsidies to promote renewable development. This is suggested because the idea of limited government is central to Republican policy preferences.

On the other hand, we might expect renewable energy development to be appealing for Republicans living in rural communities that have limited possibilities for economic development. Earlier research on wind energy has found increased support among those who view development as an opportunity to increase the local tax base, create jobs, or support rural lifestyles (Brannstrom, Jepson, and Persons 2011; Slattery et al. 2012). Economically disadvantaged or stigmatized communities are more likely to see wind power as an economic opportunity (van der Horst 2007; Toke, Breukers, and Wolsink 2008). And support may increase because of the general finding that

Republicans are more likely to say they support economic development and less concerned about environmental protection when these options are presented as a binary choice (Truelove 2012).

Economic context is not only related to levels of economic opportunities but also to the types of industries on which a community relies. For example, communities that have tourism-based economies, high proportions of seasonal residents, and retirement populations may be less accepting of wind energy (Fast and Mabee 2015), but at the same time tourism based economies in high amenity areas are increasingly voting Democratic (Scala, Johnson, and Rogers 2015). Some of the factors shown to influence attitudes toward wind energy may influence Republicans and Democrats in a similar way, such as the finding that fear that wind energy development will lower residential property values can influence attitudes toward wind energy (Gulden 2012).

The most commonly cited concern about wind energy is its visual impact, and wind energy's visual impact has a substantial influence on attitudes ( Bishop 2002; Johansson and Laike 2007; Wüstenhagen, Wolsink, and Bürer 2007). It is unknown how political orientation might influence reactions to the visual effects of wind energy, because how people view wind is very subjective. Some people see wind turbines as objects of beauty that symbolize progress (Johansson and Laike 2007; Slattery et al. 2012), while others see the huge spinning wind turbines as ugly and an eyesore (Thayer and Freeman 1987), as a symbol of the industrialization and commoditization of nature (Gulden 2012), or as a symbol of how rural areas can be impacted so urban areas can benefit ( Pasqualetti 2000; Ottinger 2013).

The partisan battle over climate change has been described as a fight between those who criticize the capitalist order and the defenders of the status quo, with conservative ideology promoting the status quo and liberal ideologies more favorable to environmental protectionism, which is viewed as a threat to capital accumulation (Jacques, Dunlap, and Freeman 2008; McCright and Dunlap 2011; Oreskes and Conway 2010). But we can envision how positive attitudes toward renewable energy could potentially fit into both of those worldviews, where renewable energy development can appeal as a source of energy to drive economic expansion and also as a symbol of environmental progress. It is possible that renewable energy technology offers a bridge between ideologies, functioning simultaneously as a source of economic development and as a response to climate change. Clearly, renewable energy as an issue does not fit neatly into the current bifurcation of beliefs sorted by political party. Renewable energy offers a complexity that could challenge presupposed political issue divisions.

**Future Patterns of Renewable Energy Development**

The past decade has been a period of rapid growth for renewables. Between 2004 and 2014 wind energy capacity worldwide grew from 48 GW to 370 GW and solar photovoltaic grew from 3.7 GW to 177 GW (Sawin et al. 2015). Future projections predict the US will install an additional 109 GW of solar and wind by 2040. If this growth occurs as predicted, by 2040 wind will displace hydropower as the largest source of renewable electrical generation in the US (EIA 2015a). As of 2014 wind and solar power accounted for 38 percent of renewably generated electricity in the US (and only 3 percent was produced with solar) (EIA 2015c).

The state of Utah currently relies on coal power for the bulk of its electrical production, and coal mining and operation of coal-fired power plants are substantial contributors to the economic base of Utah. While coal is still the main source of electricity, in recent years increases in renewable energy installations in the state and conversion to natural gas for fuel have lowered the relative share of coal in electric power production to its lowest percentage ever. The recent declining share of coal hints at the likely coming shift as the electrical system moves away from its reliance on coal. At the time of our data collection, Utah had a low level of installed renewable energy capacity, but several utility-scale wind and solar installations had been developed and were producing electricity. In the years since, additional installations of utility-scale wind and solar have increased the state's renewable electricity capacity, and Utah has a substantial wind resource with potential for many more wind energy facilities, as well as a very good solar resource (Berry et al. 2009).

Much of the growth of renewables has been a result of technological improvements that have lowered costs and increased performance; as a result recent power purchase agreements are competitive with coal-fired electrical production (Wiser and Bolinger 2015). At the same time, the boom in shale oils and resulting low oil and natural gas prices represents a challenge to renewable energy (REN21 2013). However impressive the recent pattern of growth of renewables is, these rates are slow in comparison to the growth rate required as a response to climate change. The requirement to decarbonize the energy system will require massive changes to our energy system and major shifts to renewable energy technologies ( Hoffert et al. 2002); Pacala and Socolow 2004). A transition on the scale necessary to actually tackle climate change is so massive

(Grubler 2012) as to be highly unlikely (Smil 2010). The electrical grid is one of the largest and most complicated systems ever built (Overbye 2000), and adding hundreds of thousands of sources of highly variable electric production further increases the level of complexity of the system.

The rapid growth in new forms of electrical power production is causing a shift in energy geographies, where traditional centers of production are losing relevance, and new areas without a legacy of electrical production are now host to solar and wind production facilities (Bridge et al. 2013). This has been evidenced as fears of problems from horizontal drilling and hydraulic fracturing for oil and natural gas have become a cultural touchstone and the appropriateness of this technology has been debated. This debate has also occurred over renewable energy development and will continue to be an issue, as solar and wind power are powered by fuel sources that have a much lower energy density and require a spatial footprint orders of magnitude larger than the sources they are displacing. This is particularly relevant for rural areas, which have more open space and are more likely to host large-scale renewable developments.

Whether or not the electrical system is converted quickly enough to lower carbon emissions to offer a meaningful response to climate change, realities of the technology mean that renewable energy is changing the geography of energy production and could have major social ramifications. The technical requirements of solar and wind technology have a large impact on where electricity is produced, and the realities of renewable technologies mean that the utility-scale installations will have large footprints and will be a source of change for communities close to where the developments are located. The first factor necessitating that renewable energy has a large spatial footprint is that renewable technologies are dependent on fuel sources that have low energy densities. As a result hundreds of turbines and thousands of panels are required to displace a single fossil-fuel based generation station. While wind turbines do not limit all other uses of land they are sited on they have a vast footprint: on average wind energy requires one square kilometer to produce 3 MW (Denholm et al. 2009). Secondly, wind and solar have to be sited in areas that have steady and predictable wind and solar resources and cannot necessarily be sited in the areas most convenient to the users of the power.

Finally, given the size of the installations these sources will remain highly visible—wind turbines because they need to be very tall to access steady winds, and solar because they cannot be shaded and hidden. The variability of the sun and the wind adds an additional reason that renewable energy will have an enormous spatial impact. The variability of these sources means they have much lower capacity factors than the sources they are replacing. A nuclear power plant has a capacity factor of 90% and coal power plants average 70-85%. By comparison a wind turbine's annual capacity factor, due to wind variability, is on average only around 30-35% (meaning that only 30-35% of the time will a turbine actually be producing power), while solar, depending on location, has an average of 25-30% capacity factor (Borenstein 2012). This means, for example, that while a 100 MW wind farm is capable of producing 100 MW when the wind is blowing, over the year the facility will typically produce the equivalent of a 30 MW plant with a 100% capacity factor. Because electricity is not cheaply stored and because production must exactly meet demand, this condition creates a challenge for an electrical system powered entirely by solar and wind power.

The technical necessities of solar and wind mean that as energy production transitions to renewable energy, energy production will expand geographically and develop in places that have not been traditional regions of energy production. This new expansion will inevitably create development issues for individuals, local governments, and communities. Whether or not these issues become a problem, and whether or not a community or individuals in a community will oppose local development, will depend in part on how the technologies are viewed. Here we probe how political orientation correlates with attitudes toward renewable energy, and consider whether political trends will be likely to conflict with the trend to increased reliance on solar and wind energy. Given the hypothesized relationship between political views and renewable energy attitudes, and the voting pattern differences between urban and rural America, current and future patterns of renewable energy development could create additional controversy as rural areas are likely the areas where most utility-scale renewable development will occur.

We use the state of Utah because it offers a good test case to examine if urban/rural residential patterns translate to attitudinal divides. The state offers strong clustering of population with distinct rural and urban populations. Utah is also good test case because renewable energy developments require large areas of undeveloped land as well as strong solar and wind resources both of which are found within the state. The test case of Utah, however, does present a few demographic challenges that may limit generalizability of the findings of this study. Some of the demographic differences are: the strong politically conservative skew of the population, as well as a relatively homogenous racial demographic profile and a unique religious identity, with most

Utahans followers of the Church of Latter Day Saints (Mormon). But despite these demographic differences we feel the sample offers a suitable number of non-religious, and politically liberal respondents to make adequate conclusions, especially in regard to the results comparing rural and urban attitudes.

**Methods**

To examine the influence of political orientation on energy attitudes we used a mail-based survey of adults living in the state of Utah. While Utah is a sparsely populated state it is also highly urbanized with most of the population concentrated along the base of the Wasatch Mountains. The "Wasatch Front" contains the capital city Salt Lake City and the states' four most populated counties (Davis, Salt Lake, Utah and Weber). Of the nearly 3 million residents of the state, 2.2 million live in this four-county area (74% of the state's population).

For a statewide survey to represent views outside of the Wasatch Front, we could not rely on a simple random sample because based on statistical probability the sample would draw relatively few residents outside of the urban core. We therefore drew a stratified random sample of 1,500 residential addresses from US Postal Service Delivery Sequence Files. Counties were grouped into three categories: Metro, Urban and Rural. The "metro" counties included the four most populous metropolitan counties on the Wasatch Front (Davis, Salt Lake, Utah and Weber). The "urban" counties group included two smaller and remotely located metropolitan counties (Cache and Washington) and six counties that contain smaller urban places and that adjoin the states' larger metropolitan counties (Box Elder, Iron, Morgan, Summit, Tooele, and Wasatch). The remaining less populous and more remote counties were grouped as rural counties (Beaver, Carbon, Daggett, Duchesne, Emery, Garfield, Grand, Juab, Kane, Millard, Piute, Rich, San Juan, Sanpete, Sevier, Uintah, and Wayne). Five hundred residential mailing addresses were selected from each of these groups of counties.

In October of 2013, using a tailored design mail survey (Dillman et al. 2009) approach, we mailed the sampled households a pre-notification letter explaining that they had been selected to participate in the survey. The following week they were mailed a questionnaire, a letter explaining the purpose of the survey and a postage paid return envelope. Additional mailings to encourage those who had not yet returned the questionnaire included a reminder postcard and two subsequent mailings of replacement questionnaires. A web-based option to complete the survey, with identical questions, was offered in each mailing and 12% of respondents used this method. 507 completed surveys were returned for an overall response rate of 36% (after removing 89 undeliverable addresses for an adjusted sample of 1,411 households). The groups of counties had varying response rates with a 40% response rate from the urban counties group, 38% for the rural county group, and 30% for the metro counties group.

To check for non-response bias we compared our data on age, sex, education, religion, income, and household size with census data of the statewide population characteristics. Overall our respondents were similar to the statewide population in terms of several of these socio-demographic characteristics (See Appendix A for complete table), with only small differences in sex, income, and household size. The sample does differ from the Utah population in age, education level, and religious affiliation, as survey respondents as a group were older, more highly educated and less likely to identify as

LDS (Mormon). However, none of these differences are very large, suggesting it is unlikely that our sample suffers severely from non-response bias.

## Dependent Variables

To study the possible influence of political orientation on energy preferences, environmental concern, and the appropriate role of government in fostering various energy production types we examined relationships between eight dependent variables and measures of political orientation, along with age, sex, education, income and the level of urbanization of county of residence.

The first three dependent variables are based on questions that ask about the role of government to regulate environmental protection, exploration of federal lands for oil and gas development, and the use of governmental subsidies to promote wind and solar power.

### *Government Environmental Protection Regulation*

The measure of support or opposition to government regulations of environmental protection asked: “Many government policies are designed to protect the environment, but some of these policies can be costly to corporations and other businesses. Which of the following captures your general opinion? Environmental regulations in the US are...” with response choices: Are Excessively Strong = 1; Are Too Strong, but Not Excessive = 2; Are About Right = 3; Need to be Somewhat Stronger = 4; Need to be a Lot Stronger = 5.

### *Oil and Gas Exploration on Federal Lands*

The measure of support or opposition for oil and gas production on federal lands asked: “Do you generally support or oppose the following proposals? Opening up more land owned by the federal government for oil and gas exploration.” Response choices included: Strongly Support = 1; Moderately Support = 2; Neutral = 3; Moderately Oppose = 4; and Strongly Oppose = 5.

### *Spending More Money on Developing Solar and Wind Power*

The measure of support or opposition to using government funds on solar and wind power asked: “Do you generally support or oppose the following proposals? Spending more government money on developing solar and wind power.” This variable was coded Strongly Oppose = 1; Moderately Oppose = 2; Neutral = 3; Moderately Support = 4; Strongly Support = 5. Responses to this question and several others were reverse coded from the order presented in the survey questionnaire for ease of interpretation, so that pro-environmental attitudes will be associated with larger values.

The next six dependent variables asked about energy preferences specifically, contrasting coal (the traditional source of energy in Utah) and renewable energy sources and asking if these sources should be increased or decreased:

### *Should We Use Coal to Generate Electricity?*

The measure of support or opposition to the use of coal fired power plants asked: “Some people say using coal to generate electricity is a good idea because it is readily available in North America and there are new methods for using coal that cause less pollution. Other people say most coal use is a bad idea because it still causes pollution and coal mining hurts the landscape and wildlife. What do you think? Do you approve or disapprove of using coal to generate electricity?" The response choice options were: Strongly Approve = 1; Somewhat Approve = 2; Neutral = 3; Somewhat Disapprove = 4; Strongly Disapprove = 5. These response categories were reverse coded from the order presented in the survey questionnaire for ease of analysis.

### *Increase or Decrease Coal Power?*

The measure of support or opposition to coal power asked: "Consumers, such as you, have more and more say in how electricity is produced in the United States. To meet the country's electric power needs over the next 25 years, new power plants will have to be built. Companies and government agencies need to start planning today. How should we meet this demand? For each power source listed below indicate whether you feel the US should INCREASE or REDUCE its use: Coal fired power plants." The response choice options (reverse coded from the original order) were: Increase A Lot = 1; Increase Somewhat = 2; Keep the Same = 3; Reduce Somewhat = 4; Reduce A Lot = 5.

### *Should We Use Renewable Energy to Generate Electricity?*

The measure of support or opposition to the use of renewable energy asked: "Some people say using renewable energy sources, like solar and wind power, to generate electricity is a good idea because they are readily available and better for the environment. Other people say using renewable energy sources is a bad idea because they are too expensive, can be unreliable and can still have negative environmental consequences. What do you think? Do you approve or disapprove of renewable energy sources to generate electricity?" Response choice options were: Strongly Disapprove = 1; Somewhat Disapprove = 2; Neutral = 3; Somewhat Approve = 4; Strongly Approve = 5.

***Increase or Decrease Wind Power?***

The measure of support or opposition to wind power asked: "Consumers, such as you, have more and more say in how electricity is produced in the United States. To meet the country's electric power needs over the next 25 years, new power plants will have to be built. Companies and government agencies need to start planning today. How should we meet this demand? For each power source listed below indicate whether you feel the US should INCREASE or REDUCE its use: Wind energy." The response choice options were: Reduce A Lot = 1; Reduce Somewhat = 2; Keep the Same = 3; Increase Somewhat = 4; Increase A Lot = 5.

***Increase or Decrease Solar Power?***

The measure of support or opposition to solar power asked: "Consumers, such as you, have more and more say in how electricity is produced in the United States. To meet the country's electric power needs over the next 25 years, new power plants will have to be built. Companies and government agencies need to start planning today. How should we meet this demand? For each power source listed below indicate whether you feel the US should INCREASE or REDUCE its use: Solar energy." Response choice options were: Reduce A Lot = 1; Reduce Somewhat = 2; Keep the Same = 3; Increase Somewhat = 4; Increase A Lot = 5.

**Independent Variables**

Five independent variables are used in the analysis. These variables, suggested in past research as important correlates of environmental concern (Jones and Dunlap 1992), included for measures of respondent socio-demographic characteristics: age (in years), sex (female = 1; male = 0), education (Some high school =1; High school graduate/GED = 2; Some college or associate's degree = 3; College graduate = 4; Post-graduate degree = 5), and income (under $24,999 = 1; $25,000-$49,999 = 2; $50,000-$74,999 = 3; $75,000-$99,999 = 4; $100,000-$124,999 = 5; $125,000-$149,999 = 6; $150,000-$199,999 = 7; $200,000 or more = 8). Residence in the rural, urban and metro groups was identified by respondent’s zip codes, and treated as a dummy variable with metro as the reference category. Questions concerning respondents’ race/ethnicity were not asked due primarily to the very low levels of racial diversity that characterize Utah overall, and especially the state’s rural areas.

The main independent variable was the respondent’s self-reported liberal or conservative identity. The question asked: “How do you describe your political views?” Responses were measured with the following five categories: Very Conservative, Moderately Conservative, Moderate, Moderately Liberal, Very Liberal. For analytical clarity individual response categories were treated as dummy variables, with “moderate” used as the reference category. As seen in Table 1, the response distribution to this question skews considerably to the conservative side of the scale.

**Table 1.** Response Distribution for Political Orientation.

| Response Choice | Number of Responses | Percentage of Total |
|---|---|---|
| Very Conservative | 88 | 18% |
| Moderately Conservative | 162 | 33% |
| Moderate | 151 | 31% |
| Moderately Liberal | 70 | 14% |
| Very Liberal | 21 | 4% |
| Response Rate 36% | 492 | 100% |

**Results**

In a series of linear regressions[2], we examine the influence of political orientation and socio-demographic factors to see if energy preferences are politically polarized. Table 2 shows the results of the regression analyses involving relationships between the independent variables and the first three dependent variables, which measure the appropriate role of the government, oil and gas exploration on public lands, and the use of subsidies to promote wind and solar power.

***Government Environmental Protection Regulation***

The regression analysis results mirror findings reported in the literature about political orientation and environmental views, indicating a significant correlation between political orientation and governmental regulations protecting the environment. The substantial R-square value (0.330) indicates that in combination the independent variables explain a large percentage of the variance, and the standardized regression coefficients show a clear pattern of decreased support for environmental regulation as

[2] While it a failure of assumptions to use ordinal variables as independent variables in linear regressions, we have elected to use them for our analysis because of the ease of interpretation (Pasta 2009), and because in most cases ordinal variables behave in a manner similar to continuous measure and the margin of error is often of minor consequence (Long and Freese 2006).

**Table 2.** Multiple regression analyses examining the appropriate role of the government in energy production and environmental protection.

| | | Governmental Environmental Protection Regulation | Oil and Gas Exploration on Federal Lands | Spending More Money on Developing Solar and Wind Power |
|---|---|---|---|---|
| | | Unstandardized Coefficients Standard Error in Brackets | | |
| Political Orientation | Very Conservative | -1.122*** | -.938*** | -1.073*** |
| | | [.158] | [.163] | [.182] |
| (Moderate Reference) | Moderately Conservative | -.734*** | -.588*** | -.734*** |
| | | [.13] | [.135] | [.152] |
| | Moderately Liberal | .707*** | .860*** | .662*** |
| | | [.168] | [.174] | [.194] |
| | Very Liberal | .866*** | 1.095*** | .982** |
| | | [.267] | [.286] | [.312] |
| Socio-demographics | Age | -.006* | -.004 | .006 |
| | | [.003] | [.003] | [.004] |
| (Male Reference) | Sex | .231* | .249* | .644*** |
| | | [.108] | [.112] | [.126] |
| | Education | .048 | .149** | -.005 |
| | | [.053] | [.055] | [.062] |
| | Income | -.045 | -.024 | -.072 |
| | | [.035] | [.037] | [.041] |
| County of Residence | Rural | -.379** | -.163 | -.401** |
| | | [.139] | [.145] | [.162] |
| (Metro Reference) | Urban | -.142 | -.059 | -.097 |
| | | [.13] | [.136] | [.152] |
| | R-Square | .330 | .285 | .276 |
| | N | 442 | 448 | 449 |
| | | *p<.05; **p<.01; ***p<.001 | | |

conservatism increases and increased support for environmental regulation as liberalism increases. All four political orientation categories are statistically significant as compared to the “moderate” reference category.

Age is also a statistically significant predictor, revealing that as respondents increase in age support for environmental regulation decreases, although the relationship is small. Sex is also found to be statistically significant, with females more likely to support environmental regulation. Education and income exhibit opposite relationships with the dependent variable, but neither is statistically significant. Residence in both rural and urban counties relates to lower support (relative to the metro counties) but only rural residents are statistically significantly less likely to approve of environmental regulations.

### *Oil and Gas Exploration on Federal Lands*

A very similar pattern about the acceptability of oil and gas exploration on federal lands is found in the next regression results. Again political orientation exhibits a very strong relationship with beliefs about federal land oil and gas exploration. Opposition to more development increases as respondents become more liberal, and decreases as respondents become more conservative. Being female and increased education are the only other statistically significant variables, and both are associated with increased opposition to additional oil and gas development. The R-square (0.285) value shows that political orientation along with sex and education account for a substantial percentage of variation in the dependent variable.

### *Spending More Money on Developing Solar and Wind Power*

A similar pattern of association between political orientation and support for spending government money is also found in these regression results. Support for spending government money on solar and wind power declines as conservatism increases, while support increases as liberalism increases. While the R-square value is slightly lower than was the case for the previous two regressions it is still substantial (0.276). Age, education, income and residence in urban counties are all not statistically significant predictors. However, females are more supportive of subsidies for renewables while the opposite is true for residents of rural areas.

The results from these three regressions are largely in line with earlier findings: conservatives are less concerned about environmental protection than liberals, and conservatives are more supportive of expanded oil and gas exploration and less interested in offering subsidies to wind and solar power than liberals. Further, these results mirror the national findings demonstrating a bifurcation by political orientation, where political views strongly predict environmental beliefs.

Table 3 presents the results from the next set of five multiple regressions for dependent variables regarding energy preferences, and attitudes about whether reliance on coal, wind and solar energy should be increased or decreased.

### *Should We Use Coal to Generate Electricity?*

In the first regression, as in the results about the role of government, we see a clear relationship between political orientation and attitudes about the appropriateness of coal as a source of energy. The R-square value (0.346) is the largest for all of the dependent variables tested, and shows that much of the variance in this dependent variable is accounted for by political orientation, sex, education, and rural residence. The results show a sharp difference based on political orientation, with conservatives much more likely to support coal fired electrical generation, and increased support for coal power as conservatism increases. The reverse is also true, with increased liberalism

**Table 3**. Multiple regression analyses examining relationships between political orientation, socio-demographics, and energy preferences.

| | | Should we use coal to generate electricity? | Increase or decrease coal power? | Should we use renewable energy to generate electricity? | Increase or decrease wind power? | Increase or decrease solar power? |
|---|---|---|---|---|---|---|
| | | Unstandardized Coefficients<br>Standard error in brackets | | | | |
| Political Orientation | Very Conservative | -.820***<br>[.158] | -.747***<br>[.169] | -.354***<br>[.151] | -.299*<br>[.146] | -.401**<br>[.102] |
| (Moderate Reference) | Moderately Conservative | -.506***<br>[.13] | -.429**<br>[.138] | -.278**<br>[.124] | -.102<br>(.389)<br>[.119] | -.191<br>(.062)<br>[.102] |
| | Moderately Liberal | .753***<br>[.166] | .623***<br>[.176] | .291<br>(.065)<br>[.158] | .286*<br>(.056)<br>[.151] | .225<br>(.085)<br>[.13] |
| | Very Liberal | .802**<br>[.269] | .713**<br>[.276] | .390<br>(.126)<br>[.255] | .392<br>(.106)<br>[.242] | .158<br>(.450)<br>[.209] |
| Socio-demographics (Male Reference) | Age | .004<br>[.003] | -.002<br>[.003] | .001<br>[.003] | .004<br>[.003] | .004<br>[.002] |
| | Sex | .507*<br>[.108] | .522***<br>[.115] | .184<br>[.102] | .385***<br>[.099] | .312***<br>[.085] |
| | Education | .107*<br>[.053] | .099<br>[.056] | .081<br>[.05] | .065<br>[.048] | .045<br>[.042] |
| | Income | -.083**<br>[.035] | -.089*<br>[.038] | -.071*<br>[.033] | -.045<br>[.033] | -.036<br>[.028] |
| County of Residence (Metro Reference) | Rural | -.904***<br>[.139] | -.803***<br>[.148] | -.165<br>[.132] | -.273*<br>[.127] | -.117<br>[.11] |
| | Urban | -.217<br>[.13] | -.121<br>[.14] | .040<br>[.123] | -.057<br>[.119] | .007<br>[.103] |
| | R-Square | .346 | .314 | .089 | .101 | .100 |
| | N | 448 | 415 | 446 | 436 | 436 |

*p<.05; **p<.01; ***p<.001
(p-values nearing significance or of note in parenthesis)

linked to decreasing support for coal power in general. Relationships involving respondent's age and residence in an urban county are not significant. Being female and increased education are associated with reduced support of coal power, while higher incomes and residence in a rural county are both statistically significant and associated with increased support for the use of coal for electrical generation. The beta for rural residence has the largest effect size, greater than that of being very conservative, which is not surprising given the importance of coal power for many rural economies in Utah.

### *Increase or Decrease Coal Power?*

The results for the dependent variable involving attitudes about whether reliance on coal power should be increased or decreased are not surprising, in that they generally match those for the variable focused on using coal energy in general. The relationship between this dependent variable and political orientation is statistically significant: desire to increase coal power increases with conservatism, while desire to decrease use of coal power increases with liberalism. Relationships involving age, residence in urban counties and education again are not statistically significant. Desire to decrease reliance on coal is greater among females, while rural residents are more likely to desire more coal power. The strong R-square (0.314) shows the importance these factors play in accounting for Utahans' attitudes about coal power.

### *Should We Use Renewable Energy to Generate Electricity?*

The pattern of relationships changes slightly as we test the factors that are associated with beliefs in using renewable energy to generate electricity. The role that political orientation plays does show a similar pattern to the other tested dependent variables, with support declining as conservativeness increases and support increasing as liberalness increases. However, the beta values are consistently smaller than those observed from results for coal, or the role of government. Statistical significance declines as you move from conservative to liberal, with the "moderately liberal" category close to being significantly different from the "moderate" reference category (p = 0.065), while the difference involving those who identified as "very liberal" is not statistically significant (p = 0.126). Of the other variables only income is statistically significant, with increased income associated with decreasing support for renewables, although the relationship is relatively small. Further, the R-square is much lower (0.089) than is the case for analyses involving other dependent variables, indicating that while some socio-demographic factors have some influence on beliefs about renewable energy, much less of the variance is explained. Given the small number of respondents in each of these two categories and the pattern of differences evident in the beta values, the magnitude of the regression coefficients nevertheless suggests a substantively important and consistent relationship between political orientation and attitudes toward renewable energy. The beta values for political orientation, while indicating a similar pattern to those observed for attitudes toward coal energy, indicate a weaker overall relationship. This indicates that renewable energy attitudes are less correlated to political orientation than is the case with the measure focusing on coal-based energy technologies. These results suggest that renewable energy attitudes do not break along the same political lines as attitudes for traditional energy technologies. Further, the low r-square shows that our socio-demographic variables are not very good predictors. Additional research is needed to identify other variables that might be more predictive, such as questions about different worldviews.

***Increase or Decrease Wind Power?***

A less conclusive pattern is again found in terms of the relationship between political orientation and desire to increase or decrease wind power. Beta values show a pattern similar to the other results, with those who are "very conservative" desiring a decrease of wind power. However, political orientation is not a statistically significant predictor for any of the other political orientation categories (although "moderately liberal" is very close to significance with a p-value of 0.056, and "very liberal" has a p-value of 0.106). With the exception of being female, which is associated with increased support for wind power, and residence in rural counties, which decreases support for wind power, none of the other variables have statistical significance. An R-square of 0.101 indicates that in combination these variables account for a modest portion of the variation in response to the wind power measure, but at a considerably lower level than was observed for the issue of coal and the government's role in regulating environmental protection and energy choices.

***Increase or Decrease Solar Power?***

Desire to increase or decrease solar power does not correlate strongly with political orientation, with the exception of the "very conservative" respondents who are less supportive of an increase in solar power. With the exception of sex, which shows that females are more likely to desire increased solar power, no other variable shows a statistically significant relationship with desire to increase or decrease solar power. However, relationships involving the "moderately conservative" and "moderately liberal" political orientation categories do approach statistical significance (p-values 0.062 and

0.085). The R-square of 0.10 shows that in combination these variables predict only a modest portion of the variance in attitudes toward solar power.

**Discussion**

What do these results tell us? For one thing, they show that national patterns of political polarization on certain environmental and energy utilization issues are evident in our Utah sample. We see a strong political polarization for many of the tested variables that match earlier findings about the ways political orientation corresponds with environmental and governmental regulation beliefs. Conservatives express lower support for environmental regulation, lower support for government subsidy of solar and wind, and an increased desire to expand use of coal power. Conservatives also exhibit lower support for renewable energy generation. And as political orientation moves from conservative to liberal, beliefs move in the opposite direction. Political orientation has a strong relationship with most of our dependent variables, and beta values for political orientation generally reflect relationships that are stronger than those for other independent variables.

These results confirm the assertion that on many issues, political orientation is a strong predictor of attitudes about governmental environmental regulation and energy choices. The divide between self-identified political conservatives and liberals is particularly strong for the questions focused on coal, showing that the belief about continued reliance of coal is highly aligned with political orientation. This finding makes sense in light of the earlier research on political orientation and beliefs in climate change, as one of coal's most troublesome effects is carbon dioxide emissions. It appears that for those who are less likely to be concerned with carbon emissions this source of cheap energy, and most likely the jobs connected with coal mining, are valued more than are concerns about the consequences of the pollution. Given the trends in our energy system this political polarization could have important ramifications in the future—if polarization intensifies, politically motivated opposition could hamper renewable energy development. Evidence of political polarization is also apparent in the general question of whether or not we should use renewable sources to generate electricity, although the importance of political orientation decreases when the focus shifts to questions about wind energy and is even less significant for the idea of increasing or decreasing reliance on solar energy. While these relationships between political orientation and desire to increase or decrease solar and wind power are not as strong and less consistently statistically significant than was the case when examining relationships involving attitudes about coal utilization and governmental environmental regulation, the pattern in the beta values still indicates that political conservatives and political liberals tend to have different priorities in regard to future energy choices.

Another finding that suggests potential for conflict over renewable energy development is the urban/rural divide in attitudes about energy. Rural residence did not play as strong a role as expected, and the expectation that rural residents would be opposed in general to renewable energy was not unambiguously confirmed. The biggest evidence of a rural/urban divide emerged over issues of coal and the appropriate role of the government. Even after controlling for political orientation, rural residents are more likely than those in metro regions to oppose the subsidies promoting wind and solar energy, and more opposed to wind energy in particular. The strongest connection, and an issue that should be watched, is the importance rural areas place on coal. Utah's rural residents are more likely to express support for the use coal and feel that coal use should increase. Overall it seems clear that rural residents in Utah are connected to coal; for some coal is likely a part of their identity or supports them economically. As coal is increasingly replaced with other energy sources this change could be particularly problematic for rural residents. Whether or not this translates into increased opposition to renewable energy is unknown, but given the trends identified in these results such reactions would seem likely.

Socio-demographic variables other than political orientation and rural residence play varying roles in regard to energy attitudes. Age is only statistically significant in one of the analyses (government regulations protecting the environment) and the relationship is very small, contrary to earlier findings about the connection between age and environmental concern. Education also does not play a very strong role in attitudes about energy, having statistical significance in only three of the analyses, with higher levels of education associated with increasing environmental protective beliefs. Increased education correlated with an increased desire to reduce oil and gas exploration on federal lands, and with lower support for using coal for electrical generation. These results generally match earlier findings that higher levels of education are linked to greater environmental concern. Income on the other hand produced mixed results. Higher incomes have typically been associated with increased environmental concern, but in the analyses where income had a statistically significant relationship (using coal to generate electricity) higher income correlated with increased support for using coal as a source of energy.

Sex plays a strong explanatory role in our analyses, as it is a statistically significant predictor of seven of the eight dependent variables. This result corroborates findings in other research that females generally have greater environmental concern and greater concern about pollution risks. It also shows that females are more likely to want reductions in the use of coal and increased reliance on renewable energy sources. What this means for the coming decline of coal and the development of renewable energy is unknown. However, the effect of sex in determining attitudes toward energy choices is strong and consistent, and shows that an additional layer of polarization is occurring in our sample, beyond political orientation and rural residence, as females clearly view energy in substantially different ways than males.

However, while our analyses confirmed relationships of environmental concern, support of coal and the role of government with political orientation, the independent variables were much less predictive for support or opposition for renewable energy. Likely, our results are influenced by the overall high levels of support for renewable energy in our sample; the low levels of association between measures of wind and solar energy and socio-demographic indicators could in part be statistical anomalies, limited by the small number of respondents opposed to renewable energy technologies. This may have skewed our results and limited the potential to obtain more robust correlations. Or the lack of correlation could also be because we failed to include other socio-demographic measures that might have been better predictors. For example, our survey did not ask questions of race or ethnicity. Although race has not been found to be a strong predictor in environmental concern literature, the question remains as to the role race and ethnicity might play in regard to renewable energy attitudes.

Further our results are undoubtedly influenced by the limited interaction most of the respondents had with renewable energy. Utah had low levels of installed renewable energy capacity at the time of the survey. This likely limited the extent to which respondents had any first-hand experience with living near renewable energy installations. We expect that such limited experience may have had some influence on our results, because a common concern for opponents of wind energy is the visual impacts of the wind turbines.

**Conclusion**

Barring a major technological break-through in low-carbon energy production the growth of renewable energy is almost certain, with high growth rates pushing development throughout the country to communities that may or may not be excited to be host to these changes. As another presidential race exposes deep political polarization in the United States our results reinforce the observation that climate change, environmental protection and the role of the government have become highly partisan and politically divisive issues. While renewable energy appears to operate somewhat differently, the very conservative are clearly less supportive of renewable energy—hinting that the issue of our energy future is also at least somewhat politically polarized. This finding combined with the lower rural support for renewables and the strong support for coal from conservatives and rural residents suggests that as the switch to renewable energy continues to accelerate a rift could become deeper, at least in Utah.

As a response, renewable energy developers and policy makers should be aware that the communities likely to host renewable energy are not necessarily as bullish on renewable energy development as are the people and the places where the bulk of the energy will be used. With this in mind, communities that become sites for development should be duly compensated for the adverse local impacts that may occur, and first offered the jobs that come with these new developments. It should also be remembered that in communities losing a long-established coal identity and economy, raw feelings will undoubtedly accompany the large structural changes that will occur as the 100-year-old energy system makes a radical shift toward a more renewable future.

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# CHAPTER V

# LOCAL RESIDENTS' RESPONSES TO UTILITY-SCALE WIND POWER DEVELOPMENTS: A FIVE-COMMUNITY COMPARISON

## Introduction

Wind energy has been in a period of very rapid growth in the US, with utility-scale wind generated electricity increasing from 0.0001 billion kilowatt hours in 1988 to 140.88 billion kilowatt hours by the year 2012 (EIA 2015b). Growth rates are forecast to remain high into the foreseeable future, with wind capacity growing an additional 9.8 gigaWatts (GW) in 2015 alone. This sizable increase shows the relative importance of wind power: most new electric generation installed in 2015 will be in the form of wind power, comprising nearly half of the planned 20 GW of electric capacity expected to be installed (compared to 6.3 GW of natural gas and 2.2 GW of solar) (EIA 2015a).

This rapid growth pattern can be attributed to a variety of causes such as declining installation and turbine costs, increased production capacities of turbines, and favorable policies and subsidies. Wind power has notable advantages over most traditional sources of electrical generation, as it doesn't emit carbon dioxide or other pollutants such as toxic waste. Wind-generated electricity has predictable costs for future electrical generation, as production is not tied to fluctuating fuel costs. Another advantage is low cost, as technological innovations and subsidies have made wind one of the lowest-cost sources of new electrical production.

Wind, however, is not without problems, as development comes with environmental and social costs. Effects on wildlife and visual impacts are leading complaints for opponents. While wind is generally viewed by the public as a preferred source of generation, wind power installations are not universally embraced, and controversy is often encountered during the planning process. As wind power grows rapidly and expands to new communities around the country we can expect more contention to accompany its development.

In this paper we examine the results of a survey conducted in five communities located in the Intermountain West region that are near active or proposed wind energy installations. We explore why wind energy is valued in general but is often locally unwanted, and why some wind installations are developed without controversy whereas others are highly contentious. While we expect reaction to vary between individuals, we show that attitudes are also different at a community scale, and that public response to wind power is influenced by the community context, or the characteristics unique to each community, in which development takes place. Just as wind power development has both positive and negative impacts for the environment, wind energy offers both opportunities and threats for the communities in which it is developed. Our survey shows that each community recognizes both the opportunities and threats from wind power, but individual communities weigh threats and opportunities differently. In this paper we explore public attitudes toward wind energy, examine socio-demographic characteristics of proponents and opponents of wind energy, explore the impacts and benefits of wind development, and compare reactions to wind energy across five local community settings to illustrate how communities react in different ways to the opportunities and threats of wind development.

**Low Environmental and Social Impact,
But Not Benign**

Growth trajectories for wind energy can be attributed in part to innovation and advances in turbine technology and manufacturing. These advances have lowered costs and have meant that in areas with good wind resources, wind energy can be cost-effective and frequently cost-competitive with other forms of traditional and renewable electrical production (Wiser and Bolinger 2015).

While much of the growth can be attributed to economical electrical production, wind energy offers some notable noneconomic opportunities over many other forms of electric power production. A primary benefit of wind power, with the current recognition of the need to reduce carbon emissions, is that wind energy does not emit carbon dioxide. Wind power also does not emit other air pollutants such as sulfur dioxide, nitrous dioxide, or mercury or produce toxic or other waste streams. Reduced emissions of these pollutants are expected to save millions of dollars annually by lowering health care costs as the electric system is converted away from polluting fossil fuel electrical generation toward non-polluting sources like wind (Buonocore et al. 2015). These environmental and health benefits and the renewable nature of wind energy are often used as justifications for continued government subsidy of wind power (Ciocirlan 2008).

But even with these opportunities, wind energy still presents threats from its development; such as impacts to wildlife, electromagnetic interference and local climate change (Dai et al. 2015). Birds and bats are often killed by the spinning blades of turbines (Kunz et al. 2007; Smallwood 2007) that rotate at speeds over 80 meters per second (Dykes et al. 2014). Wind energy can impact wildlife in others ways, as it can exacerbate habitat loss when wind facilities are sited in previously undeveloped areas, or by fragmenting habitats with additional infrastructure upgrades of service roads and power lines necessary to connect wind turbines to the grid (Kuvlesky et al. 2007). However, even though wind energy is harmful to wildlife, traditional forms of industrial development and fossil-fuel based electric power production have a much larger toll on wildlife than wind power (Sovacool 2009).

In addition to impacts to wildlife, wind energy installations can change local climatic conditions as the wind turbines can alter prevailing wind patterns. One study of large wind farms in Texas showed substantial warming of the local area (0.72 degrees C per decade) around large wind farms (Zhou et al. 2012).

Wind energy development also presents a variety of local economic opportunities and threats, ranging from lease payments to participating landowners to a new tax base to creation of jobs for workers who install and maintain the facility. Wind developments can bring economic growth to areas near development, with potential for substantial new public revenues in the form of taxes levied on the value of the turbines. These tax revenues can be substantial for the initial years after development occurs, but usually decline as depreciation schedules rapidly reduce tax revenues. An alternative form of taxation of wind power that can create more stable revenue effects is a production tax credit. For example, the states of Wyoming and Minnesota impose a tax on each kilowatt of electricity produced (Minnesota Department of Revenue n.d.; Wyoming Department of Revenue n.d.), creating a steady long-term source of tax revenue that does not create a boom and bust tax situation for local governments. Besides taxes, wind energy can also provide economic growth in the form of jobs, especially notable during the construction phase of the project. However, much like the tax revenue based on the value of the turbines, employment effects are mostly short-term, with only a few long-term jobs required for facility maintenance and operation. These factors mean that the overall economic impact for a community from wind power is typically modest, and unlikely to have much influence on overall economic conditions unless the local area is economically disadvantaged or has a small economic base.

**Public Response to Renewable Energy**

The environmental and economic benefits outlined above are among the reasons a majority of individuals in the US and Europe are supportive of renewable energy (Wolsink 2007; Ansolabehere and Konisky 2014). US national opinion polls find wind is the most preferred source of electric power generation following solar power (Jacobe 2013), and most Americans support government mandates to encourage their development (Mills, Rabe, and Borick 2015). Majorities of the population support renewables even in states like Wyoming and Utah that depend heavily on and have strong cultural identities tied to extractive industries like coal mining and oil drilling. And majorities, even in western states (AZ, CO, MT, NM, UT, WY) that are typically wary of the federal government, desire continued government support of wind and solar energy (Colorado College State of the Rockies Project 2015). However, while wind energy is broadly supported in general, a shift often occurs when a wind energy development is proposed locally. Local opposition to development is a frequent occurrence (Warren et al. 2005; Phadke 2011).

This disconnect has been described as a 'social gap' between generally positive attitudes about wind energy and opposition to local developments that often limits wind energy development (Bell et al. 2005; Bell et al. 2013). Bell et al. posit that the social gap is a consequence of two factors, saying, "the evidence suggests that there are large numbers of qualified supporters and (some) place-protectors as well as a few unqualified opponents and, perhaps, some self-interested NIMBYs, who may all work together to oppose particular wind energy developments" (2013:130). Besides place-protecting explanations, issues of fairness in terms of siting processes and development impacts have also been offered as helping to account for this discrepancy, with public response mediated by whether or not the development process was viewed as fair to all involved (Haggett 2011).

We consider this social gap somewhat differently, based on ideas presented by Gramling and Freudenburg (1992), who showed that some people view potential changes from development as 'opportunities,' while others are more likely to concentrate on the consequences of development as 'threats.' We propose that because wind energy has both beneficial and negative consequences, recognition of both opportunities and threats can help to explain the variable levels of support or opposition exhibited within and across communities that experience wind energy development.

A variety of factors that can be identified as opportunities and threats have been linked to public perceptions of wind energy, but often these factors are found to be important in one study and not in another and sometimes they appear to play conflicting roles. Low environmental impact is one such opportunity that has been found to increase the public's support ( Smith and Klick 2007; Ansolabehere and Konisky 2012; Jacquet and Stedman 2013), yet fears of environmental harm have also been found to influence attitudes, with wind energy's impacts on wildlife a common concern expressed by opponents (Rose 2014).

Similarly, the belief that wind energy development is an opportunity to increase the local tax base, create jobs, produce new income opportunities, or support rural lifestyles (Brannstrom, Jepson, and Persons 2011; Slattery et al. 2012) is by no means universal, and some studies have produced conflicting results (Groth and Vogt 2014). The importance of economic development potential as a driver of public response is further complicated by variations in local economic contexts. Economically disadvantaged or stigmatized communities are more likely to see wind power as an opportunity for economic development (van der Horst 2007; Toke, Breukers, and Wolsink 2008). Economic context is not only related to levels of economic opportunities but also to the types of industries on which the community relies; for example, communities that have tourism-based economies, high proportions of seasonal residents, and retirement populations may be less accepting of wind energy (Fast and Mabee 2015).

Similarly, fears that wind energy development represents an economic threat by potentially lowering residential property values can influence attitudes toward wind (Gulden 2012), although this fear might be misplaced as lowered property values for communities and residences near wind facilities have not been documented (Hoen et al. 2009). Another economic issue shown to influence attitudes toward wind energy relates to whether the economic benefits brought by wind are viewed as being shared fairly by the entire community rather than benefiting only a few (Bolinger et al. 2004). But even the fairness of the shared community economic benefits (such as payments from wind developers to build communal resources like recreation centers) have been questioned, as some may consider them to be little more than bribes paid to a community to accept impacts caused by wind energy (Cass, Walker, and Devine-Wright 2010).

The most commonly cited complaint about wind energy is its visual impact, and visual impact has been shown to exert a substantial influence on attitudes toward wind energy (Wüstenhagen, Wolsink, and Bürer 2007). Little can be done to ameliorate visual impacts, as tall turbine heights and the need for unobstructed access to winds means turbines are necessarily visible from long distances, on clear days as far as 30 km (Bishop 2002). The subjective nature of visual impact makes this a particularly difficult issue to resolve, because while some people may view wind energy as beautiful and a symbol of progress (Johansson and Laike 2007; Slattery et al. 2012) others see wind development as ugly and disruptive of the natural environment (Thayer and Freeman 1987). Others may see the visual impact of wind as an industrialization or commoditization of nature (Gulden 2012) or another form of exploitation of the periphery by the core, with rural areas impacted for the benefit of the urban areas ( Pasqualetti 2000; Ottinger 2013). Negative aesthetics of wind energy are also a recognized concern even among supporters of wind, though supporters will tend to believe that visual impacts are overridden by the benefits of job opportunities, energy independence, and lower electricity rates (Firestone and Kempton 2007). The subjective nature of visual impact along with landscape variability and the importance people place on specific views and places additionally complicate the ways in which visual impact influences attitudes toward wind energy (Devine-Wright 2009). For example, if a place is valued for environmental or natural benefits, people often view the wind turbines as larger and less acceptable, while residents who view the site as appropriate for development and representing opportunities for economic growth see the development matching the place, and consider the development as more acceptable (Devine-Wright and Howes 2010). Perceptions that the planning process was conducted fairly (Wolsink 2007), with an opportunity for the public to voice concerns and offered adequate information about the development, are also suggested as an important component of the public's attitudes towards wind energy (Gross 2007).

We see that having wind installations that do not match perceptions of what is "appropriate" development as an explanation for the social gap. Those who see wind energy as an 'opportunity' typically consider it as a source of green or clean energy or as a source of economic development; while those who view wind energy as a 'threat' usually focus their concerns on aesthetics (Pasqualetti, Gipe, and Righter 2002), impacts to wildlife, or decreasing adjacent property values (Jobert, Laborgne, and Mimler 2007). No doubt, the positive and negative effects that result from wind energy development help account for the conflicting results offered by public opinion research on wind energy development. We attempt to make sense of these muddled findings by exploring how differing local contexts might influence how communities focus in differing ways on opportunities or threats related to wind energy development. Recognizing the role community context plays can help us to understand the many factors that influence public opinion about such facilities and why response has been so variable in previous literature.

**Goals of the Study**

While a number of studies have explored how attitudes are connected to the opportunities and threats wind power development brings (for example: Ansolabehere and Konisky 2012; Slattery et al. 2012; Bidwell 2013; Groth and Vogt 2014; Van Rijnsoever and Farla 2014), fewer studies have considered how the community context in which wind development occurs might also influence attitudes towards wind power. The community context, for the purpose of this chapter, involves the many factors that make the setting for each renewable energy develop unique. These contextual differences are varied and many, such as the trajectories of local history, a community's economic opportunities and dependencies, the nature of physical geographies, or differences that may arise with respect to the public's awareness about and engagement in the development process. While such differences cannot be directly measured using survey data, a qualitative familiarity with such distinctions across study settings can help to illuminate the possible ways in which community context might help to account for differential responses across particular development situations.

Our goal in this study is to explore the similarities and differences in attitudes and beliefs about wind power development by comparing survey results from five communities where utility-scale wind power has been developed or is in advanced stages of pre-development planning and likely to be installed. This allows for comparison so we can assess the extent to which differing levels of support for such facilities might be linked to community-level phenomena, including differences in local socio-demographic composition. The comparison also allows us to explore how attitudes are correlated with the belief that wind energy represents either a source of opportunity or a threat. We can explore how communities come to develop differing views about the opportunities and threats of a local wind energy development and if these views are different or similar across communities. While attitudes toward wind energy are highly variable between individuals, our research helps to examine the ways that localized contexts in which development takes place can influence response to wind energy at the community level.

**Study Approach—2014 Five-Community Survey**

To examine differences in attitudes toward wind energy we selected five communities in Utah, Idaho, and Wyoming that were located near existing utility-scale wind developments (the communities of eastern Idaho Falls, Idaho, and Milford, Utah) or near proposed sites in advanced stages of planning for wind development (the towns of Saratoga and Rawlins, Wyoming, and Monticello, Utah) (see appendices F and G). Two hundred and fifty households were randomly selected from public utility records or municipal property lists from each of the five communities (1,250 total), with additional addresses for replacing vacant or erroneous addresses also selected randomly. To increase response rates and minimize non-coverage error (Steele et al. 2001) we used drop-off/pick-up survey administration procedures to contact selected households and request participation in the study. To further randomize the selection of respondents within the sampled households we asked the adult member of the household with the most recent birthday to complete the self-administered survey questionnaire. The survey was conducted between May and August, 2014. Survey response rates ranged from 64% in Rawlins to 79% in Monticello; in total 906 questionnaires were returned completed for an overall response rate of 72.8% averaged across the five communities. See Appendix B for information on differences in the socio-demographic characteristics of respondents across the five study areas.

**Five Distinct Study Settings**

*Eastern Idaho Falls, Idaho*: The sampled area, located on the eastern most rural-urban fringe of the Idaho Falls metropolitan area (pop. 136,108 in 2010 census), included the small towns of Iona and Ammon and surrounding areas of unincorporated Bonneville county. The Idaho Falls metro area has in recent years been characterized by a rapidly growing population and an expanding economy, with substantial 'high-tech/scientific' employment at the Idaho National Engineering Lab. Four nearby and highly visible wind facilities (215 total turbines) are sited on private lands along a ridgeline located immediately to the east of the study area.

*Milford, Utah* is a predominantly Mormon rural community located far from a major metropolitan area (230 miles from Salt Lake City; pop. 1,420 in 2010). It has a small, stable, mostly agricultural and natural resource based economy. Milford has for years exhibited slow population growth and little economic growth. However, Milford is the home of Utah's largest wind farm (165 turbines), sited on a mixed public/private land area 10 miles to the north in a low-lying desert landscape.

*Monticello, Utah* is also a remotely located and predominantly Mormon community (288 miles from Salt Lake City; pop. 1,958 in 2010) with a legacy of resource dependency. Monticello has experienced substantial economic stagnation following the collapse of uranium mining/milling in the 1960s, and many area residents have experienced long-term health effects from uranium mining (Malin 2015). Many residents commute 50 miles (one-way) for service jobs in the tourism-dependent economy of Moab, Utah. Three companies have proposed wind power projects near Monticello, with the closest of these located less than one mile from the center of town (Hollenhorst 2012)[3].

*Rawlins, Wyoming* is a remote, small urban community located in southern Wyoming (149 miles from Cheyenne; pop. 9,259 in 2010). The community is familiar with energy development, serving for many years as a regional center for processing and shipping of oil, gas and coal. The nearby town of Sinclair (6 miles west of Rawlins) is home to a large oil refinery. Rawlins is also near the proposed site of what would become the nation's largest wind facility, the proposed Sierra-Madre/Chokecherry wind farm (total 1,000 turbines). This project, which was in final permitting stages at the time of data collection, is sited on a 'checkerboard' of public/private ranchland 3-4 miles located to the south of Rawlins.[4]

*Saratoga, Wyoming,* is also a remotely located rural town (130 miles from Cheyenne; pop. 1,690 in 2010), known as a 'high-amenity' tourist and retirement destination because of its scenic setting near mountains and within an expansive sage-brush steppe. The economy has been transitioning away from a mostly ranching economy to one based in tourism, centered around the high-quality hunting and fishing opportunities of the area. Saratoga is located at the eastern edge of the proposed Sierra-Madre/Chokecherry wind farm, which would extend into an area approximately 10 miles northwest of town.

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[3] Construction of that closest wind power facility commenced in late 2015
[4] Construction of the first phase of this project, involving a total of 500 turbines, was approved by the USDI-Bureau of Land Management in January 2017.

Our study areas were selected because of their proximity to wind energy development, but also because they share a few similarities and a few key differences selected to help test the factors that have been identified in earlier research as being important influences on attitudes about wind power development. First, residents of all communities were presumed to have substantial familiarity with wind energy given local experiences with nearby wind energy development. Given the average American's low knowledge about energy issues (The National Environmental Education and Training Foundation 2002) it was thought to be important for respondents to have been at least introduced to the idea of wind power so they were more likely to have developed opinions about the technology. Full understanding about the technology is not a prerequisite for having attitudes about wind energy, but familiarity about local wind energy development was expected to help increase salience of the survey and to potentially increase response rates. While those living in three of the surveyed communities had not yet experienced living near operating wind energy projects, the development proposals had been discussed frequently in local news media, and wind developers and government agencies had conducted outreach and public involvement sessions. Anecdotal evidence in the form of conversations with residents showed that while not all residents were aware of all of the details, most were well aware of plans to develop wind energy near their community.

One substantial difference between communities is the local area population size, which ranges from very small and remote (like Monticello, Saratoga and Milford) to the medium-sized community of Rawlins to the much larger population of the Idaho Falls area. Difference in population size was not a selection criteria but it is related to another key difference expected to play a role in attitudes about wind energy—the communities' economic character and the local availability of economic opportunities. Economically disadvantaged communities are more likely to see wind power as an opportunity for economic development (van der Horst 2007; Toke, Breukers, and Wolsink 2008), while communities dependent on tourists or with large numbers of seasonal residents or retirement populations are expected to be less accepting of wind energy (Fast and Mabee 2015).

**Analysis**

In order to explore the factors influencing public attitudes about wind energy in our surveyed communities we asked questions about beliefs regarding the costs/benefits of wind energy, and other factors identified in earlier research shown to influence public attitudes about wind energy. These factors are: belief that wind energy is 'green,' that wind energy causes a negative visual impact, is a harm to wildlife, provides economic benefits, causes property value declines, and that residents had a voice during the planning process and received adequate information about the development. Although these are all issues identified in other research as having an important influence on attitudes toward wind energy, as discussed above they have been shown to exert mixed or conflicting effects across various studies. In our analysis we examine how these may relate to the dependent variable (support or opposition to the local wind power development), and how these factors may be mediated by community context. We also control for respondent socio-demographic characteristics.

To measure the above factors we used the combined results of the five-community survey with relevant questions used to create summated measurement scales (For the complete questionnaire and notes on development see Appendices F and G). Respondents were able to rate their level of agreement to a series of questions about utility-scale wind energy development in general, and about the proposed or existing wind development in the nearby area. Utility-scale wind energy development was defined as a wind farm with at least 100 250-foot tall towers.

Our response categories were Likert scales with either five or six response choices. The choices were “strongly oppose,” “somewhat oppose,” “neutral,” “somewhat support,” and “strongly support.” The sixth response choice, if offered, was “don’t know,” and the limited number of responses for this category were removed from analysis. Responses indicating negative views about wind energy impacts were coded with a one, and those indicating strong agreement that wind energy had positive attributes were coded with a five; response scales were reverse coded if needed to insure directional consistency of scale values. We included 19 independent variables in our analysis, as follows:

*Is wind energy a source of green energy?*—To test the influence of the belief that wind energy is environmentally friendly or ‘green’ we created a summated scale of four questions asking level of agreement that utility-scale wind energy: “Is a safe energy source,” “Is a clean energy source,” “Results in no greenhouse gas emissions,” and “Is a renewable resource.” The Cronbach’s Alpha test of internal reliability produced an alpha of 0.837, well above the 0.7 level commonly used as benchmark for assessing the internal reliability of a summated scale (Spector 1992). The scale has a range from 4–20.

*Does wind energy cause harm to wildlife?*—To assess the level of agreement that wind energy harm causes harm to wildlife we used responses to a single question: "Do you agree or disagree with the following statements about utility-scale wind power? Is a danger to wildlife."

*Does wind energy cause a visual impact?*—To measure beliefs that wind energy creates a visual impact we created a summated scale of two questions: "Wind power is an unattractive feature of the landscape," and the reverse coded question, "Adds an interesting feature to the landscape." This scale had a Cronbach's Alpha of 0.802, with a range from 2–10.

*Does wind energy create economic benefits?*—To measure attitudes that wind energy is a source of economic development we created a summated scale of two questions asking respondent's level of agreement that wind energy "Provides economic benefit to the local area," and "Creates new job opportunities for local residents." The scale exhibited high internal reliability, with a Cronbach's Alpha of 0.899 and a range from 2–10.

*Does wind energy impact property values?*— To measure beliefs that wind energy has effects on property values we used a single question asking residents to indicate their level of agreement that utility-scale wind energy "Causes a decline in nearby property values."

*Did you have an opportunity to voice concerns?*—Opportunity for residents to have a voice in the planning and decision-making process was measured using the question "To what extent do you agree or disagree that you have had adequate opportunity to participate in public meetings or other parts of the planning process for the wind power facilities [proposed/that has occurred] near your community?"

*Was adequate information provided about the wind energy project?*—To measure if respondents felt they were informed about nearby wind power development we used a single question that asked: "To what extent do you agree or disagree that you received adequate information about the wind power development near your community [before it was built/during the pre-construction planning period]?"

We also included in our model eight control variables that have been identified in prior research as having important association with environmental beliefs and attitudes about environmental protection (Jones and Dunlap 1992). While attitudes about renewable energy may be influenced by different factors than those associated with general environmental attitudes, the important connections between renewable energy and environmental quality suggests that many if not most of the socio-demographic factors identified in the environmental concern literature may also be related to attitudes about renewable energy.

Accordingly, we controlled in the analysis for respondents' sex, age, education, length of residence, the presence of children in the home, political orientation, religious identity, and income. The control variables and assigned values to each category are as follows:

*Sex*—Male = 1, Female = 0

*Age*—was measured by asking the year the respondent was born, and then subtracted from the year 2014.

*Education*—was measured by asking for the highest level of education completed, with the response choices: 1 = some high school; 2 = high school graduate/GED; 3 = some college or associate's degree, 4 = college graduate bachelor's degree; and 5 = post graduate degree (Master's/PhD).

*Length of residence*—was measured with response choices to the question: "How long have you lived in this community?" 1 = less than one year; 2 = one to two years; 3 = between two and five years; 4 = between six and ten years and 5 = more than ten years.

*Children present in home*—was measured with the responses to the question: "are any of those currently living in your household under the age of 18?"; responses were coded yes = 1 and no = 0.

*Political orientation*—was measured by asking respondents to describe their political views with the following response categories: 5 = very conservative; 4 = moderately conservative; 3 = moderate; 2 = moderately liberal; 1 = very liberal.

*Religious identity*—was measured by asking respondents their religious affiliation (if any); the four most common response choices (Catholic, Protestant, Latter-Day Saint, and None) were used as dummy variables with no religion (none) selected as the reference category.

*Income*—was measured by asking respondents to report total household pre-tax annual income across 8 response categories: 1 = $0-24,999; 2 = $25,000-49,999; 3 = $50,000-74,999; 4 = $75,000-99,999; 5 = $100,000-124,999; 6 = $125,000-149,999; 7 = $150,000-199,999; and 8 = $200,000 or more.

*Community*—Cross-community variation was assessed by treating residence in each of the study communities as a dummy variable. Milford, Utah was selected as the reference category, because the very high levels of support for wind energy in this community aided in the interpretation of the findings.

*Wind power support/opposition*—The key dependent variable for our logistic regression analysis is the response to this question; "If given the choice, would you vote [have voted] for or against the development of wind power near your community?" This variable was selected because it succinctly captures overall sentiment regarding wind power development that has occurred or has been proposed near each of the study areas. Overall, a strong majority of survey respondents expressed support for wind energy, with a combined total of 71% in favor and 29% opposed. However, as indicated in Figure 1, there is significant variation in response across the five communities, with expression of support ranging from 85% voting in favor of the development in Milford, Utah, to less than a majority (48%) saying they would have voted for wind energy in eastern Idaho Falls.

**Considerable Cross-Community Variability**

Substantial differences in attitudes about the opportunities and threats of wind energy were observed in a cross-community comparison. Here, we examine response distributions to measures of threats and opportunities that accompany wind energy development, with focus on cross-community variations (see charts C1–C7 in Appendix C).

*Belief that wind power is a danger to wildlife*—Both Milford and Monticello stand apart as communities in which residents are least likely to view wind as very

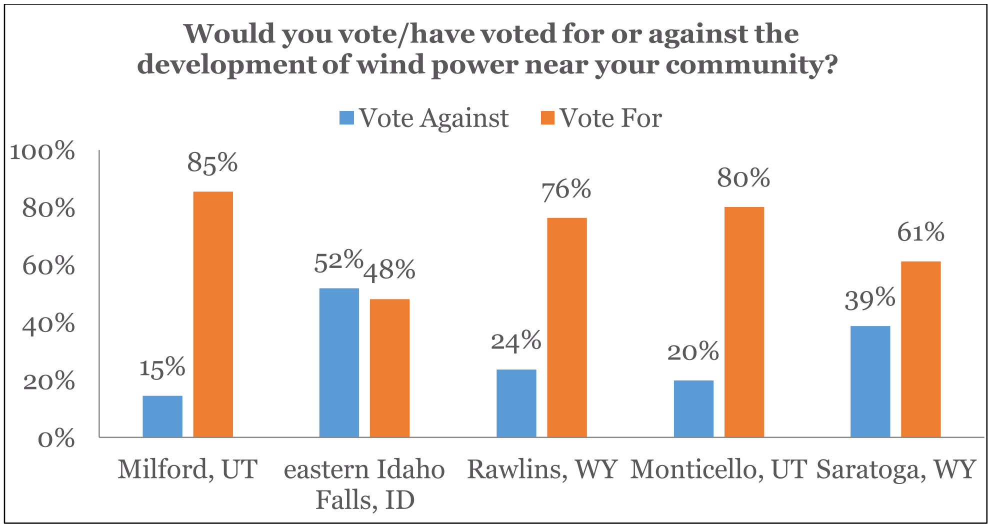


**Figure 1.** Response by community to hypothetical vote for local wind energy project.

dangerous to wildlife. In contrast, Saratoga and Rawlins are communities with a much higher percentage of respondents who believe wind is impactful to wildlife. Residents of the eastern Idaho Falls study area are much more evenly distributed across response categories.

*Does wind power cause a decline in nearby property values?*—Milford is the outlier in regard to this measure, with respondents most likely to select the strongly disagree response option, although residents of Monticello were also more likely to strongly disagree that wind development causes a decline in property values. Concerns that wind energy will cause (or did cause) property value declines are considerably higher in eastern Idaho Falls and in Saratoga than in any of the other study areas.

*Belief that wind power is visually impactful*—Residents of Saratoga and eastern Idaho Falls were much more likely than those living elsewhere to view wind as visually impactful, with nearly half of respondents strongly agreeing that wind power development has negative visual effects. In contrast, 63% of Milford residents indicated that they somewhat or strongly disagreed with the statement. Residents of Monticello and Rawlins fell between these extremes, with 48% and 45% of respondents respectively saying they somewhat or strongly disagreed with the statement. Overall, the response distributions reveal a pattern of either strong disagreement or strong agreement, with few responses falling into the neutral category for any of the study communities.

*Belief that wind power brings local economic benefits—* Most residents living in all of the study areas, other than eastern Idaho Falls, tended to believe that wind power is a local economic benefit, with majorities of those living in Rawlins (79%), Milford (68%), Monticello (66%) and Saratoga (63%) selecting either the somewhat agree or strongly agree response categories. In sharp contrast, nearly half (46%) of respondents from eastern Idaho Falls expressed some level of disagreement with the statement.

*Belief that wind power is "clean and green"—* Belief that wind power is a "clean and green" source of electricity is generally agreed upon across the study sites. Most communities are in high agreement with the statement, and no community stands apart in the belief that wind energy is not clean and green. Even residents of the eastern Idaho Falls study area are in general agreement that wind energy is "clean and green." Milford and Saratoga exhibited notably high agreement, with 44% of respondents in Milford and 42% of Saratoga respondents in complete agreement that wind power is a source of clean energy.

*Levels of agreement that adequate opportunities were provided to participate in the planning process—*Responses to the question about adequate opportunities to participate in planning were mixed, without clear tendencies regarding agreement or disagreement across most of the study communities. One exception was eastern Idaho

Falls, where a majority of respondents (59%) indicated that the opportunities for such participation had been inadequate. In contrast, a majority of respondents in Saratoga (57%) responded in agreement that adequate opportunities to participate were available.

*Levels of agreement that adequate information about nearby wind power development was provided*—In general, the distribution of responses to this measure is close to a normal bell curve for four of the study areas. The exception is eastern Idaho Falls, where a much higher percentage of respondents expressed strong disagreement that they had been provided with adequate information about wind power development projects prior to facility construction.

Overall, these response distributions for measures addressing the threats and opportunities of wind energy development suggest that residents of the different communities weigh the consequences and benefits of wind energy development differently. Even in the case of communities located near to the same wind farm (as in Saratoga and Rawlins), such projects maybe viewed quite differently. Whereas residents of some communities are more likely to see wind power as an eyesore, a threat to wildlife, or a cause of declines in property values, those living in other communities are more likely to view wind energy development as a source of green energy, or as a source of newly-created jobs or other economic benefits.

### *Regression Analysis Examining the Role of Community Context*

To further explore if the different ways communities weigh threats and opportunities are a result of distinctive local contexts or if they are instead a result of socio-demographic composition differences, we first conducted a series of multivariate regression analyses for which each of the opportunities/threats identified in the variables measurement section was treated as a dependent variable, with the socio-demographic (compositional) variables and the community dummy variables included as independent variables.

Table 4 shows the results of these regressions. Overall the results support the hypothesis that community context is an important component in determining residents' reactions to wind power, and that demographic traits, with the exception of political orientation, are not consistent predictors of beliefs that wind energy is viewed as either a threat or an opportunity.

*Clean and Green Scale*—Sex and political orientation are the only statistically significant socio-demographic predictors in the regression of the clean and green scale, with men and liberals more likely to view the technology as clean and green. But the community variable is also an important correlate with the clean and green scale, as three of the communities (eastern Idaho Falls, Rawlins, and Saratoga) exhibited statistically significantly different response tendencies, viewing wind energy as more clean and green, when compared with response patterns from the reference community, Milford.

*Economic Benefit Scale*—Overall, the socio-demographic indicators do not correlate very strongly with the economic benefit scale. Only political orientation exhibited a statistically significant relationship, with conservatives less likely to agree that wind energy creates local economic benefits. Views regarding economic benefits were also generally similar across the study areas, with community of residence a significant predictor only in the case of eastern Idaho Falls, where residents were less

**Table 4.** Seven opportunity-threat beliefs regarding wind energy development regressed on respondents' socio-demographic characteristics and community of residence.

| | | Clean and Green Scale | Economic Benefit Scale | Visual Impact Scale | Harmful to Wildlife | Effects Property Values | Opportunity to participate in planning | Availability of information during planning |
|---|---|---|---|---|---|---|---|---|
| Socio-demographic | Sex | .079* | .026 | -.025 | .028 | .023 | .032 | .026 |
| | Education | -.032 | .075 | -.036 | -.130*** | -.050 | -.036 | .046 |
| | Length of residence | .048 | .056 | -.088* | -.064 | -.078 | -.083* | -.033 |
| | Political orientation | -.120** | -.107** | -.144*** | .106** | .134*** | -.096* | -.100** |
| | Household income | .077 | -.006 | -.130*** | -.007 | -.053 | -.007 | -.022 |
| | Age | -.016 | .075 | -.089* | -.005 | -.061 | -.077 | -.074 |
| | Children | .005 | -.056 | .059 | .030 | .036 | .008 | .012 |
| Religious Affiliation (Reference None) | Catholic | .050 | .069 | -.011 | .029 | .013 | .030 | .007 |
| | Protestant | .042 | -.056 | -.004 | -.036 | .020 | .024 | .025 |
| | LDS | .005 | -.026 | .061 | .177*** | .076 | -.058 | -.052 |
| Community (Reference Milford, UT) | Monticello, UT | .029 | .016 | -.119** | -.007 | -.159*** | .053 | .168*** |
| | eastern Idaho Falls, ID | .145** | -.247*** | -.288*** | -.204*** | -.253*** | .185*** | .312*** |
| | Rawlins, WY | .159*** | -.064 | -.121** | -.223*** | -.108* | -.037 | .073 |
| | Saratoga, WY | .188*** | .077 | -.264*** | -.247*** | -.276*** | -.082 | .071 |
| *N* | | *670* | *716* | *752* | *737* | *633* | *763* | *760* |
| R Square | | .085 | .125 | .184 | .187 | .126 | .07 | .096 |

Standardized regression coefficients reported. *p<.05; **p<.01; ***p<.001

likely to think wind power is a source of local economic benefits as compared to the response patterns observed in Milford.

*Visual Impact Scale*—More socio-demographic indicators correlate with the belief that wind energy causes negative visual impacts than was the case for any of the other opportunity/threat factors. Longer length of residence, conservative political orientation, higher household income and older age all are statistically significant predictors of the belief that wind power is a visual intrusion. The "community" effect is also statistically significant for all communities, suggesting that residence in each of the four listed communities increases the likelihood that wind is viewed as more visually unacceptable as compared to Milford, Utah. The regression produced a relatively robust R-square value (0.184), indicating that for visual impact a meaningful share of variance can be explained by community of residence and several socio-demographic factors.

*Harmful to wildlife*—Belief that wind energy is harmful to wildlife is correlated with a somewhat different set of factors, with increased education, conservative political orientation, and LDS affiliation all exhibiting statistically significant relationships with the belief that wind energy is harmful. Residence in three of the four communities is also a significant factor influencing the belief that wind is harmful to wildlife. The R-square of 0.187 shows that in combination these variables account for nearly 19% of the variance in belief that wind energy impacts wildlife.

*Impacts on property values*—Conservative political orientation is the only socio-demographic factor that is a statistically significant predictor of the belief that wind energy development has a negative effect on local property values. In addition, each of the four community dummy variables is statistically significant, indicating that residents of these areas are more likely than residents of Milford (the reference category) to believe that wind energy has a negative effect on property values.

*Opportunity to participate in planning*—Belief that there was adequate opportunity to participate during the planning process for wind power development is related at statistically significant levels with length of residence, political orientation and residence in the eastern Idaho Falls study area. Living in a community longer, a conservative political orientation, and residence in eastern Idaho Falls all correspond to lower levels of agreement that adequate opportunity to participate in the planning process had occurred. However, an R-square of 0.07, the lowest obtained for the various regressions, suggests that the socio-demographic and community of residence variables are not particularly effective in explaining variance in residents' attitudes about opportunity to participate in the planning process.

*Availability of information during planning*—Residence in eastern Idaho Falls and Monticello, as well as conservative political orientation, are the only statistically significant predictors of beliefs regarding the adequacy of information about wind development during the planning process.

Overall, these results reveal that relationships between socio-demographic factors and attitudes about the threats and opportunities related to wind development are mixed and inconsistent. Sex, education, age, household income, and LDS affiliation are each significant only once across the seven different analyses presented in Table 4. Length of residence is found to be a statistically significant predictor in two of the regressions. Having children in the home is not significantly correlated in any of the regressions.

However, political orientation is a significant predictor of beliefs about opportunities and threats of wind energy in each of the regressions. Across each of the dependent variables liberals are more likely to view wind as an opportunity, and conservatives to view wind as a threat. The beta values indicate that conservatives are less likely to view wind as source of green and clean energy or as creating local economic benefits. Instead, they tend to concentrate on the threats of wind energy development, seeing wind as impacting wildlife and views, causing property value declines, and proceeding without adequate information about the development or adequate opportunity to participate in the planning process. This suggests that wind energy has to some extent become co-opted by politics and is a culturally divisive issue, similar to how environmental issues in general have become polarized politically (McCright and Dunlap 2011). But while attitudes about wind energy development show political polarization we see an indication that wind energy operates differently than other polarized issues, because attitudes towards wind energy are skewed in favor (in total 71% of our sample voted for wind energy). Despite apparent political polarization of this issue majorities support wind development in all of the surveyed communities except eastern Idaho Falls, indicating that this issue does not resonate in the same way as other more politicized issue like climate change. Still, it is noteworthy that political orientation is the most consistent compositional predictor of whether or not wind energy is viewed as a threat or an opportunity.

The next most consistent predictor is the community variable, with residence in the eastern Idaho Falls study area a statistically significant predictor across all of the regressions. Although the community dummy variables representing residence in other locations were not statistically significant in every analysis or with each community, all of the other communities showed at least some significant differences relative to the reference community of Milford, Utah.

Residents in eastern Idaho Falls, Monticello, Rawlins and Saratoga generally view wind as being more visually impactful than was the case for respondents living in Milford, and are more likely to believe that wind energy development leads to decreased property values. Belief that wind energy is a clean and green energy source and belief that wildlife is impacted varied significantly across three of these four communities. And the residents of Monticello and eastern Idaho Falls are significantly more likely to believe that not enough information was offered during the planning process.

Importantly, the regressions show that the varied reaction to wind energy development is not a result of socio-demographic compositional differences across these communities, since very few of the relationships involving socio-demographic characteristics are significant. Rather, the results indicate that residents of the different communities see the threats and opportunities related to wind development differently, as the community variable is frequently a significant explanatory factor.

### *Logistic Regression of Examining the Role of Community Context*

To further explore the role community context plays in influencing attitudes toward wind power we include the full set of the socio-demographic, opportunity-threat beliefs, and community variables as independent variables in a logistic regression to predict responses to the "vote yes/vote no to local wind development" measure. This analytic approach will help us to determine whether the community variable is influencing response to the voting behavior measure independent of beliefs about threats or opportunities, or whether when controlling for the variety of opportunity-threat attitudes the community variable loses significance.

Table 5 shows that of the socio-demographic variables only political orientation and Catholic religious affiliation are statistically significant predictors of the vote for/vote against measure. Among the measures of beliefs about the threats and opportunities of wind power development visual impact, wildlife impacts, clean and green energy, and local economic benefits exhibit statistically significant relationships. Beliefs about property value impacts, opportunities to participate, and provision of adequate information were not significant predictors of support or opposition. For the community variable, only eastern Idaho Falls emerged as being different at a statistically significant level from Milford, but that relationship involved the largest effect size of any of the independent variables.

This analysis shows that support or opposition to wind energy is strongly influenced by whether or not wind energy is perceived as a threat or an opportunity. The results outlined in Table 5 show that most of the factors identified in earlier research as influencing attitudes toward wind energy do exhibit statistically significant relationships with the voting behavior measure. Beliefs that wind energy is a source of clean and green energy and that it provides economic opportunities were associated with increased likelihood of voting for wind power development, while beliefs that wind causes visual and wildlife impacts were predictive of a lower likelihood of being in favor. Fear that property values will decline had a similar negative relationship that approaches statistical significance. This again shows the importance of how beliefs about threats and

**Table 5.** Logistic regression of "vote for/against" wind power development on socio-demographic characteristics, beliefs about opportunities & threats, and community.

| | B | S.E. | Sig. | Exp. (B) |
|---|---|---|---|---|
| Socio-demographic (compositional) variables | | | | |
| Respondent age | 0.003 | 0.013 | 0.792 | 1.003 |
| Respondent sex | -0.168 | 0.357 | 0.639 | 0.846 |
| Respondent education | -0.342 | 0.192 | 0.075 | 0.71 |
| Length of residence | 0.23 | 0.159 | 0.149 | 1.259 |
| Children living in home | 0.599 | 0.409 | 0.143 | 1.821 |
| Household income | -0.169 | 0.111 | 0.128 | 0.845 |
| Religious identity (None as reference) | | | | |
| Latter-Day Saint (Mormon) | 0.207 | 0.526 | 0.695 | 1.23 |
| Catholic | 1.833** | 0.607 | 0.003 | 6.253 |
| Protestant | 0.542 | 0.519 | 0.695 | 1.23 |
| Political orientation (liberal-conservative) | 0.581** | 0.214 | 0.007 | 1.787 |
| Attitudes/beliefs about wind power development | | | | |
| Visual impacts | -0.571*** | 0.102 | 0.000 | 0.565 |
| Wildlife impacts | -0.865*** | 0.180 | 0.000 | 0.421 |
| Property value impacts | -0.336 | 0.186 | 0.071 | 0.715 |
| "Clean/green" energy source | -0.150** | 0.056 | 0.008 | 0.861 |
| Local economic benefits | -0.424*** | 0.084 | 0.000 | 0.654 |
| Opportunity to participate in planning | 0.190 | 0.222 | 0.393 | 1.209 |
| Adequacy of information | -0.030 | 0.213 | 0.889 | 0.971 |
| Community – Milford (Beaver County) as reference | | | | |
| Monticello (San Juan County) | 0.963 | 0.628 | 0.125 | 2.621 |
| Eastern Idaho Falls (Bonneville County) | 1.973*** | 0.608 | 0.001 | 7.191 |
| Rawlins (Carbon County) | -0.650 | 0.721 | 0.367 | 0.522 |
| Saratoga (Carbon County) | 0.615 | 0.663 | 0.354 | 1.849 |

-2 Log likelihood = 245.43 Cox & Snell R2 = .536 Nagelkerke R2 = .703 *p<.05; **p<.01; ***p<.001

opportunities from wind energy can influence levels of support for or opposition to local project siting. Our results reinforce results of most previous research regarding factors thought to influence opposition or support for wind energy, with the exception of issues regarding access to information and opportunity to engage the planning process. For our sample, planning and information opportunities (or a lack thereof) do not exhibit statistically significant relationships with response to the voting measure.

The logistic regression results also show that when controlling for the different ways people weigh the threats and opportunities of wind energy development the community variable becomes a less important factor in accounting for support or opposition. This is an important finding because it shows that residents of these communities are not forming attitudes about wind energy independent of beliefs about threats and opportunities, but instead are weighing their possible support for such facilities based on whether they are expected to provide benefits or cause impacts.

However, the results for eastern Idaho Falls clearly stand apart from what seems to be occurring in the other study areas. Even after controlling for views about the threats and opportunities, residence in eastern Idaho Falls is the single most significant predictor of opposition to wind development. This result is not entirely unexpected, as the effect of eastern Idaho Falls on attitudes was also identified as an important factor in the earlier regression results involving the various opportunity/threat measures as dependent variables. Local opponents to wind energy developments east of Idaho Falls have been loud and vocal, and this is the only community with a majority of residents opposed to the development. It is also the only study community where there has been an active and visible public campaign against wind energy.

We can offer no explanation for why Catholics in our sample are 6.25 times more likely than those reporting no religious identity to say they would vote against wind energy, or why the effect of Catholicism had no statistical significance in the earlier regression tests analyzing other dependent variables. Besides the Catholic conundrum, the other results are more in line with the previous results in the regression tables. Political orientation again shows that the wind energy issue has become politicized, with those who are very conservative 1.78 times more likely to indicate they would vote against local development than those who identify as very liberal. Again this shows that the debate over renewable energy has become a partisan issue, and that polarization extends through this issue to a local level.

**Conclusion**

Our study shows that opposition or support for wind energy is influenced by how opportunities and threats are weighed, and that not all people or communities weigh opportunities and threats in the same way. The threats and opportunities related to wind energy development are important determinants of support or opposition to wind energy, but the relative importance of those factors is not consistent across communities.

For instance, beliefs that wind energy offers certain benefits do not necessarily signal acceptance of wind energy development. For example, Saratoga residents expressed very high agreement that wind energy is a green and clean energy source (79% were in high or complete agreement that wind energy is clean and green, only second to Milford's 83% agreement). However, the recognition of the green benefits do not override other concerns among Saratoga residents, as they also were more likely than residents of Milford, Monticello and Rawlins to say they would vote against local wind power development. This is important because it shows us that support and opposition to wind power is influenced by a suite of factors, the importance of which is relative to the concerns of the local population. For another example, belief that wind energy is a threat to wildlife has an odds ratio of 0.421 in our logistic regression, meaning respondents who believe that such impact will occur are about half as likely to vote in favor of wind energy. But the communities most likely to express agreement that wind energy is impactful to wildlife are Saratoga and Rawlins, communities that exhibit substantially different views as to whether local wind development should occur. Fifty-nine percent of Saratoga respondents and 57% of Rawlins respondents strongly or somewhat agree that wind energy development impacts wildlife. However, response to the voting behavior question was very different, with only 24% of Rawlins residents saying they would vote against local wind power development compared to 39% of Saratoga residents. While residents of these two communities expressed similar beliefs about wildlife impacts, they also had very different beliefs about the economic benefits wind power development could provide, with 45% of Rawlins respondents strongly agreeing that wind energy will help economic development, compared to only 25% of Saratoga residents.

It is likely that wind energy will continue its recent pattern of rapid growth and expand and spread to new communities, each with their own unique contexts and views on the threats and opportunities wind energy might represent. As we have shown here in attempting to understand and anticipate local response to utility-scale wind power developments, it is wise to pay attention to the local context. Efforts to frame such developments as ‘clean and green’ may encourage positive response in one setting, and be ineffective in another. In some locations concentrating on ‘economic development’ may be far more resonant, as we have seen in Rawlins. Similarly, community concerns about threats such as visual impacts, wildlife impacts, and property value impacts have important consequences, but views about such issues are highly variable across development contexts. Further, framing positive benefits and expecting those benefits to outweigh threats is not always likely to occur, and applying a “one size fits all” approach by those who promote wind energy will likely produce failed siting efforts or create ill will towards proposed projects. And in the case of a divided community like eastern Idaho Falls, addressing both the benefits and threats explored in this study still does not fully account for the community’s reaction, suggesting that additional issues will need to be identified.

An additional finding from this study is the need to continue to watch for political polarization of wind energy. While a majority of the American public remains supportive of wind energy, as this technology further expands to new communities we could see heightened polarization as more communities confront the ‘social gap’ between general support and local opposition. Political contention that exploits this social gap, that pits states losing energy jobs as the electrical system converts away from coal against those who support renewable energy, has the potential to the split this into an issue fully divided along partisan lines. Additional research is needed to more fully understand the level of this political polarization and whether or not wind energy development may become an issue linked to more broad-based ‘culture wars.’

Further research is also needed to understand the strong opposition by Catholics, and whether or not this is a statistical aberration involving these particular study communities or if Catholics in other settings are truly opposed to wind power development, and why.

Finally, we offer the following advice for future development: wise siting is sensitive to local contexts, whether it be the backdrop behind the wind facility or the values and needs of the community. We feel that recognizing the unique siting context is one potential response to confronting the social gap, in order to create positive community responses that look more like those observed in Milford, Utah, rather than the negative reactions observed in eastern Idaho Falls, Idaho.

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# CHAPTER VI

# PUBLIC OPINION TOWARD WIND POWER: NIMBY, PROXIMITY, AND VARIED BELIEFS ABOUT UTILITY-SCALE WIND FACILITY EFFECTS

## Introduction

The use of wind power has been growing very rapidly in the United States in recent years, with wind powered electrical generation rising from just .0001 billion kilowatt hours in 1988 to 140.88 billion kilowatt hours by the year 2012 (EIA 2015b). Wind energy capacity was expected to grow by an additional 9.8 gigawatts (GW) in 2015 alone, and account for nearly half of the 20 GW of electric capacity to be installed in that year (compared to 6.3 GW of natural gas and 2.2 GW of solar) (EIA 2015a). This rapid growth is expected to continue into the foreseeable future, with some projections indicating that wind facilities may provide over 300 billion kilowatt hours of electric power in the US by 2040 (EIA 2015b).

Wind energy has a much lower environmental impact than most other forms of utility-scale electrical production, as it does not emit carbon or air pollutants, is renewable, and requires no fossil fuels. Wind energy is certainly not without impact: among the drawbacks of wind energy are bird and bat mortality, habitat fragmentation, noise, visual pollution, electromagnetic interference, and local climate change (Dai et al. 2015). Nevertheless, wind energy is generally well supported by the American public. The March 2013 Gallup poll found that 71% of respondents preferred greater emphasis to be placed on wind power, compared to 31% preferring greater emphasis on power production from coal, with wind second only to solar as the most preferred source of energy production (Jacobe 2013). Evidence of broad-based public support for renewable energy in general, and wind power specifically, has been demonstrated in other national surveys as well (Ansolobehere and Konisky 2014). Yet, despite the favorable nature of public opinion toward wind energy in general, local siting of wind power facilities is often highly controversial.

In an effort to better understand local response to wind energy development we surveyed residents of a rural-urban fringe area located on the eastern edge of the Idaho Falls, Idaho, metropolitan area. Between 2006 and 2011 three large wind farms with a combined total of 215 turbines were sited along ridgelines located directly to the east of this area. Given the high profile of the wind turbines and their ridgeline locations they are highly visible throughout the study area, unless obscured by very localized topographic features, tall buildings, or vegetation. As a consequence, most residents in the study area inevitably see the wind turbines very frequently. While 61% of survey respondents expressed support for renewable energy in general, and 51% approved of developing more wind power in Idaho, only 22% said they would support additional wind power development if it involved facilities built within sight of their homes. Citizen dissatisfaction regarding the local development of wind power facilities has contributed to the formation of a local opposition organization, the Energy Integrity Project (energyintegrityproject.org), which has engaged in a long-term billboard campaign calling for a stoppage of future wind power development. Local dissatisfaction and controversy regarding these facilities led a former state legislator, Representative Eric Simpson (R-Idaho Falls), to propose in 2014 new legislation designed to impose a statewide moratorium on all new wind energy projects (H265). Although that bill failed in committee Representative Simpson said the bill was successful in slowing development, as the wind industry was unwilling to risk development and potentially strand assets in the event that the bill passed (Simpson 2014). While H265 failed, another bill, SCR 127, was passed that required a committee to study the impacts of wind power and to make a recommendation to the Idaho state senate as to whether or not additional wind power projects should be allowed in the state.

It was in this context that we studied public reactions to energy production issues in general and wind power specifically, with a goal of better understanding the factors that contribute to expressions of support and opposition toward this technology. While wind energy development has slowed in Idaho following the proposed moratorium, and at present there are no plans for further expansion of wind power facilities in locations near Idaho Falls, this case offers potentially important insight into the nature of local responses to wind energy development. Given continued regional and national expansion of wind power, efforts to understand public responses and to isolate the factors that influence support or opposition for further development become increasingly important.

We turn next to a review of a major theme to emerge from the previous literature: the so-called NIMBY (Not in My Backyard) response. First we examine conceptualization issues with NIMBY, and explain that proximity may provide a poor operationalization of NIMBY because distance is a poor measure of the concept of a 'backyard,' and because proximity does not always measure actual impacts associated with the presence of wind turbines. We then consider whether and how a NIMBY response may characterize the reactions of local residents to wind power development in the case of the eastern Idaho Falls study area. We examine survey respondents' stated preferences regarding the acceptability of various wind facility siting distances, and use spatial measures of proximity to explore how actual distance from wind turbines may influence opinions about local wind power development. Next, we consider several additional factors: economic, environmental and visual (other than proximity) that have been identified in earlier research as influencing public reactions to wind power development. Through use of logistic regression models we look at how these factors correlate with a hypothetical vote on wind energy development near Idaho Falls. We find evidence of multiple rationalities about wind energy, with supporters 'seeing' the benefits from wind power development and opponents 'seeing' the impacts of wind power.

## NIMBY: Conceptual and Measurement Concerns

Previous research has attempted to explain the apparent contradiction between what are usually high levels of public support for wind power in general and frequent localized project siting controversies. Bell, Gray, and Haggett (2005) refer to this as the 'social gap' in wind energy development and identify NIMBY reasoning as one possible means of accounting for the fact that even though wind power is broadly perceived as beneficial, it is often locally unwanted. This term, NIMBY, has been used ubiquitously in the media and in research to describe opposition to proposed land use changes that are viewed as societally desirable (or needed) but unwanted by local residents. Sewage treatment plants, nuclear and other hazardous waste storage, prisons, concentrated animal feeding operations, and homeless shelters are examples of developments where opposition is often characterized as a NIMBY reaction (Burningham 2000). In the case of wind energy opposition NIMBY has been used both as an explanation for and a description of opposition to wind power (Devine-Wright 2009).

Unfortunately, NIMBY is less a concept or a framework than it is a colloquialism. Its frequent use only defines as much as the acronym describes: “not in my backyard.” Actual academic definitions (if offered) are usually no more detailed than the Merriam-Webster definition “opposition to the locating of something considered undesirable (as a prison or incinerator) in one’s neighborhood” (2015). With the concept used interchangeably as both an explanation for opposition and a description of opposition, research attempting to assess NIMBY responses toward wind energy development has produced mixed results.

Although it lacks much denotative meaning, the NIMBY term has been ascribed with negative connotations and is often used as a pejorative label for opponents accused of selfishly blocking development of a project that would be beneficial to society, or for people who are poorly informed about project benefits or hyperbolic with respect to impacts (van der Horst 2007). Luloff, Albrecht, and Bourke argue that the NIMBY concept has limited use for research, because:

> An absence of conceptual clarity is reflected in its application to a broad range of often dissimilar and even contradictory behaviors, situations, and circumstances. This pattern of blurred and inconsistent usage results in the concept having little real utility for either research purposes or policy development” (1998: 82).

For instance, how is a backyard conceptualized? It is unlikely that the word ‘backyard’ for an opponent to some development literally means the extent of one’s yard. It is much more likely that distance is contextually relative, and will vary based on many factors such as the development in question, the context of the site, the reasons for opposition, and who stands to benefit. The probability that the population of a study area universally agrees upon a specific distance associated with some conceptualization of a ‘backyard’ is extremely low.

Some studies exploring NIMBYism and attitudes toward wind energy have substituted distance from a particular facility as a proxy for the notion of the ‘backyard’ (Braunholtz and McWhannell 2003; Warren et al. 2005; Swofford and Slattery 2010). Unfortunately, distance is not an appropriate operationalization of backyard, because backyard is not an actual measure of distance but a metaphor for an unacceptable land development in a particular place. And place, while geographically bounded, is subjectively defined by individuals, with personal conceptions of place possibly varying greatly. Additionally, as backyard is subjective, the impacts caused by wind energy do not, necessarily, diminish linearly with increased distance from a wind turbine. Studies exploring possible relationships between NIMBYism and attitudes about wind energy have generally failed to grapple with the issues and limitations that accompany use of the term, done little to clarify its definition or conceptualization, and have done a poor job at measuring it (Bell, Gray, and Haggett 2005; Devine-Wright 2005; Warren et al. 2005)

Poor conceptualization and inconsistent measurement likely account for much of the conflicting results found in studies trying to understand NIMBY and its relationship to attitudes about wind energy. Partially due to mixed results and because the term is considered too simplistic to capture the multiple factors thought to combine to influence attitudes about wind power, some scholars have called for abandoning its use entirely in studies focused on wind power attitudes (Burningham 2000; Wolsink 2006; Devine-Wright 2009; Swofford and Slattery 2010). However, while NIMBYism is likely a poor and incomplete explanation for opposition, calls to abandon use of the term have often been made for the wrong reasons. As a result of conflicting uses and unresolved conceptual issues the term remains poorly studied. Calls to stop labeling opponents as NIMBYs are at best premature, because in general the NIMBY phenomenon has not been measured effectively. Better instead would be to rigorously define the concept, and to then devise appropriate strategies for measuring it.

For this paper NIMBYism is defined as a situation involving attitudes that reflect general support for some type of development or technology, while simultaneously there is also expression of opposition to local development or implementation of the technology. NIMBY is found to be a useful although simplistic descriptor of opposition. We only argue for continued use of the term because we find evidence for the occurrence of NIMBYism in our survey results: in general respondents were in favor of wind energy, but considerably less favorable of having the technology sited near their residences. As we delve more deeply into this response, we will see that the term should not be used without caveat.

Besides definitional problems and the lack of a standard measure for a backyard, there remain additional conceptual issues that require attention. NIMBY has been dismissed by some because the NIMBY response, while found in individual reaction, is not found to be universal in terms of aggregate response patterns (Swofford and Slattery 2010). But while NIMBYism might not be found among a majority of respondents, only one person needs to consider a development to be unacceptably close for evidence of a NIMBY effect to be present, and for the term to represent a potentially useful, albeit incomplete, descriptor of local response.

The occurrence of local opposition to a generally supported development is not unusual. For instance, both sewage treatment and sanitary landfills are socially desirable in general, yet they are often locally unwanted and opposed. These examples make sense because although residents near a proposed sewage treatment plant benefit from the treatment of their sewage, they are at the same time impacted by odors and other possible effects, while others who receive the benefits of treated sewage are not exposed to those adverse impacts; and in the planning process it takes only a few opponents to stage protest. Even a very small minority can make a loud sound during public review and participation processes. If the majority of the population has a positive opinion but no reason to be champions, siting debates can primarily involve just a few vocal supporters (most likely with something to gain) and a few vocal opponents (most likely with something to lose), while the vast majority remain unconcerned and unmotivated to take a stand. Given that developers have resources (and financial backing), it's easy to see how this process is tilted in the favor of developing many types of potentially controversial projects, including large-scale wind energy facilities. So in that vein dismissing the term NIMBY because we do not find attitudes towards wind energy influenced in aggregate by NIMBYism does not mean the person who is opposed to a wind turbine being sited near their residence (but supports wind energy in general) is not rightly labeled a NIMBY.

### Factors That Influence Public Acceptance of Wind Energy

Moving past the NIMBY debate, a number of other more nuanced factors have been found to influence attitudes about wind energy and the local development of wind power facilities. These factors, in contrast to NIMBY, provide detail to the reasons that people may express either fears about or positive expectations regarding wind energy. Along with distance, three major themes have been explored in prior research that people believe to be associated with attitudes towards wind power: economic, environmental and visual consequences, though these factors have often been found to have mixed or even conflicting effects in different studies.

***Economic Consequences***

Beliefs and expectations regarding local economic benefits, such as an increased tax base, lease payments to participating private landowners, the creation of new local jobs, or the potential for wind energy to help support the rural farming economy, have been identified as key contributors to attitudes about wind power development Brannstrom, Jepson, and Persons 2011; Slattery et al. 2012; Bidwell 2013). However, empirical evidence regarding the presence of such relationships is mixed, and in some contexts beliefs about economic benefits have not been identified as playing a strong role in shaping such attitudes (Groth and Vogt 2014). While support may in some cases arise from beliefs that wind energy will bring positive economic development consequences, such outcomes may be most frequently identified and anticipated by residents of stigmatized places (van der Horst 2007) or economically depressed places (Toke, Breukers, and Wolsink 2008).

At the same time, there is evidence that expectations of negative economic effects resulting from wind energy development can also play an important role in shaping public response to such facilities. In particular, those who oppose such developments frequently express fears about the potential for lowered residential property values, though evidence of actual declines in property values of residences adjacent to wind facilities have not been observed in large-scale economic analyses (Hoen et al. 2009; Brown et al. 2012). Expressions of concern about issues of economic fairness (especially shared community benefits) have also been noted, particularly when only a few property owners stand to benefit from lease agreements or when benefits are viewed as accruing primarily to non-local interests and landowners (Bolinger et al. 2004). Also, some local residents may consider industry provision of things like school program funding or other community benefits as little more than bribes paid to reduce local opposition and garner increased willingness to accept development and accommodate project-induced impacts (Cass, Walker, and Devine-Wright 2010).

***Environmental Consequences***

Wind energy has a much lower environmental footprint than fossil-fuel based systems and reduced pollution effects, especially those involving release of carbon dioxide, have been the primary justification for federal, state and local policies that incentivize or subsidize the technology (Ciocirlan 2008). There is also evidence that the lower environmental impact of wind energy is a key factor influencing the public's support for increased wind power production (Ansolabehere and Konisky 2012).

However, expressions of concern about the potential for utility-scale wind power projects to have adverse environmental consequences are also widely evident, and may play key roles in shaping response to such facilities. In particular, wind energy's possible impacts on wildlife have emerged as a common issue of concern for opponents (Rose

2014). And fear of impacts on wildlife is a valid concern as birds and bats are often killed by the spinning blades of turbines (Kunz et al. 2007; Barclay, Baerwalk, and Gruver 2007) that rotate at speeds over 80 meters per second (Dykes et al. 2014). Wildlife is not only impacted by the spinning turbines, but also because of habitat fragmentation that occurs as a result of additional infrastructure development from service roads and power line construction necessary to connect wind turbines to the grid (Kuvlesky et al. 2007). In addition to direct impacts to wildlife from turbines and turbine development, local ecosystems can be affected by local climate effects. Large wind energy installations can modify local wind patterns and potentially cause substantial localized warming (Zhou et al. 2012). Wind energy consequences are not limited to environmental impacts, but can also cause electromagnetic interference, and acoustic disturbance (Dai et al. 2015).

***Visual Effects***

Utility-scale wind power turbines are huge, standing on towers 80–220 meters tall. And, because they require access to steady winds, turbines are usually required to be placed in highly visible locations, often atop ridgelines or other higher-elevation settings. This high visibility, along with the movement (and shadow flicker) of the turning blades, represents the most common source of complaints expressed by those who oppose or express dissatisfaction with wind power. Visual impact has been identified as one of the strongest predictors of attitudes about wind energy. As Wolsink observed, “the most salient public concerns in considering the costs and benefits of a wind power scheme involve landscape values” (2007:2694).

However, wind turbines are not universally considered to be visually impactful (Johansson and Laike 2007; Slattery et al. 2012). Some people view these large turbines as not visually ugly, but rather as eye-catching and even beautiful (Righter 2011). At the same time, others view them as monstrous, out-of-scale, and destructive of a view (Thayer and Freeman 1987), and as an unwanted industrialization of rural areas and undeveloped landscapes (Phadke 2011). Just as attitudes about wind turbines are subjective, so are social constructions of the places where they are sited. A view is composed of many factors such as topography, vegetation, current land-use, spatial location of the viewer, and the backdrop. Cultural and individual understandings of appropriate land use and the subjective nature of aesthetics add further complexity to the situation and significantly influence public response to proposed land use changes (Greider and Garkovich 1994). All of these factors mean that visual impact is highly dependent on the context of the wind farm, the context of the viewer, and is modified, subjectively, by personal feelings of whether or not a turbine represents a visual intrusion.

Views are an issue of the commons, and most homeowners are willing to pay more for a view, even though it is something they can't own. A beautiful view has social and economic value; for example, in most work environments the corner office with windows on two sides is a symbol of prestige, and a house high on a hill with large picture windows overlooking the valley is the hallmark of high-end homes. Unobstructed views of the ocean in one location increased house prices by 60% (Benson et al. 1998).

Overhead power lines, with their tall height, share some similarities with wind turbines. They provide a service that everyone uses but can be considered an eyesore, and development of new power lines can cause contention and opposition (Furby et al. 1988). Although they have become so commonplace as to often become part of the landscape and are most often tolerated, when given the choice people often desire them to be hidden from view. Many communities and neighborhoods, particularly those characterized by higher property values and wealth levels, require power and telephone lines to be buried to hide the cables from view. Burying has advantages, especially in heavily treed areas, but burying cables is much more expensive, and depending on the substrate can be as much as 10 times the price of line and pole (Hall 2012). Unfortunately, wind turbines have no such alternative and in order to access the wind are unable to be hidden.

Some of the wealthiest Americans have been at the center of opposition to wind power based on concerns about visual aesthetics, arguing that the development of certain wind power facilities would destroy highly valued views. For example, Robert F. Kennedy Jr., an environmentalist and liberal politician, has been an advocate for increased development of renewable energy but has vocally opposed the Cape Wind project, an offshore project proposed for development off the coast of Nantucket, because of visual impacts (Kennedy Jr. 2005). Kennedy Jr. and other wealthy Nantucket residents who might be willing to advocate for wind power in other places have wielded their influence and money, and successfully stonewalled the project for more than 10 years (Williams and Whitcomb, 2007).

The example of opposition to Cape Wind on aesthetic grounds is illuminating of how visual impact from wind power development can be viewed as negative and explains why wind power visual impacts are not properly measured using distance. Distance does not take into account contextual factors such as the presence of a highly-valued view (and money to mount a legal battle) or a scenic backdrop, nor does it separate those who view wind as sign of progress from those who view it as incompatible and unacceptable industrial development. In addition to subjective landscape differences, distance does not take into account how topography or vegetation might mediate visual accessibility and modify visual impact. Turbine siting location is heavily influenced by local context and certain topographic features (like turbines sited on ridgelines) accentuate visual access, while others features, like tall forests, help limit visual accessibility.

Research exploring the connection between distance from turbines and attitudes toward wind power attitudes has been inconsistent: proximity to wind facilities has been found to be associated with increased opposition as well as decreased opposition or to play an insignificant role. In an early study of attitudes about wind power close proximity was linked to increased opposition (Thayer and Freeman 1987), and a more recent study by Swofford and Slattery found "an inverse relationship between proximity and positive attitudes, whereby acceptance of wind energy decreases closer to the wind farm. Those living closest to the wind farm indicate the lowest levels of support for them, while those living farthest away indicate much stronger support" (2010: 2514).

In contrast, other studies have found that favorability increases as proximity to the wind facility decreases. This type of reaction has been labeled an 'inverse NIMBY' (Warren et al. 2005). This inverse NIMBYism has been found in multiple situations (Krohn and Damborg 1999; Braunholtz and McWhannell 2003). In further contrast, proximity has been shown to not play a significant role in shaping attitudes, such as the results of a study that found no differences in opposition to wind power development between three groupings of respondents at different levels of proximity to wind power development (Johansson and Laike 2007).

It is important to note how the term proximity is used in this chapter. The term, much the same as was noted in the discussion of the term backyard, is one that describes a relative distance and not an actual measurement. Proximity, or being close to something, is an imprecise representation of distance. It is just as accurate to say, "that a neutron is in the proximity of a proton" as it is to say, "the earth is in the proximity of the sun." So the use of the term in this article must be caveated with an understanding of the relative scale of proximity in the case studied. We measure the differences in attitudes within a single geographic area abutting a wind energy development, and where all of the households in the study areas are, in relative terms, within close proximity to the wind energy development at the eastern edge of the Idaho Falls, Idaho metropolitan area. This context of relatively similar proximities experienced by survey participants likely has ramifications for the results from and generalizability of findings from this study. Research focusing on more varied levels of proximity involving different scales (such as might be observed when comparing two towns—one near a wind energy development and the other out of sight distance of the same development) would likely produce different results.

The research reported here represents an attempt to make sense of the conflicting evidence regarding the role proximity might play in shaping attitudes about wind power, to further examine the idea of NIMBYism, and to explore if distance from wind turbines has an influence on attitudes or if distance is an oversimplification that does not adequately capture local contextual factors. To accomplish this we examine survey responses provided by residents of our study area.

## Methodology

### *Data Collection*

The study setting considered in this research is a rural-urban fringe area located on the eastern-most edge of the Idaho Falls, Idaho, metropolitan area. This area, which includes the small towns of Ammon (population 13,816 at 2010 Census) and Iona (population 1,803) along with surrounding unincorporated portions of Bonneville County, is dominated by low-density residential land use scattered across what was until recently a largely agricultural landscape. Between 2006 and 2012 four utility-scale wind energy facilities with a combined total of 215 turbines ranging from 118.5 meters to 138.5 meters in height were constructed along ridgelines several kilometers to the east of the study area. Due to the height of the turbines, their locations along prominent ridgelines, and the low-growing vegetative cover of the area, the turbines are highly visible from nearly all locations throughout the study area.

Study area boundaries that extended approximately 16 kilometers from north to south and 8 kilometers from east to west were delineated in a manner designed to insure inclusion of residences located at varied distances from the wind turbines. Street addresses for residential parcels located within this study area were obtained from the Bonneville County tax recorder's office. We then selected an initial random probability sample of 250 addresses, along with an additional set of randomly-selected 'replacement' addresses for use in cases where a sampled address was subsequently determined to be undeveloped, vacant, or otherwise invalid.

Self-completion questionnaires that included a range of questions focused on energy preferences, environmental attitudes and respondent demographics were administered to study area residents using a personalized “drop-off/pick-up” methodology (see Steele et al. 2001)(see appendices H and I). Over the course of seven days in June, 2,014 members of the research team delivered survey materials to adult members of sampled households, and then returned (usually within 24-48 hours) to retrieve the completed questionnaires. Multiple attempts to establish contact with sampled households, as well as multiple call-back attempts to retrieve delivered questionnaires, were made at different times of day across multiple days in an effort to minimize the potential for sampling inaccuracies that can result from non-contact and non-response errors. Once contact had been established an adult (age 18 or older) household member was ‘randomly’ selected (by asking to speak with the person whose birthday had occurred most recently), and that individual was asked to complete the survey questionnaire. Potential respondents who were unable to or failed to return the questionnaire by the time the research team left the area were provided with a postage-paid envelope and asked to return the completed questionnaire by mail (For the complete questionnaire and notes on development see Appendices H and I).

These procedures resulted in successful delivery of survey materials to 249 households, and retrieval of 184 completed questionnaires. The 74% response rate is much higher than the average response rates typically obtained for mail and telephone surveys, which in the contemporary era of survey research generally fall in the 25-45%

range (Dillman et al. 2009). This high rate of response allows for considerable confidence in the ability of sample-based estimates to accurately represent the perspectives and characteristics of the larger population of the study area.

**Variable Measurement**

*Dependent variable*. The survey asked a broad range of questions about energy preferences in general and the wind farms near Idaho Falls in particular. Our dependent variable is based on responses to a question that asked, "If given the choice, would you have voted for or against the development of wind power near your community?" In total, 168 survey participants answered the question, with 48.2% selecting the "vote for" response option and 51.8% selecting the "vote against" response.

*Independent variables*. Many factors have been investigated for the roles they might play in shaping public reactions to local wind energy development. Among the factors most frequently highlighted in previous research are concerns about visual impact, beliefs about dangers to wildlife, expectations regarding economic benefits, concerns about property value changes, and the belief that wind energy is a source of clean or "green" energy. In this study we consider all of those factors, but also focus particular attention on the potential importance of the distance between residences and nearby wind power facilities as a factor influencing such response. The measure of distance from turbines was calculated using the Near Distance tool in ArcGIS, which measured the distance of each respondent's home from the nearest wind turbine, as reported by the USGS Energy Resources Program Wind Farm map (USGS 2014). Along with comparing attitudes and actual distances from wind turbines we asked residents what distances from their homes were appropriate for wind energy development. To assess preferred siting distances for wind power development we used the question "How would you feel about the construction of a new utility-scale wind power facility (with at least 100 250-foot tall towers) that would be built" with the following response categories: "within sight of your home," "within 5 miles of your home," "within 10 miles of your home," "within 25 miles of your home," and "within Idaho."

Respondents' attitudes about visual impacts were measured using a summated scale based on responses to two Likert-scale questions: "Do you agree or disagree with the following statements about utility-scale wind power? (1) Is an unattractive feature of the landscape and (2) Adds an interesting feature to the landscape" (reverse coded). The resulting summated scale produced a Cronbach's alpha reliability coefficient of 0.839, indicating a high degree of internal consistency in patterns of response to the two component items.

Levels of concern regarding the potential for wind power facilities to pose a danger to wildlife were measured asking respondents to indicate the extent to which they agreed or disagreed that utility-scale wind power "is a danger to wildlife." Beliefs that wind power is a source of producing "clean/green" energy supplies were measured by asking whether respondents agreed or disagreed that utility-scale wind power is "a clean energy source." Beliefs regarding possible economic benefits were addressed by a question that asked for expressions of agreement or disagreement with the statement that utility-scale wind power "provides economic benefit to the local area." Finally, views about the possibility that such facilities might affect property values were measured by asking respondents to indicate whether they agreed or disagreed that utility-scale wind power "causes a decline in nearby property values."[5]

**Results**

Given the inconsistent relationship between attitudes toward wind energy development and proximity, one of our main research objectives is to examine the role proximity plays in this context. Our first examination of the role proximity plays is to report acceptable siting distances. For our respondents close proximity to wind turbines, according to stated preferences, is generally unwanted. Table 6 shows the response to the question of acceptable siting distance from respondent's homes to a new wind energy facility. For a majority of respondents (55%) proximity closer than five miles to wind turbines is undesired, and even when sited more than 10 miles away almost half (45%) of respondents indicated they would be opposed. While most respondents opposed developments of wind turbines in close proximity to their residence, as siting distance is increased support also increases. For example, 51% of our respondents said they strongly or somewhat support wind power development in the state of Idaho, compared to 61% of respondents who said they are strongly or somewhat opposed to wind turbine development within sight of their home.

These numbers suggest a strong occurrence of a NIMBY reaction, with a majority of respondents supportive of the technology so long as it not built near their residence. With responses regarding the acceptability of wind power development increasing as

[5] For all of these measures responses to the individual survey questions were recorded on a five-point Likert-type scale, with values ranging from 1 (strongly agree) to 5 (strongly disagree). Summated scales based on response to two or more items were considered for measurement of the economic and environmental effects variables, but not used because the combined effects of nonresponse to individual items would have significantly reduced the number of cases available for computation of summed scale scores and for inclusion in analytic models.

**Table 6.** Support or opposition at varying distance from residence.
How would you feel about the construction of a new utility-scale WIND POWER FACILITY (with at least 100 250-foot tall towers) that would be built:

| Answer Options | Strongly Oppose | Somewhat Oppose | Neutral | Somewhat Support | Strongly Support | Response Count |
|---|---|---|---|---|---|---|
| Within sight of your home | 40% | 21% | 17% | 12% | 10% | 182 |
| Within 5 miles of your home | 34% | 21% | 15% | 13% | 18% | 182 |
| Within 10 miles of your home | 29% | 15% | 16% | 19% | 21% | 182 |
| Within 25 miles of your home | 20% | 13% | 20% | 21% | 26% | 182 |
| Within Idaho | 19% | 5% | 25% | 21% | 30% | 183 |

siting distance increases, we would expect to see a similar pattern emerge from analysis that consider the relationship between actual household distance from existing wind turbines and support or opposition for local wind power.

To check that visual impacts were shared by all households ArcGIS's viewshed tool was used to see whether or not all responding households could view the wind turbines from their residence. The analysis concluded that with the 130-meter height of the turbines, (but excluding vegetation effects) all respondents would be able to see the turbines, as their homes were within the viewshed of the wind turbines. We expect that the residents who are closest to wind turbines will be most likely to say they would vote against any new wind energy development.

Table 7 compares the mean distance from each residence to the nearest wind turbine and whether they would have voted, if given the opportunity, for or against the development of wind power facilities. The results show that although increased household distance from turbines does in fact correlate with increased support for wind

**Table 7.** Mean distance and voting for or against the wind energy development near the community of Idaho Falls.

| Predictor | Vote For | Vote Against | Total |
|---|---|---|---|
| Distance from Turbines (in meters) | 7238 | 7172 | 7204 |
| N | 80 | 84 | 164 |
| Std. Deviation | 1342 | 264 | 1415 |
| S.E. | 150 | 162 | 110 |
| F=.087 | | Significance=.769 | |

facility development, the mean distance difference is extremely small (a difference of 66 meters) and is not statistically significant.

As a further test, using a methodology similar to previous studies on wind facility proximity (Braunholtz and McWhannell 2003; Warren et al. 2005; Swofford and Slattery 2010), residences were grouped using 5 concentric zones. A cross-tabulation of hypothetical voting preference and residences grouped by proximity shows that household distance from turbines has little correlation with voting patterns (Table 8). While some of the categories have a smaller than ideal N, the analysis of the effect of proximity by grouped distances suggests that in the case of the eastern Idaho Falls study area residents' proximity to turbines has no statistically significant relationship with stated voting choice.

We next analyzed the spatial distribution of "vote for" and "vote against" using a Moran's Index spatial autocorrelation (see Appendix D) to determine whether there was any pattern of spatial distribution to the voting behavior. The resulting z-score of 1.56 and a p-value of 0.11 suggest that the pattern of spatial distribution of voting behavior is

**Table 8.** Cross-tabulation of votes by grouped residence distance.

| Household distance from nearest turbines | Vote For (Count) | Vote Against (Count) |
|---|---|---|
| Less than 4000 Meters | 50% (3) | 50% (3) |
| Between 4K and 5K Meters | 22.2% (2) | 77.8% (7) |
| Between 5K and 6K Meters | 63.6% (7) | 36.4% (4) |
| Between 6K and 7K Meters | 38.9% (14) | 61.1% (22) |
| Greater than 7K Meters | 52.9% (54) | 47.1% (48) |
| Total | 48.8% (80) | 51.2% (84) |
| Pearson Chi-Square | 5.632 | p=.228 |
| Total N=180, 16 missing (8.9% did not vote) | | |

not significantly different than random. A visual confirmation of a lack of a pattern is also evident (see Appendix E) from an examination of the spatial distribution of responses to the voting behavior measure in relation to proximity to the wind turbines.

We next used a logistical regression to assess the relationship between distance and voting behavior. As the results reported in Table 9 indicate, there is essentially no relationship between votes for or against wind energy and distance from wind turbines.

Our results reveal that "voting preferences" regarding nearby wind power development are unrelated to household proximity to wind turbines. For this reason we need to look to other factors that may prove to be more important determinants of support for or opposition to such projects. While the observed lack of correlation of proximity and support or opposition contradicts findings that have suggested close proximity to wind turbines increases levels of opposition (Swofford and Slattery 2010), the proximity argument has a potentially important but misattributed reasoning. If we substitute close proximity for increased contact, our results are more in line with Swofford and Slattery's results that "suggest that those individuals with greater chance of daily contact with wind turbines show higher levels of opposition than those living at greater distances from the

**Table 9.** Logistic regression analysis of distance and votes for or against the wind energy development near the community of Idaho Falls.

| Predictor | B | S.E. | Sig. | Exp (B) |
|---|---|---|---|---|
| Distance from Turbines | .000 | .000 | .767 | 1.00 |
| Constant | .286 | .814 | .726 | 1.331 |

N= 164
-2 Log Likelihood=227.167 Cox and Snell $R^2$=.001 Nagelkerke $R^2$=.001

wind farm. This speaks to the locally restricted nature of many of the commonly cited negative aspects of wind energy such as noise and visual pollution"(2010:2516) (and the corollary idea that proximity might also represent positive benefits, i.e., landowners receiving lease payments).

The respondents in our sample have a high level of contact with the local wind power facilities, with 88% reporting they see the turbines every day, and an additional 8% seeing the turbines at least every few days. Given this, we could perhaps attribute low levels of support for wind power in our study area to the very high levels of contact experienced by residents of the area. However, if we accept the argument that impacts increase with increased contact, we would expect a more homogeneous reaction from the respondents in our sample. It would appear that contact alone is not a key explanatory factor since nearly half of our respondents did indicate support for local wind power development.

Earlier we outlined some of the problems with using proximity as a factor influencing responses to wind power projects, two of which are particularly germane here. First, proximity does not take into consideration that impacts will be modified by local contexts (like topography) that can either emphasize or minimize impacts. Second, proximity does not account for whether or not benefits and impacts are equally shared by those who experience a similar spatial distance from a turbine. In the first instance respondents may view the impacts or benefits to be the same, but proximity to turbines doesn't account for differences in actual impacts caused by being close to the wind facility. For example, two residents within a similar proximity of a wind facility both feel that wind turbines are aesthetically unpleasing and cause visual impact. But, in this example, tall trees block one respondent's view of the turbines, which minimizes the visual impact to this resident.

The second instance of where proximity is an incomplete measure of potential impacts involves a tendency for certain respondents to view the impacts and benefits of wind power very differently. For example, two respondents might live in residences that are a similar distance from a wind turbine, but only one of these residences receives annual lease payments and the other is paid nothing. In both of these instances it seems illogical to anticipate similar attitudes of respondents based solely on the commonality of proximity. And it seems unhelpful to claim that because we do not find a uniform reaction based on proximity that we cannot use NIMBY to describe opposition from some individuals. Instead, it may be more useful to measure beliefs about whether wind energy offers impacts or benefits, as a way of explaining why even with increased contact we see varied reactions to uniformly high levels of visually accessibility to a wind farm. We expect that measures of anticipated or experienced impacts and benefits will prove to be more consistent predictors of attitudes about wind energy.

To test if beliefs about the impacts or benefits of wind power development are better predictors of support or opposition, the next step in our analysis uses logistic regression to examine relationships involving several factors that have been identified in earlier research as having important influence on attitudes toward wind power. We test the relationship between our measure of "voting" for or against local wind power development and distance from turbines, the belief that wind power facilities cause visual impacts, the belief that such facilities harm wildlife, the belief that wind power is a source of clean energy, that it brings economic benefits, and that it causes a decline in property values. The results are informative in that they further discount the influence of proximity, while strengthening the case that support or opposition is correlated with the belief that wind energy development either offers benefits or causes adverse impacts.

The results show that respondents can view the same wind farms very differently, with two competing perspectives emerging about the technology (see Table 10). One concentrates on the impacts caused by wind power, viewing the installation as visually impactful and a danger to wildlife. The other view sees wind power as offering benefits in the form of economic growth, and as a clean source of energy.

Distance from turbines has no effect in the analysis, as evidenced by a statistically insignificant beta coefficient with a value very near to zero. In comparison there is a strong correlation with opposition to the local wind facilities because they are visually impactful. Respondents who see turbines as visually unattractive are half as likely to vote for wind, and this factor has a p-value with the highest statistical significance of the variables. Belief that wind is a danger to wildlife has a slightly larger beta and a robust p-value; the exponent b shows those who view wind as dangerous to wildlife are half as likely to vote in favor of the local wind development as those who do not express such concerns.

**Table 10**. Logistic regression analysis for voting for or against the wind energy development near the community of Idaho Falls.

| Predictor | B | S.E. | p-Value | Exp (B) |
|---|---|---|---|---|
| Distance from Turbines | .000 | .000 | .658 | 1.00 |
| Visual Impact Scale | -.610 | .163 | .000 | .543 |
| Danger to Wildlife | -.648 | .275 | .018 | .523 |
| Source of Clean Energy | .840 | .438 | .055 | 2.317 |
| Economic Benefit to the Community | .465 | .230 | .044 | 1.592 |
| Causes Decline in Property Values | -.427 | .286 | .136 | .653 |
| Constant | 2.326 | 2.007 | .247 | 10.237 |
| N= 142 | | | | |
| -2 Log Likelihood=82.174 | Cox and Snell $R^2$=.526 | Nagelkerke $R^2$=.703 | | |

Voting behavior changes for the respondents who perceive wind as offering benefits. While the correlation between voting and respondents who view wind energy as a source of clean energy has a p-value of less than 0.05, it does approach statistical significance, and the beta value shows a strong effect size. The economic benefit to the community measure has a strong effect and a p-value of less than 0.05, with those who agree that wind power brings economic benefits more than 1.5 times as likely to vote in favor of wind development. The fear that wind energy will decrease nearby property values has been identified as an important factor influencing opposition to wind power, but in our results it does not play a statistically significant role in voting behavior (although the beta is in the expected direction).

These results strengthen the argument against using proximity to test for NIMBY, not only because distance is not a direct measure of ‘backyard’ but also because increased distance does not directly correlate with decreased impact. As our results show, support or opposition to wind power are not correlated with a linear distance, but instead vary independent of distance.

While our results show that proximity is not a good predictor of support or opposition, this finding in regards to NIMBY presents an unresolved dilemma: Why does actual proximity to turbines apparently not affect the public's attitudes about wind energy when respondents as a whole offer unambiguous aversion at the idea of having wind energy built near them? Our study design does not permit satisfactory resolution of these two contradictory findings. While absence of a proximity effect on attitudes is counter to our expectations, at least for our relatively localized study area the distance of residences from turbines can be dismissed as a factor informing attitudes.

However, while our findings do not reveal a distance effect, important contextual factors should be noted before distance is dismissed in other settings. Given the high visibility of the turbines relative to the sampled area, nearly all residents in the study area are situated within sight of turbines. While a small number of households may not have a direct view of the turbines from their homes, the wind turbines are visible during the course of daily life throughout the study area. In other settings distance might be a more important predictor. For example, distance-related change in visual access may become more evident in cases involving offshore wind development or development in relatively flat landscapes. Additionally, the households farthest from the turbines in our study area are still relatively close, with the farthest residents less than 10 km from the wind turbines. Examination of these relationships across a more spatially extensive study area could conceivably produce different results.

**Conclusion**

Wind energy is in a period of enduring growth, and as we recognize the need to respond to climate change, that growth curve will likely increase. Alongside this growth there will inevitably come siting challenges, as some residents will see the development of wind power projects as having impacts that outweigh the benefits. It is in regard to this future development that we can hopefully apply the lessons learned from this study.

The first lesson is that while NIMBYism sentiment may be expressed by at least some areas residents, labeling local opponents of wind energy as NIMBYs should be cautioned against. This is not necessary because we don't find evidence for the phenomenon, as some respondents do tell us they are NIMBYs and do not want wind power close to them. However, because social scientists have been unable to provide conceptual clarity and reliable operationalization concerning the term, its use does not offer much utility to inform either research or policy. While additional conceptualization and thoughtful operationalization of the term may prove to be useful, given the negative connotations perhaps the term is too loaded and should be replaced with a more objective construct. At the same time, our findings make it clear that future applications should avoid simply substituting proximity for NIMBY.

We can also reject the use of proximity as an overly-simplistic conceptualization of a more complex and contextually dependent reality, one that requires us to consider things like land features and to ask who is benefiting and who is being impacted. And while increased recognition of these complexities is needed in regard to studying the influence of proximity, our results concerning contesting rationalities can perhaps be simplified. When distilled, the result appears evident: when people view wind power as a benefit that may offer opportunity they tend to support it, but when they see something as damaging they are likely to oppose it.

The recognition that wind power developments are interpreted through contesting rationalities, even within a single community experiencing wind development, has ramifications for how we understand support and opposition to wind power. Attempting to resolve divisive issues regarding wind energy development is not as simple as increasing distance of the turbines from residences. Acknowledging that wind energy development opposition and support cannot solely be attributed to distance creates a challenge for those who are either trying to stop development or encourage it. Both rationalities are correct about the costs and benefits of wind energy development, and like most divisive issues, siting controversies involve battles not just over facts, but also over values.

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# CHAPTER VII

# CONCLUSION

Renewable energy technologies involving solar and wind power are quickly becoming mature and tested, and the recent high rates of growth in their utilization are in part a result of their proven effectiveness. While technical barriers such as managing intermittency and electric storage remain substantial challenges, these technical issues are not necessarily the barriers that will limit future growth. The electrical energy system is not only a technical system but is enmeshed within a complex social system with many stakeholders like political actors, powerful corporations, and the public who have different interests, priorities, needs, and investments in the system. As such, barriers to widespread reliance on renewable energy involve not only the challenge of finding solutions to technical problems, but also managing the different (and sometimes) competing interests of the actors in a complex social world that uses, regulates, and profits from the electricity these technologies generate.

This dissertation has responded to the call for an increased use of social science research to help inform the coming transition to our electrical system (Sovacool et al. 2015) by examining some of the social issues that potentially challenge future growth of renewable energy. The chapters in this dissertation have explored the drivers of the recent growth of renewable energy and examined how public attitudes are influenced by political orientation, community differences, and proximity to developments. The dissertation used a literature and policy review and analysis of data from two public opinion surveys to more thoroughly understand the components of why members of the public support or oppose renewable energy. More specifically, through analysis of the survey data sets, the dissertation addressed the following questions: (1) Is political orientation a determining factor of support or opposition to renewables in general and to wind energy in particular? (2) How do the unique characteristics of a local community affect support or opposition to local wind energy development? (3) Does household distance from wind turbines influence support or opposition for wind energy development?

Before answering these specific questions about the nuances of public understanding of renewable energy, Chapter III ("Renewable Energy in the United States: Trends, Prospects, and Implications of Rural Development: 2016 Update") introduced the reader to the technologies and types of solar and wind power and discussed the patterns of past development, forecasts for future development of renewable energy, and the forces that have constrained and propelled that growth. We reviewed how advances in technology have lowered costs and increased generation capacities and discussed the complicated regulatory structures and supportive policies that have been both key drivers and major barriers. We then discussed how further expansion of renewable energy technologies will have specific implications in rural areas that will tend to be the sites of current and future development, and offered policy recommendations to minimize local impacts while still encouraging renewable energy development. Key findings derived from Chapter III include the following:

- Rapid growth of utility-scale renewable energy development has occurred in the recent past, and future forecasts predict high rates of growth to continue.
- Policy choices are both drivers and barriers to growth.

- Policy decisions can cause unwanted negative effects but are also key to help limit localized social impacts.
- Special policy attention is recommended for the rural areas that will likely host most utility-scale renewable energy development, to increase the likelihood that these areas to be beneficiaries of some of the economic benefits in exchange for the negative impacts resulting from development.

Chapter IV ("Political Orientation and Energy Preferences in Utah") explored whether political orientation could be playing an important role influencing attitudes toward wind and solar energy. The current highly polarized political climate (Abramowitz and Saunders, 2008), the politicization of environmental issues, and the many environmental benefits that are often used as a justification for the subsidies designed to promote wind and solar energy development suggested a hypothesis that public attitudes about renewable energy align with political orientations. Key findings from this chapter include:

- Political beliefs are correlated with attitudes about renewable energy: political conservatives are more opposed to solar and wind energy, whereas political liberals are more in favor.
- Rural residents are less likely than urban residents to support wind and solar energy.
- Women are stronger supporters of renewable energy than are men.
- Renewable energy has broad support, and attitudes do not align as strongly with political ideology division lines as they do with attitudes toward the use of coal and government regulation.

Using data from the Utah statewide mail survey we examined how support or opposition to renewable energy correlated with political orientation and if current patterns of political polarization and/or residence in metropolitan, urban or rural counties might relate to attitudes about renewable energy, and considered if these traits could become barriers to future renewable energy development. The results show that support or opposition is indeed coupled with political orientation as well as rural residence: political conservatives and rural residents are more opposed to solar and wind energy, whereas political liberals and urban residents are more in favor.

As Guber (2012) observed, in the highly polarized current political climate political orientation is strongly correlated with environmental concern and beliefs about anthropogenic climate change. Our results align with the findings of McCright and Dunlap (2011) that the American public views climate change and environmental issues as highly polarized topics. Our results also confirm the connection identified in McCright, Xiao, and Dunlap (2014) between political orientation and support or opposition for governmental spending on environmental protection.

However, while attitudes about renewable energy are correlated with political orientation, the results for our sample of Utah residents show that attitudes regarding this issue operate differently than other environmental and energy issues such as attitudes about government environmental regulation and preference for coal energy—both issues that are much more strongly polarized politically. Along with polarization by political orientation and polarization of urban/rural residents, sex was also identified as a factor of division for our sample, with females more supportive of renewable energy than males. This result corroborates findings in other research that females generally have greater environmental concern and greater concern about pollution risks. What this additional finding portends for future development is unknown, but it shows yet another complexity in the issue of energy preferences. Despite the divisions found in our sample, our results still suggest cautious optimism for continued renewable energy development, since majorities of survey respondents expressed support for renewable energy. So long as the patterns of division by sex, political orientation and rural/urban residence do not become more contentious, renewable energy development in Utah still appears to have good prospects.

Chapter V ("Local Residents' Responses to Utility-Scale Wind Power Developments: A Five-Community Comparison") examines why wind energy is generally preferred over other energy sources but is often locally unwanted, and why some wind energy facilities are constructed with strong community support whereas others are highly contested. Key findings from this analysis include:

- Attitudinal differences in renewable energy development are explained in part by individual-level socio-demographic characteristics of study area residents.
- Attitudes are also influenced at a community level. Collectively it appears that communities weigh the benefits and impacts of wind energy differently, independent of differences in the socio-demographic composition of local populations.
- Communities may see the consequences and opportunities of renewable energy development differently, even in cases where they are located near the same development.

This chapter compared survey data from five communities in Utah, Idaho, and Wyoming with existing developed wind facilities or with proposed projects in advanced permitting stages to show that attitudinal differences are explained in part by compositional socio-demographic characteristics but also by a community factor, indicating that communities weigh the benefits and impacts of wind energy differently. A majority of our survey respondents view renewable energy as the most preferred source of electrical production, confirming a long established trend as the public has been supportive of the technology since it was first commercialized (Brunner and Vivian 1980) and again in recent polls (Jacobe 2013; Ansolabehere and Konisky 2014). Yet, levels of support for wind energy development varied widely in our sample, with one community, the eastern Idaho Falls area, showing a small majority opposed to wind energy development.

This research offers a contribution to our understanding of the 'social gap', or the difference between general support and localized opposition (Bell, Gray, and Haggett 2005; Bell et al. 2013), and it helps to explain why such a large number of factors have all been found to be important influences of attitudes toward wind energy. Attitudes about benefits, threats, and the development process have all been found to be important determinants. For example, Wolsink (2007) found attitudes influenced by the belief that the development planning process was conducted fairly; Gross (2007) found attitudes were connected with the belief that the public was offered adequate information and an opportunity to voice concerns. Other research has connected supportive attitudes with that belief that development would increase the local tax base, create jobs, produce new income opportunities, or support rural lifestyles (Brannstrom, Jepson, and Persons 2011;

Slattery et al. 2012); or to the belief that the economic benefits had been viewed as being shared fairly by the entire community (Bolinger et al. 2004). Other research connected attitudes stemming from the belief that the technology offers a lower environmental impact (Smith and Klick 2007; Ansolabehere and Konisky 2012; Jacquet and Stedman 2013), that development harms wildlife (Rose 2014), or that development will impact residential property values (Gulden 2012).

Our study found many of these factors had some relevance, although no single factor was a primary correlate to attitudes. Instead we found that a suite of factors, connected to how opportunities and threats from the development are weighed, influences opposition or support for wind energy. The threats, such as visual impacts or harm to wildlife, and opportunities, such as environmental benefits or economic growth related to wind energy development, are important determinants of support or opposition to wind energy. However, the relative importance of those factors are not consistent across communities or individuals.

Furthermore, our results revealed that differences in support or opposition are not easily distilled to differences in socio-demographic factors. We did find meaningful correlations between socio-demographic factors and wind energy attitudes; for instance, the belief that wind energy causes visual impacts was correlated with longer-term residence, political conservatism, higher household income, and older age. But socio-demographic indicators were inconsistent across the various threats and opportunities and offered modest correlations in general, with the exception of political orientation. The correlation with wind energy attitudes and political orientation helps to further confirm the results of Chapter IV and offers additional generalizability as the analysis was of a different survey with samples drawn from multiple locations. But with the exception of political orientation, our results demonstrate the limited utility of using socio-demographic characteristics to predict support or opposition to wind energy development.

Our results offer some additional explanation for the 'social gap.' At both the community level and individual level opposition develops when wind installations do not match perceptions of what is "appropriate" development (i.e., matching landscape, economic needs, environmental concerns, etc.). Those who see wind energy as an 'opportunity' typically consider it as a source of green or clean energy or as a source of economic development; while those who view wind energy as a 'threat' usually focus their concerns on aesthetics (Pasqualetti, Gipe, and Righter 2002), impacts to wildlife, or decreasing adjacent property values (Jobert, Laborgne, and Mimler 2007).

The key takeaway from these results includes a recognition of the unique context in which each wind energy development project takes place, and of the necessity to understand how and why a particular community may see the consequences and opportunities differently, even in cases where they are located in proximity to the same development. This recognition can help us to understand why blanket assertions about the benefits and impacts of wind energy development do not always resonate; it should also temper impulses to promote wind energy's environmental or economic benefits to drive public support or expect that stoking fears about property value declines, bothersome visual impacts, or harm to wildlife will automatically create opposition.

Chapter VI ("Public Opinion Toward Wind Power: NIMBY, Proximity, and Varied Beliefs About Utility-Scale Wind Facility Effects") examined the controversial subject of NIMBY (not in my backyard), a widely discussed subject often presented as a factor influencing public opinion about wind energy. Key findings from this analysis include:

- NIMBY is a conceptually imprecise term and is difficult to measure.
- Proximity is not a substitute for NIMBY, and proximity is a poor indicator of impacts from wind energy.
- Increasing proximity to wind turbines has no correlation with attitudes about renewable energy development.
- Support and opposition are correlated with respondents' views that wind energy provides benefits or causes impacts.

The chapter began by reviewing literature discussing NIMBY and wind energy attitudes and discussed conceptual and methodological inconsistencies that play a part in the confusion over this term. Unwanted development is often labeled a NIMBY reaction (Burningham 2000), and regarding opposition to wind energy in particular, the term NIMBY has been used both as an explanation for and a description of opposition to wind power (Devine-Wright 2009). The use of the term to understand opposition to wind energy development has been criticized as too simplistic in many articles (Wolsink 2000; Devine-Wright 2005; van der Horst 2007) although a few studies that have attempted to conceptualize and measure NIMBY (Braunholtz and McWhannell 2003, Warren et al. 2005, Swofford and Slattery 2010) have simply substituted the metaphorical notion of a 'backyard' as distance from wind turbines rather than rigorously conceptualize and accurately measure this sentiment. For instance, the acronym makes reference to a unit of space (i.e., a backyard) that is a distance where wind energy development is unacceptable, but does not define the spatial boundaries of that space. Although some research has used spatial proximity to developments as a proxy for 'backyard,' researchers have not come to a consensus about the role that proximity plays in informing attitudes about wind energy. However, it seems self-evident that proximity is likely to be an unreliable measure to study NIMBY-type reactions to wind energy development, because distance from turbines does not directly correlate with impacts or benefits.

While proximity to wind turbines is a poor measure of NIMBY, it is still a potentially relevant and important variable in efforts to understand variation in wind energy attitudes. However, the nature of relationships involving this variable remains unclear, as the literature offers mixed evidence regarding the role that proximity to wind turbines might play in terms of attitudes toward wind energy. While some studies have found close proximity linked to increased opposition (Thayer and Freeman 1987; Swofford and Slattery 2010), other studies have reported finding 'inverse NIMBYism' with favorable attitudes correlating with closer proximities (Krohn and Damborg 1999; Braunholtz and McWhannell 2003; Warren et al. 2005). Our results do not confirm either of these findings. Rather, as with results reported by Johansson and Laike (2007), we find that proximity does not play a significant role in shaping attitudes, at least in terms of the levels of proximity experienced by survey respondents in our study area.

Using multiple tests of the data we could find no significant correlation between distance from wind turbines and support or opposition to the local wind power facilities. Rather than distance from turbines, we found that how respondents view the impacts or benefits from wind energy development is most influential in accounting for their opposition or support. The takeaway from this study, as with the findings from the five-community comparison chapter, is that respondents weigh the benefits and impacts of utility-scale wind power developments differently and that beliefs are correlated with a more complex and nuanced array of factors than can be captured with the simplistic logic that is involved in analyses focusing primarily on linear distance from turbines. This finding again (as explored in the previous chapter) helps to explain why such a myriad of explanatory factors have been offered to account for varying attitudes toward wind energy, and why factors identified as important in one study can show little effect in another. This result helps to clarify the contradictory findings in the body of literature exploring wind energy attitudes by recognizing the importance of the larger contexts each specific development is set within, and reminds us of the need to be careful of over-generalizing our findings when extrapolating from particular study settings.

**Limitations and Directions for Future Research**

The studies contained within this dissertation are, as with all research, limited. The results presented here are of course limited by budget, time, and the blind spots of the researcher. Although these limitations necessarily influence and in some ways constrain the results presented herein, they are also offered as opportunities to further understand the complexities of the factors that might influence public attitudes about the current energy transition. Addressing these limitations will provide further insight and help to address and ameliorate complications caused by this rapid and far-reaching technological change. Of note are three issues that are particularly limiting to our current studies as well as the larger body of research and that represent especially relevant considerations for future research: time, space, and replication.

**Time**

As is true of all studies based on cross-sectional survey data, one important limitation that should be addressed in future research is the limitation of the 'snapshot in time' of public attitudes at the day, week, or month the survey was administered. In the absence of longitudinal studies we are left with measures that attempt to capture the views of our respondents at only this single moment in time, and we lack the information needed to fully understand the richness of beliefs, to determine the possible impacts of certain events and experiences in the lives of individuals, or to know how broader patterns of social change may be influencing people's reactions to renewable energy systems in general or to specific renewable developments. Further, we do not know how the attitudes we have measured might change over time. For example, our understanding of opposition to wind power would greatly benefit from follow-up studies to understand if support or opposition is long-lasting or merely a temporal 'blip' as residents of local communities become accustomed or grow to dislike the presence of large-scale renewable facilities and the changes they create. Cross-sectional survey data have been used in most research focused on attitudes toward renewable energy, and as such, all of our knowledge suffers from this 'snapshot in time' effect. Additional studies would be wise to resample previous study populations to help clarify the effect that time has on attitudes about renewable energy.

**Space**

Just as our results suffer from being time bound, they also suffer from the limitations of the specific geographic area and local study sites included in our research.

Our five-community survey and the statewide reach of our Utah mail survey help to show that views about renewable energy are influenced by local area contexts, yet at the same time display consistencies that help to support the generalizability of our findings. Nevertheless, we are left without the ability to confidently generalize our results to larger scales and different contexts. The proximity paper in particular would benefit from studies including additional development settings and a broader range of spatial scales involving both greater proximity and greater separation between residences and wind turbines. Expanding our sample to other contexts and to include a greater range of distances from turbines would enhance the ability to assess the possible effects of proximity on attitudes about wind energy development.

**Replication**

There has been much confusion in the research about the effects of different factors on attitudes toward renewable energy. Chapter VI dissected one particularly messy factor, NIMBY, and showed how earlier research poorly measured and poorly conceptualized this term. Just as much of the confusion about this term is due in part to measurement issues, a number of other contradictory results reported from research about renewable energy attitudes also may be due to inconsistencies and limitations in measurement techniques. The issues of space and time identified above would be much more easily confronted and future research would benefit greatly from more consistent conceptualization and the use of more standardized measures of relevant concepts. Repeated use of the same measures across multiple studies and multiple study settings, including repeated use of our questionnaire (in whole or even in part), would help us understand the influence of time and other factors on attitudes as well as increasing the ability to generalize findings beyond the contexts of specific study areas. Repeated use of the survey instrument would limit the differences caused by question wording and would offer stronger comparisons between sampled areas. Through more consistent research efforts, social scientists will be better prepared to apply what we have learned and identify strategies to better manage both the benefits and the impacts caused by the technological shift in energy systems, and help to smooth the inevitable social and economic transitions that will occur as human societies respond to living in a carbon-constrained world.

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# APPENDICES

# APPENDIX A

## SOCIO-DEMOGRAPHIC CHARACTERISTIC COMPARISON OF UTAH SURVEY RESPONDENTS AND STATEWIDE POPULATION

| Subject | **Categories** | **Utah** | **Weighted sample** |
|---|---|---|---|
| Age (years) | 18-29 | 28.9% | 13.5% |
| | 30-49 | 37.2% | 34.6% |
| | 50-69 | 24.9% | 35.8% |
| | 70 and over | 9.0% | 16.2% |
| Sex | Percent male | 50.2% | 50.3% |
| | Percent female | 49.8% | 49.7% |
| Educational attainment (25 years or older) | Some high school | 9.4% | 1.8% |
| | High school graduate/GED | 24.4% | 13.4% |
| | Some college or associate's degree | 36.6% | 37.3% |
| | College graduate (bachelor's degree) | 20.1% | 26.2% |
| | Post graduate degree (master's/PhD) | 9.5% | 21.2% |
| Religion | Latter-day Saints (LDS) | 69.0% | 58.9% |
| | Non-LDS | 31.0% | 41.1% |
| Income ($) | 0–24,999 | 17.5% | 14.4% |
| | 25,000–49,999 | 24.7% | 28.3% |
| | 50,000–74,999 | 22.2% | 20.8% |
| | 75,000–99,999 | 14.5% | 12.3% |
| | 100,000–149,999 | 13.7% | 17.8% |
| | 150,000–199,999 | 4.1% | 3.1% |
| | 200,000 or more | 3.3% | 3.3% |
| Residence 1 year ago | Percent same | 82.3% | 95.1% |
| | Percent different | 17.7% | 4.9% |
| Average household size | | 3.06 | 2.97 |

# APPENDIX B

# SOCIO-DEMOGRAPHIC CHARACTERISTIC COMPARISON OF FIVE COMMUNITY SURVEY RESPONDENTS BY COMMUNITY AND SURVEY AVERAGES

| Subject | Categories | Survey Average | Bonneville County | Beaver County | Rawlins (Carbon County) | Saratoga (Carbon County) | San Juan County |
|---|---|---|---|---|---|---|---|
| Age (years) | 18-29 | 9.7% | 6.3% | 12.9% | 10.5% | 9.2% | 9.5% |
| | 30-49 | 40.0% | 45.1% | 43.2% | 40.8% | 23.6% | 46.6% |
| | 50-69 | 35.9% | 36.0% | 30.8% | 35.5% | 45.4% | 32.3% |
| | 70 and over | 14.4% | 12.6% | 12.9% | 13.2% | 21.8% | 11.6% |
| Sex | Percent female | 46.4% | 48.3% | 45.2% | 48.4% | 38.6% | 51.3% |
| | Percent male | 53.6% | 51.7% | 54.8% | 51.6% | 61.4% | 48.7% |
| Educational attainment | Some high school | 3.8% | 1.1% | 6.4% | 5.2% | 2.3% | 4.2% |
| | High school graduate/GED | 23.1% | 15.6% | 29.4% | 31.8% | 22.2% | 17.9% |
| | Some college or associate's degree | 39.8% | 38.3% | 42.8% | 40.9% | 36.4% | 40.5% |
| | College graduate (bachelor's degree) | 21.9% | 29.0% | 14.4% | 16.9% | 25.0% | 23.7% |
| | Post graduate degree (master's/PhD) | 11.4% | 16.0% | 7.0% | 5.2% | 14.2% | 13.7% |
| Religion | Latter-day Saints (LDS) | 38.0% | 58.6% | 51.4% | 5.6% | 5.9% | 62.0% |
| | Catholic | 13.2% | 2.5% | 10.9% | 21.7% | 15.9% | 15.8% |
| Income ($) | 0–24,999 | 13.6% | 8.8% | 17.9% | 12.1% | 17.0% | 12.2% |
| | 25,000–49,999 | 25.6% | 21.3% | 26.2% | 18.6% | 24.5% | 35.4% |
| | 50,000–74,999 | 23.6% | 20.0% | 29.8% | 21.4% | 20.1% | 26.0% |
| | 75,000–99,999 | 16.0% | 20.6% | 11.9% | 22.1% | 13.8% | 12.7% |
| | 100,000–124,999 | 11.1% | 15.0% | 9.5% | 10.0% | 15.1% | 6.6% |
| | 125,000-149,999 | 5.1% | 5.0% | 3.0% | 10.7% | 4.4% | 3.3% |
| | 150,000–199,999 | 3.0% | 6.3% | 1.8% | 3.6% | 1.9% | 1.7% |
| | 200,000 or more | 2.0% | 1.0% | 0.0% | 1.4% | 3.1% | 2.2% |
| Residence 1 year ago | Percent same | 95.0% | 96.7% | 95.7% | 94.2% | 93.2% | 94.8% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Percent different | 5.0% | 3.3% | 4.3% | 5.8% | 6.8% | 5.2% |
| Average household size | | 3.0 | 3.4 | 3.1 | 2.7 | 2.5 | 3.3 |

# APPENDIX C

# CHARTS COMPARING THREATS AND OPPORTUNITIES OF WIND ENERGY BY COMMUNITY

**Chart C-1.** Belief that wind power is a danger to wildlife.

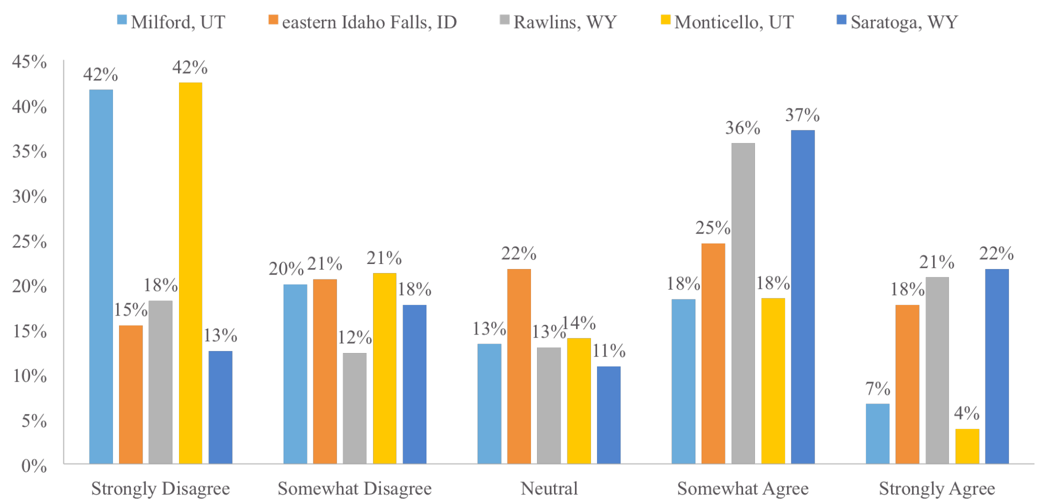



**Chart C-2.** Belief that wind power causes a decline in nearby property values.

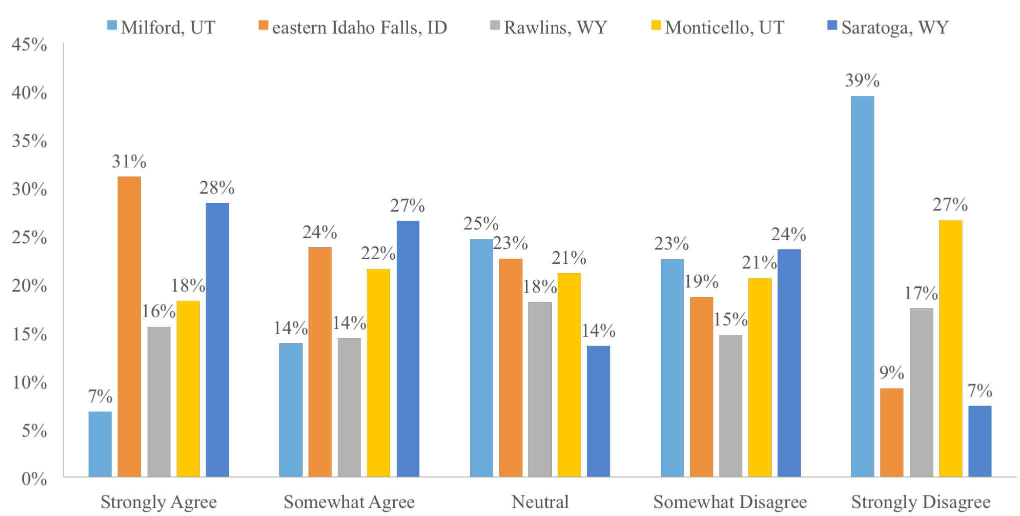
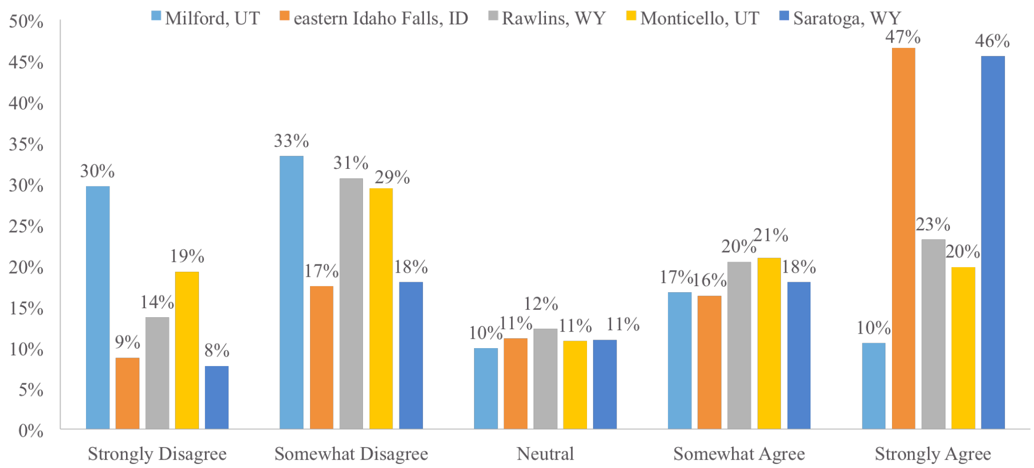
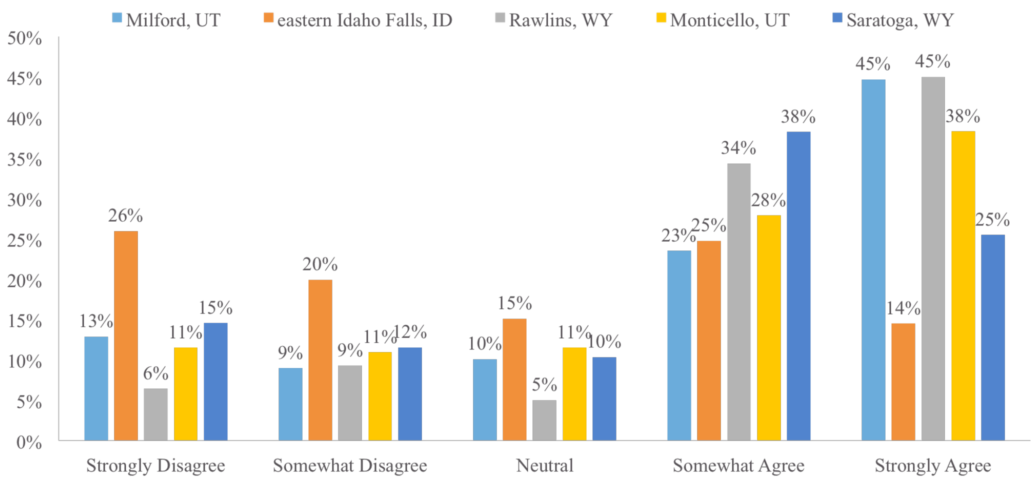


**Chart C-3.** Belief that wind power is visually impactful.



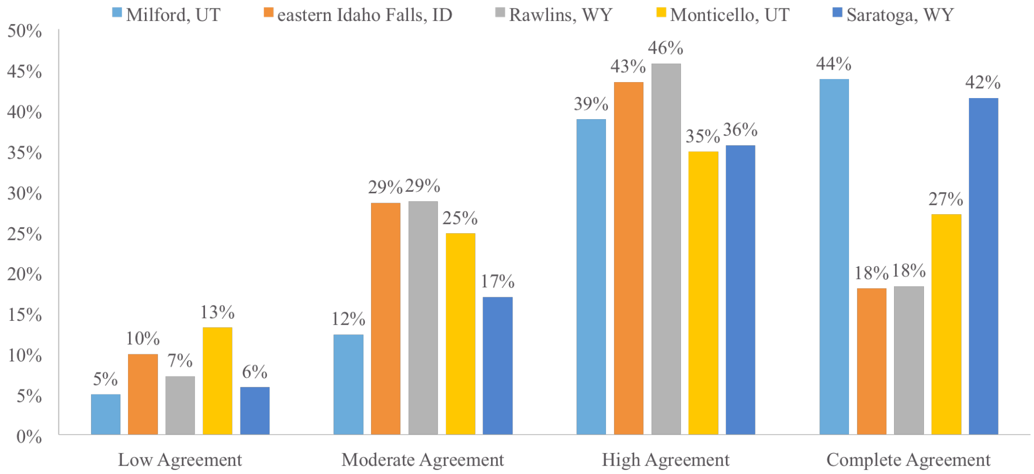

A summated scale of two five item Likert questions: "Wind power is an unattractive feature of the landscape," and reverse coded, "Adds an interesting feature to the landscape" Cronbach Alpha: .802

**Chart C-4.** Belief that wind power brings local economic benefits.




Summated scale of two 5-item Likert questions: "Provides economic benefit to the local area," "Creates new job opportunities for local residents." Cronbach Alpha= .899

**Chart C-5.** Belief that wind power is a "clean and green" energy source.




Summated Scale of four 5-item Likert questions: "Is a safe energy source," "Is a clean energy source," "Results in no greenhouse gas emissions," "Is a renewable resource." Cronbach Alpha: .837

**Chart C-6.** Levels of agreement that adequate opportunities were provided to participate in public meetings or other parts of the planning process for nearby wind power facilities.

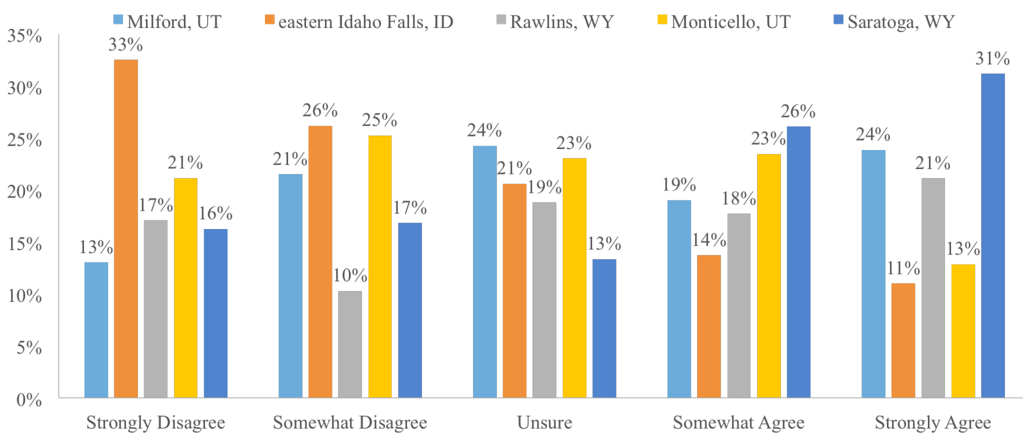
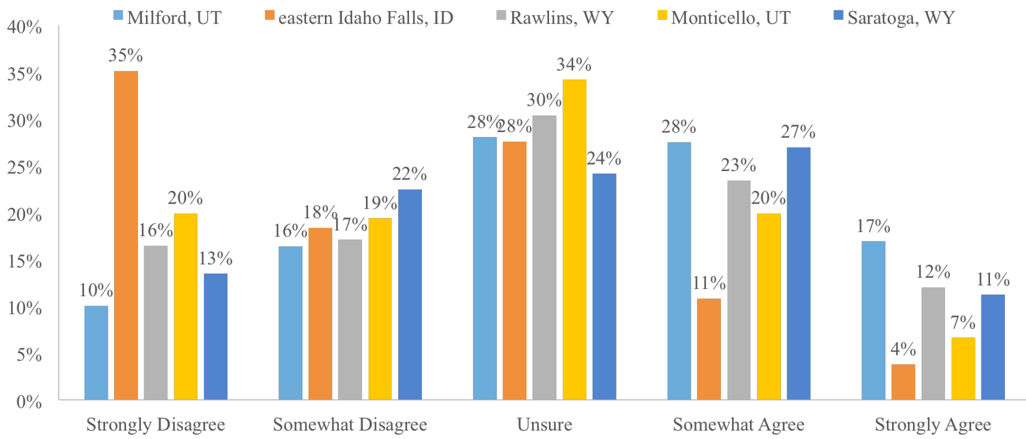


**Chart C-7.** Levels of agreement that adequate information about nearby wind power development was provided before it was built/during the pre-construction planning period.

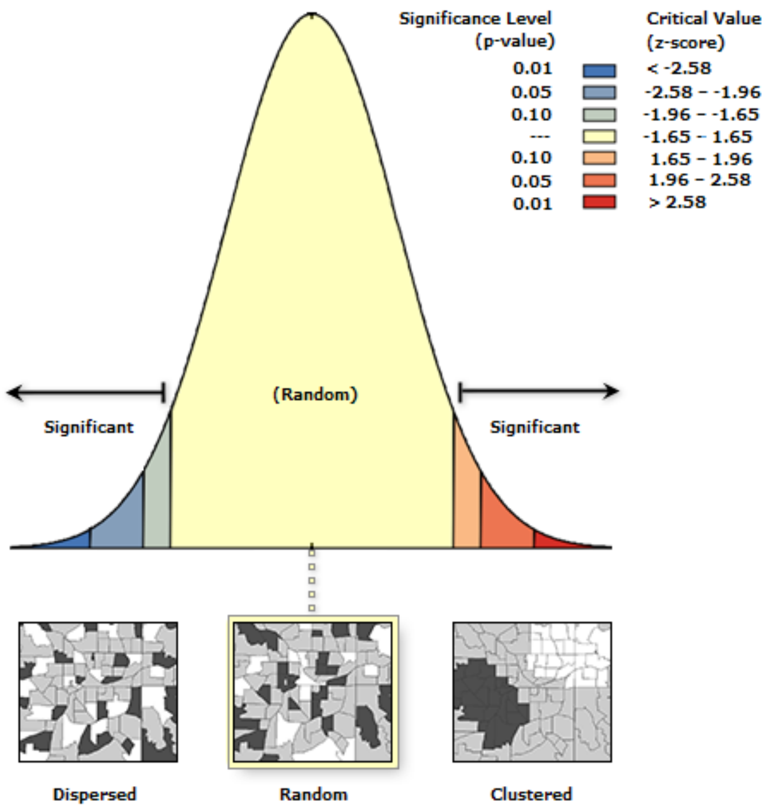


APPENDIX D

SPATIAL AUTOCORRELATION REPORT OF PATTERNS OF VOTING

"FOR" OR "AGAINST" WIND DEVELOPMENT

**Moran's Index:** 0.024589
**z-score:** 1.561742
**p-value:** 0.118349

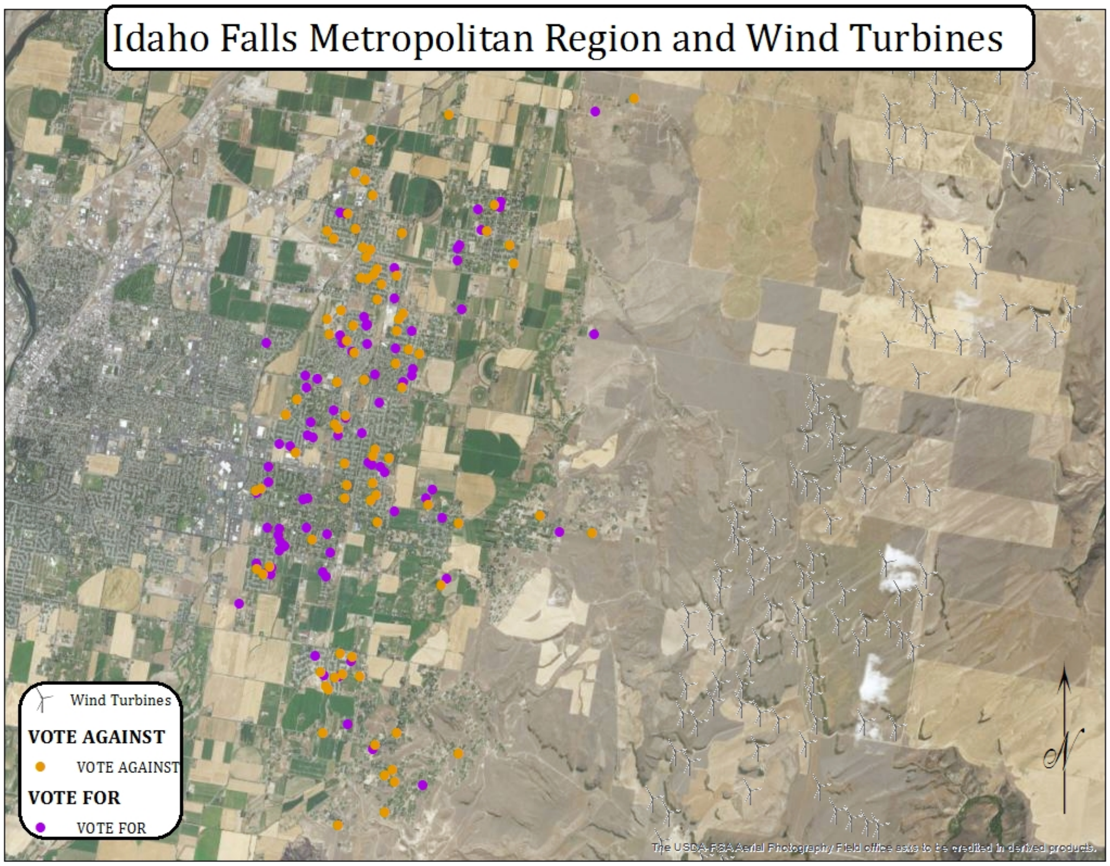



Given the z-score of 1.56, the pattern does not appear to be significantly different than random.

| Global Moran's I Summary | |
|---|---|
| Moran's Index: | 0.024589 |
| Expected Index: | -0.006135 |
| Variance: | 0.000387 |
| z-score: | 1.561742 |
| p-value: | 0.118349 |

# APPENDIX E

## MAP OF "VOTES FOR" AND "VOTES AGAINST" WIND ENERGY DEVELOPMENT AND PROXIMITY TO WIND TURBINES



APPENDIX F

UTAH MAIL SURVEY QUESTIONNAIRE

**Your Views on the Environment, Energy, and Solar and Wind Energy**

We would like you to participate in a survey being conducted by Utah State University (USU) regarding your attitudes and views on the environment, traditional energy sources, and solar and wind energy. In this survey, you will be asked to voice your opinions on a variety of issues, including current and future development of utility-scale solar and wind power.

If you come to a question you are unable to answer please just leave it blank and move on to the next question. The survey should take approximately 15 minutes to complete.

**Who should complete this questionnaire?**

*This questionnaire is being delivered to a random sample of households throughout Utah. To further randomize participation in the survey, we ask that this questionnaire be completed by the adult (age 18 or older) member of your household whose birthday occurred most recently.*

- Please carefully read all directions and mark your responses clearly.
- Feel free to write any comments or explanations directly on the questionnaire in the margins or in available blank space.
- As soon as you have finished, please seal the completed questionnaire in the provided business reply envelope, and drop it in the mail. No postage is necessary.
- To insure your privacy please do not write your name or address on the questionnaire.

If you have any questions, please contact Dr. Richard Krannich at Utah State University either by email (Richard.Krannich@usu.edu ) or by telephone (435-797-1241).

**Thank you very much for your help!**

1. **Do you regularly participate in any of the following outdoor activities?**
**(*Please place an 'x' in the box of all the activities you participate in)***

- ☐ Hiking?
- ☐ Hunting?
- ☐ ATV or dirt-biking?
- ☐ 4-wheel driving or jeeping?
- ☐ Bicycling or mountain biking?
- ☐ Camping or backpacking?
- ☐ Bird watching, wildlife viewing or nature photography?
- ☐ Target shooting (archery or firearms)?
- ☐ Picnicking?
- ☐ Motor-boating?
- ☐ Fishing?
- ☐ Snow sports (skiing, snowboarding, cross-country, etc)?
- ☐ Gardening?
- ☐ Other outdoor activities?

2. **How would you rate the condition of the environment, in the areas where you most frequently engage in outdoor recreation activities, that is, the overall condition and quality of the air, water, land, and wildlife?**

| ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|
| Excellent | Good | Fair | Poor |

3. **How would you rate the overall condition of the environment in your <u>LOCAL COMMUNITY</u>?**

| ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|
| Excellent | Good | Fair | Poor |

4. **How would you rate the overall condition of the environment in the state of <u>UTAH</u>?**

| ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|
| Excellent | Good | Fair | Poor |

5. **How would you rate the overall condition of the environment in the <u>WORLD</u>?**

| ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|
| Excellent | Good | Fair | Poor |

6. **Following are several statements regarding general environmental attitudes. To what extent do you agree or disagree with the following statements? (*Please place an 'x' in the box corresponding to your answer)***

| | Strongly Disagree | Somewhat Disagree | Unsure | Somewhat Agree | Strongly Agree |
|---|---|---|---|---|---|
| We are approaching the limit of the number of people the earth can support. | □ | □ | □ | □ | □ |
| Humans have the right to modify the natural environment to suit their needs. | □ | □ | □ | □ | □ |
| When humans interfere with nature it often produces disastrous consequences. | □ | □ | □ | □ | □ |
| Human ingenuity will insure that we do NOT make the earth unlivable. | □ | □ | □ | □ | □ |
| Humans are severely abusing the environment. | □ | □ | □ | □ | □ |
| The earth has plenty of natural resources if we just learn how to develop them. | □ | □ | □ | □ | □ |
| The so-called "ecological crisis" facing humankind has been greatly exaggerated. | □ | □ | □ | □ | □ |
| The earth is like a spaceship with very limited room and resources. | □ | □ | □ | □ | □ |
| The balance of nature is very delicate and easily upset. | □ | □ | □ | □ | □ |
| If things continue on their present course, we will soon experience a major ecological catastrophe. | □ | □ | □ | □ | □ |

7. **Many government policies are designed to protect the environment, but some of these policies can be costly to corporations and other businesses. Which of the following captures your general opinion? Environmental regulations in the U.S. are...**

| ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|
| Excessively Strong | Too Strong, but Not Excessive | About Right | Need to be Somewhat Stronger | Need to be a Lot Stronger |

8. **Do you generally support or oppose the following proposals?** ***(Please place an 'x' in the box corresponding to your answer)***

| | Strongly Support | Moderately Support | Neutral | Moderately Oppose | Strongly Oppose |
|---|---|---|---|---|---|
| Setting higher emissions and pollution standards for business and industry | ☐ | ☐ | ☐ | ☐ | ☐ |
| Spending more government money on developing solar and wind power | ☐ | ☐ | ☐ | ☐ | ☐ |
| Spending government money to develop alternate sources of fuel for automobiles | ☐ | ☐ | ☐ | ☐ | ☐ |
| Imposing mandatory controls on carbon dioxide emissions and other greenhouse gases | ☐ | ☐ | ☐ | ☐ | ☐ |
| Opening up more land owned by the federal government for oil and gas exploration | ☐ | ☐ | ☐ | ☐ | ☐ |
| More strongly enforcing existing federal environmental regulations | ☐ | ☐ | ☐ | ☐ | ☐ |
| Setting higher emissions standards for automobiles | ☐ | ☐ | ☐ | ☐ | ☐ |
| Expanding the use of nuclear energy | ☐ | ☐ | ☐ | ☐ | ☐ |

**According to the U.S. Environmental Protection Agency, global warming involves** ***"the recent and ongoing rise in global average temperature near the Earth's surface. It is caused mostly by increasing concentrations of greenhouse gases in the atmosphere. Global warming is causing climate patterns to change. However, global warming itself represents only one aspect of climate change...climate change includes***

***major changes in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer.***"

9. **There is a lot of talk about global warming caused by carbon dioxide emissions from automobiles, industrial processes, and burning coal, natural gas, and oil to generate electricity. In thinking about the important problems facing the United States, do you consider this problem:**

| ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|
| Very Important | Somewhat Important | Not Very Important | Not Important At All |

10. **Which of the following statements comes closest to your views about global warming and climate change? *(Please mark the appropriate box)***

☐ Global warming is a very serious problem and should be one of the highest priorities for government action
☐ Global warming is serious but does not need to be a high priority for action right now
☐ Global warming is not a serious problem and can be addressed years from now if and when it becomes necessary
☐ Global warming does not exist at all

11. **Some ways of generating electricity may be harmful to the environment because they produce air pollution, water pollution, toxic wastes, or other environmental problems. How environmentally harmful do you think each of these power sources is? (*Please place an 'x' in the appropriate box)***

| | Very Harmful | Moderately Harmful | Somewhat Harmful | Slightly Harmful | Not Harmful At All | Don't Know |
|---|---|---|---|---|---|---|
| Coal fired power plants | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Wind energy | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Solar energy | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Geothermal energy | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Hydro power | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Nuclear energy | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| | Very Harmful | Moderately Harmful | Somewhat Harmful | Slightly Harmful | Not Harmful At All | Don't Know |
|---|---|---|---|---|---|---|
| Oil fired power plants | □ | □ | □ | □ | □ | □ |
| Natural gas fired power plants | □ | □ | □ | □ | □ | □ |

12. **Consumers, such as you, have more and more say in how electricity is produced in the United States. To meet the country's electric power needs over the next 25 years, new power plants will have to be built. Companies and government agencies need to start planning today. How should we meet this demand? For each power source listed below indicate whether you feel the U.S should INCREASE or REDUCE its use.**

| | Reduce A Lot | Reduce Somewhat | Keep Same | Increase Somewhat | Increase A Lot | Don't Know |
|---|---|---|---|---|---|---|
| Coal fired power plants | □ | □ | □ | □ | □ | □ |
| Wind energy | □ | □ | □ | □ | □ | □ |
| Solar energy | □ | □ | □ | □ | □ | □ |
| Geothermal energy | □ | □ | □ | □ | □ | □ |
| Hydro power | □ | □ | □ | □ | □ | □ |
| Nuclear energy | □ | □ | □ | □ | □ | □ |
| Oil fired power plants | □ | □ | □ | □ | □ | □ |
| Natural gas fired power plants | □ | □ | □ | □ | □ | □ |

13. **Some people say using coal to generate electricity is a good idea because it is readily available in North America and there are new methods for using coal that cause less pollution. Other people say most coal use is a bad idea because it still causes pollution and coal mining hurts the landscape and wildlife. What do you think? Do you approve or disapprove of using coal to generate electricity?**

| ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|
| Strongly Disapprove | Somewhat Disapprove | Neutral | Somewhat Approve | Strongly Approve |

14. **Some people say using renewable energy sources, like solar and wind power, to generate electricity is a good idea because they are readily available and better for the environment. Other people say using renewable energy sources is a bad idea because they are too expensive, can be unreliable and can still have negative environmental consequences. What do you think? Do you approve or disapprove of renewable energy sources to generate electricity?**

| ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|
| Strongly Disapprove | Somewhat Disapprove | Neutral | Somewhat Approve | Strongly Approve |

15. **When government and private companies make policy decisions concerning the kind of generating plants that produce electricity and the fuel those plants would use, how important do you think each of the following considerations should be?**

| | Extremely Important | Very Important | Moderately Important | Not That Important |
|---|---|---|---|---|
| Safety considerations at the power plants and the areas surrounding them | ☐ | ☐ | ☐ | ☐ |
| Reducing the country's dependence on foreign sources of oil | ☐ | ☐ | ☐ | ☐ |
| Reducing pollution and the risk of other damage to the environment | ☐ | ☐ | ☐ | ☐ |
| Keeping prices for electricity at current levels | ☐ | ☐ | ☐ | ☐ |
| Encouraging economic growth and job creation | ☐ | ☐ | ☐ | ☐ |

16. **To meet new electricity demand, utilities will have to build additional power plants. How would you feel if a new <u>NATURAL GAS FIRED POWER PLANT</u> was built within 25 miles of your home?**

| □ | □ | □ | □ | □ |
|---|---|---|---|---|
| Strongly Disapprove | Somewhat Disapprove | Neutral | Somewhat Approve | Strongly Approve |

17. **How would you feel if a new <u>COAL FIRED POWER PLANT</u> was built within 25 miles of your home?**

| □ | □ | □ | □ | □ |
|---|---|---|---|---|
| Strongly Disapprove | Somewhat Disapprove | Neutral | Somewhat Approve | Strongly Approve |

18. **How would you feel if a new <u>NUCLEAR POWER PLANT</u> was built within 25 miles of your home?**

| □ | □ | □ | □ | □ |
|---|---|---|---|---|
| Strongly Disapprove | Somewhat Disapprove | Neutral | Somewhat Approve | Strongly Approve |

*The next four questions focus on your views and attitudes about utility-scale wind and solar power. When we ask about solar or wind power we are not asking you to think about household rooftop solar panels or a single wind turbine, but instead to think about utility-scale developments. Utility-scale means a large installation of these technologies, such as a wind farm with 100 or more wind turbines that are 200-300 feet tall, 500-3000 acres of photo-voltaic solar panels, or 500-3000 acres of mirrors and a 400-500 foot tall tower for a concentrated solar thermal power plant.*

19. **Have you ever seen a utility-scale <u>WIND POWER FACILITY</u>?**

□ Yes □ No

20. **Have you ever seen a utility-scale <u>WIND POWER FACILITY</u> anywhere in <u>UTAH</u>?**

□ Yes □ No

21. **Have you ever seen utility-scale SOLAR POWER FACILITY?**

□ Yes □ No

22. **Have you ever seen a utility-scale SOLAR POWER FACILITY anywhere in UTAH?**

□ Yes □ No

23. **How would you feel about the construction of a utility-scale WIND POWER FACILITY (with at least 100 250-foot tall towers) being built:** ***(Please place an 'x' in the appropriate box)***

| | Strongly Oppose | Somewhat Oppose | Neutral | Support | Strongly Support |
|---|---|---|---|---|---|
| Within sight of your home | □ | □ | □ | □ | □ |
| Within 2 miles of your home | □ | □ | □ | □ | □ |
| Within 25 miles of your home | □ | □ | □ | □ | □ |
| Within Utah | □ | □ | □ | □ | □ |
| Within the U.S., but outside of Utah | □ | □ | □ | □ | □ |

24. **How would you feel about the construction of a utility-scale SOLAR POWER FACILITY (covering 500 or more acres) being built:**

| | Strongly Oppose | Somewhat Oppose | Neutral | Support | Strongly Support |
|---|---|---|---|---|---|
| Within sight of your home | ◻ | ◻ | ◻ | ◻ | ◻ |
| Within 2 miles of your home | ◻ | ◻ | ◻ | ◻ | ◻ |
| Within 25 miles of your home | ◻ | ◻ | ◻ | ◻ | ◻ |
| Within Utah | ◻ | ◻ | ◻ | ◻ | ◻ |
| Within the U.S., but outside of Utah | ◻ | ◻ | ◻ | ◻ | ◻ |

25. **Do you agree or disagree with the following statements about utility-scale <u>WIND POWER FACILITIES</u>?**

| | Strongly Agree | Somewhat Agree | Neutral | Somewhat Disagree | Strongly Disagree | Don't Know |
|---|---|---|---|---|---|---|
| Is an unattractive feature of the landscape | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Is a danger to wildlife | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Is a safe energy source | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Is a clean energy source | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Results in no greenhouse gas emissions | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Requires little or no water | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Is an unreliable source of electricity | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Is a renewable resource | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Provides economic benefit to the local area | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Creates new job opportunities for local residents | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Adds an interesting feature to the landscape | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Produces unacceptable levels of noise | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

26. **Do you agree or disagree with the following statements about utility-scale <u>SOLAR POWER FACILITIES</u>?**

| | Strongly Agree | Somewhat Agree | Neutral | Somewhat Disagree | Strongly Disagree | Don't Know |
|---|---|---|---|---|---|---|
| Is an unattractive feature of the landscape | □ | □ | □ | □ | □ | □ |
| Is a danger to wildlife | □ | □ | □ | □ | □ | □ |
| Is a safe energy source | □ | □ | □ | □ | □ | □ |
| Is a clean energy source | □ | □ | □ | □ | □ | □ |
| Results in no greenhouse gas emissions | □ | □ | □ | □ | □ | □ |
| Requires little or no water | □ | □ | □ | □ | □ | □ |
| Is an unreliable source of electricity | □ | □ | □ | □ | □ | □ |
| Is a renewable resource | □ | □ | □ | □ | □ | □ |
| Provides economic benefit to the local area | □ | □ | □ | □ | □ | □ |
| Creates new job opportunities for local residents | □ | □ | □ | □ | □ | □ |
| Adds an interesting feature to the landscape | □ | □ | □ | □ | □ | □ |

27. **Have any utility-scale wind or solar power facilities been built near where you live, or in a place that you regularly spend time?**

□ Yes→ If you select yes, please continue to QUESTION 28
□ No→ If you select no, please SKIP ahead to QUESTION 35

28. **What type of renewable energy facility has been developed near where you live or in a place that you spend time?**

□ Wind
□ Solar
□ Other (please specify)

29. **When was this renewable energy facility developed?**

| ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|
| Still in the planning stages | Currently under construction | Less than one year ago | Within the past two years | More than two years ago |

30. **How close do you live to this renewable energy facility?**

| ☐ | ☐ | ☐ |
|---|---|---|
| Less than one mile | Between one and five miles | More than five miles |

31. **How often do you see this renewable energy facility?**

| ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|
| Every day | A few times a week | A few times a month | A few times a year or less |

32. **What was your general attitude about this renewable energy facility before it was built?**

| ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|
| Very Negative | Somewhat Negative | Neutral | Somewhat Positive | Very Positive |

33. **Has this project changed how you feel towards renewable energy?**

| ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|
| I am more supportive | I am slightly more supportive | No change | I am slightly more opposed | I am more opposed |

34. **How has renewable energy development changed conditions in the local area where this project was built?**

| ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|
| Made Much Better | Made Slightly Better | No Change | Made Worse | Made Much Worse |

***To enable us to compare the responses of residents with similar or different characteristics, in this section we ask you to provide us with some information about yourself and your household. Please indicate the appropriate answer or fill in the appropriate information for each question. As with all your answers, the information that you provide will remain completely confidential.***

35. **What is your gender?**

- ◻ Female
- ◻ Male

36. **In what year were you born? (enter 4-digit birth year; for example, 1976)**

[ ]

37. **What is the highest level of education you have completed?**

- ☐ Some high school
- ☐ High school graduate/GED
- ☐ Some college or associate's degree
- ☐ College graduate (Bachelor's degree)
- ☐ Post graduate degree (Master's/PhD)

38. **In what ZIP code is your home located? (enter 5-digit ZIP code; for example, 84322)**

[ ]

39. **How long have you lived in this community?**

| ◻ | ◻ | ◻ | ◻ | ◻ |
|---|---|---|---|---|
| Less than one year | One to two years | Between two and five years | Between six and ten years | More than ten years |

40. **How many people currently live in your household?**

[ ]

41. **Are any of those currently living in your household under the age of 18?**

☐ Yes ☐ No

42. **How do you describe your political views?**

| ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|
| Very Conservative | Moderately Conservative | Moderate | Moderately Liberal | Very Liberal |

43. **What is your religious affiliation, if any?** ***(Please place an 'x' in the appropriate box)***

| | |
|---|---|
| ☐ Buddhist | ☐ Muslim |
| ☐ Catholic | ☐ Protestant (e.g., Baptist, Episcopalian, Lutheran, Methodist, etc.) |
| ☐ Jewish | ☐ Latter-Day Saint |
| ☐ Hindu | ☐ None |

☐ Other religious faith not listed above:

44. **Which of the following best approximates your total pre-tax annual household income?**

| | |
|---|---|
| ☐ $0-$24,999 | ☐ $100,000-$124,999 |
| ☐ $25,000-$49,999 | ☐ $125,000-$149,999 |
| ☐ $50,000-$74,999 | ☐ $150,000-$199,999 |
| ☐ $75,000-$99,999 | ☐ $200,000 or more |

*Thank you for your cooperation! Please feel free to use any available space in this questionnaire or in a separate letter to tell us any additional information or share other comments.*

**Once you have completed the questionnaire please seal it in the business reply envelope provided, and just drop it in the mail – no additional postage is needed.**

# APPENDIX G

## NOTES ON QUESTION DEVELOPMENT FOR UTAH MAIL SURVEY

Notes on Question Development for Utah Mail Survey, "Your Views on the Environment, Energy, and Solar and Wind Development"

In designing our survey, a number of sources were consulted either as a guide or, anticipating comparisons, as a source of questions for the survey questionnaire.

Survey question sources included the following:

CNN Nuclear Power Survey. Conducted by Opinion Research Corporation in March 19-20 2011. Abbreviated: CNN 2011.

Gallup Poll Social Series: Environment. American's Split on Energy vs. Environment. March 8-11 2012. Abbreviated: Gallup 2012.

ICPSR Poll number 23443. Conducted by Inter-University Consortium for Political and Social Research for CBS/New York Times Monthly Poll April 2007. Abbreviated: CBS/NYT 2007.

MIT Energy Survey. Knowledge Network survey conducted for Stephen Ansolabehere at Massachusetts Institute of Technology in June 28, 2002. Abbreviated: MIT 2002.

MIT Energy Survey. Knowledge Network survey conducted for American Clean Skies Foundation in January 29, 2008. Abbreviated: MIT 2008.

Wind Energy Public Perception Survey. Conducted by Jeffery Swofford with the Texas Christian University Wind Research Initiative in 2009. Abbreviated: Swofford 2009.

The survey instrument question numbers listed below correspond to individual items in the Utah statewide mail survey questionnaire (appendix 1a). Questions not derived from other surveys are omitted. Modifications to the question or response scale are noted below.

Question 2-5: Modified from: "How would you rate the condition of the environment in the WORLD today, that is, the overall condition and quality of the air, water, land, and wildlife? Is it excellent, good, fair, or poor?" CBS/NYT 2007

Question 6: Truncated NEP scale from original 15-item scale created by Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). Measuring endorsement of the new ecological paradigm: A revised NEP scale. Journal of Social Issues, 56(3), 425-442.

Question 7: Same wording in MIT 2002 survey.

Question 8: Gallup 2012. Modified response scale from 3 item (Favor, Oppose, Unsure) to 5-item scale strongly support-strongly oppose.

Question 9: Same wording in MIT 2002 survey

Question 10: CBS/NYT 2007

Question 11: MIT 2002

Question 12: MIT 2002

Question 13-14: CBS/NYT 2007

Question 15: CNN 2011

Questions 16-18: MIT 2008

Question 19-22: Designed for this survey.

Question 23: Modified from Swofford 2009, changing wording of the original question and expanding response categories.

Question 24: Modified from Swofford 2009, changing subject (from wind to solar) and wording of the original question and expanded response categories.

Question 25: Modified from Slattery 2012, increased response categories from 3-item to 6-item scale. Removed two question choices and added four additional questions.

Question 26: Modified from Slattery 2012, changed question subject from wind to solar and increased response categories from 3-item to 6-item scale. Removed two question choices and added four additional questions.

Question 27: Designed for this survey.

Question 28: Designed for this survey.

Question 29: Designed for this survey.

Question 30: Designed for this survey.
Question 31: Designed for this survey.

Question 32: Swofford 2009.

Question 33: Designed for this survey.

Question 34: Designed for this survey.

Questions 35-44: Standard demographic questions.

# APPENDIX H

## FIVE-COMMUNITY DROP-OFF/PICK-UP SURVEY QUESTIONNAIRE

Five-Community Drop-Off/Pick-Up Survey Questionnaire "Perspectives on Energy Development in [County Name]"

**Perspectives on Energy Development in Beaver County, Utah**
*A Survey of Beaver County Citizens*

We would like you to participate in a survey being conducted by Utah State University regarding your views on renewable energy, traditional energy sources, and the environment. In this survey, you will be asked to voice your opinions on a variety of issues, including recent and future development of utility-scale wind power facilities near your community.

If you come to a question you are unable to answer please just leave it blank, and move on to the next question. The survey should take approximately 15-20 minutes to complete.

**Who should complete this questionnaire?**

*This questionnaire is being delivered to a random sample of households in Beaver County. To further randomize participation in the survey, we ask that the questionnaire be completed by the adult (age 18 or older) member of your household whose birthday occurred most recently.*

- Please carefully read all directions and mark your responses clearly.
- Feel free to write any comments or explanations directly on the questionnaire in the margins or in available blank space.
- When you are finished please seal the completed questionnaire in the provided envelope, and attach it to your front door using the plastic doorknob bag. This will allow us to pick it up at the time we've arranged with you, even if you're not home then.
- To insure your privacy, please do not write your name or address on the questionnaire.

If you have any questions, please contact Dr. Richard Krannich at Utah State University either by email (Richard.Krannich@usu.edu ) or by telephone (435-797-1241).

**Thank you very much for your help!**

**1. Some ways of generating electricity may be harmful to the environment because they produce air pollution, water pollution, toxic wastes, or other environmental problems. How environmentally harmful do you think each of these power sources is?** ***Please place an 'x' in the appropriate box.***

| | Very Harmful | Moderately Harmful | Somewhat Harmful | Slightly Harmful | Not Harmful At All | Don't Know |
|---|---|---|---|---|---|---|
| Coal fired power plants | □ | □ | □ | □ | □ | □ |
| Wind energy | □ | □ | □ | □ | □ | □ |
| Solar energy | □ | □ | □ | □ | □ | □ |
| Geothermal energy | □ | □ | □ | □ | □ | □ |
| Hydro power | □ | □ | □ | □ | □ | □ |
| Nuclear energy | □ | □ | □ | □ | □ | □ |
| Natural gas fired power plants | □ | □ | □ | □ | □ | □ |

**2. Consumers such as you have more and more say in how electricity is produced in the United States. To meet the country's electric power needs over the next 25 years, new power plants will have to be built. Companies and government agencies need to start planning today. How should we meet this demand? For each power source listed below indicate whether you feel the U.S. should INCREASE or REDUCE its use.**

| | Reduce A Lot | Reduce Somewhat | Keep Same | Increase Somewhat | Increase A Lot | Don't Know |
|---|---|---|---|---|---|---|
| Coal fired power plants | □ | □ | □ | □ | □ | □ |
| Wind energy | □ | □ | □ | □ | □ | □ |
| Solar energy | □ | □ | □ | □ | □ | □ |
| Geothermal energy | □ | □ | □ | □ | □ | □ |
| Hydro power | □ | □ | □ | □ | □ | □ |

| | Reduce A Lot | Reduce Somewhat | Keep Same | Increase Somewhat | Increase A Lot | Don't Know |
|---|---|---|---|---|---|---|
| Nuclear energy | □ | □ | □ | □ | □ | □ |
| Natural gas fired power plants | □ | □ | □ | □ | □ | □ |

**3. Some people say using coal to generate electricity is a good idea because it is readily available in North America and there are new methods for using coal that cause less pollution. Other people say most coal use is a bad idea because it still causes pollution and hurts the landscape and wildlife. What do you think? Do you approve or disapprove of using coal to generate electricity?**

| □ | □ | □ | □ | □ |
|---|---|---|---|---|
| Strongly Disapprove | Somewhat Disapprove | Neutral | Somewhat Approve | Strongly Approve |

**4. Some people say using renewable energy sources, like solar and wind power, to generate electricity is a good idea because they are readily available and better for the environment. Other people say using renewable energy sources is a bad idea because they are too expensive, can be unreliable, and can still have negative environmental consequences. What do you think? Do you approve or disapprove of using renewable energy sources to generate electricity?**

| □ | □ | □ | □ | □ |
|---|---|---|---|---|
| Strongly Disapprove | Somewhat Disapprove | Neutral | Somewhat Approve | Strongly Approve |

**5. Some people say using nuclear energy to generate electricity is a good idea because it provides consistent power and does not release carbon dioxide. Other people say using nuclear energy is a bad idea because it is too expensive and produces radioactive waste that is difficult to store. What do you think? Do you approve or disapprove of using nuclear energy to generate electricity?**

| □ | □ | □ | □ | □ |
|---|---|---|---|---|
| Strongly Disapprove | Somewhat Disapprove | Neutral | Somewhat Approve | Strongly Approve |

**6. Some people say using natural gas to generate electricity is a good idea because it is readily available in North America and burns with less pollution than other fossil fuels. Other people say that burning natural gas still causes pollution and that some methods of extracting natural gas, such as hydraulic fracturing or fracking, can damage the environment. What do you think? Do you approve or disapprove of using natural gas to generate electricity?**

| ◻ Strongly Disapprove | ◻ Somewhat Disapprove | ◻ Neutral | ◻ Somewhat Approve | ◻ Strongly Approve |
|---|---|---|---|---|

**7. How would you feel about the construction of a new utility-scale <u>WIND POWER FACILITY</u> (with at least 100 250-foot tall towers) that would be built:**
***Please place an 'x' in the appropriate box for each item.***

| | Strongly Oppose | Somewhat Oppose | Neutral | Somewhat Support | Strongly Support |
|---|---|---|---|---|---|
| Within sight of your home | ◻ | ◻ | ◻ | ◻ | ◻ |
| Within 5 miles of your home | ◻ | ◻ | ◻ | ◻ | ◻ |
| Within 10 miles of your home | ◻ | ◻ | ◻ | ◻ | ◻ |
| Within 25 miles of your home | ◻ | ◻ | ◻ | ◻ | ◻ |
| Within Utah | ◻ | ◻ | ◻ | ◻ | ◻ |

8. **Do you agree or disagree with the following statements about utility-scale <u>WIND POWER</u>?**

| | Strongly Agree | Somewhat Agree | Neutral | Somewhat Disagree | Strongly Disagree | Don't Know |
|---|---|---|---|---|---|---|
| Is an unattractive feature of the landscape | ◻ | ◻ | ◻ | ◻ | ◻ | ◻ |
| Is a danger to wildlife | ◻ | ◻ | ◻ | ◻ | ◻ | ◻ |
| Is a safe energy source | ◻ | ◻ | ◻ | ◻ | ◻ | ◻ |
| Is a clean energy source | ◻ | ◻ | ◻ | ◻ | ◻ | ◻ |
| Results in no greenhouse gas emissions | ◻ | ◻ | ◻ | ◻ | ◻ | ◻ |
| Is an unreliable source of electricity | ◻ | ◻ | ◻ | ◻ | ◻ | ◻ |

| | | | | | | |
|---|---|---|---|---|---|---|
| Is a renewable resource | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Provides economic benefit to the local area | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Creates new job opportunities for local residents | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Adds an interesting feature to the landscape | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Produces unacceptable levels of noise | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Causes a decline in nearby property values | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

*The next few questions focus on your views about the wind energy development that has occurred a few miles to the north of Milford.*

**9. How close do you live to these wind turbines?**

| ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|
| Less than one mile | Between one and five miles | Between five and ten miles | More than ten miles |

**10. How often do you see these wind turbines?**

| ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|
| Every day | A few times a week | A few times a month | A few times a year or less |

**11. Has the development of this wind energy project near your community changed how you feel towards wind energy?**

| ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|
| I am much more supportive | I am slightly more supportive | No change | I am slightly more opposed | I am much more opposed |

**12. What benefits, if any, do you believe <u>HAVE RESULTED</u> from the development of the wind power facility near your community?** ***Please check YES or NO for each of the following.***

| **Yes** | **No** | |
|---|---|---|
| □ | □ | Increased tax revenues |
| □ | □ | Increased job opportunities |
| □ | □ | Payments to land owners with turbines on their property |
| □ | □ | Payments to nearby landowners with no turbines on their property |
| □ | □ | Cleaner air |
| □ | □ | Cheaper electricity |
| □ | □ | A positive new image for your community |
| □ | □ | New worker training programs |
| □ | □ | New educational opportunities for local students |
| □ | □ | Increased tourism |
| □ | □ | Other (*Please specify*): |

**13. Are there any particular community benefits you <u>WISH</u> would occur as a result of the development of nearby wind energy facilities?** ***Please write them in below.***

**14. What costs or disadvantages, if any, do you feel wind power development has created for your community?** ***Please check YES or NO for each of the following.***

| **Yes** | **No** | |
|---|---|---|
| □ | □ | Increased electricity costs |
| □ | □ | Spoiled the view |
| □ | □ | Hurt wildlife |
| □ | □ | Decreased nearby property values |
| □ | □ | Decreased tourism |
| □ | □ | Caused social conflict within the community |
| □ | □ | Some landowners benefit greatly while others do not |
| □ | □ | Other (*Please specify*): |

**15. To what extent do you agree or disagree that you have had adequate opportunity to participate in public meetings or other parts of the planning process for the wind power development that has occurred near your community?**

| ◻ | ◻ | ◻ | ◻ | ◻ |
|---|---|---|---|---|
| Strongly Disagree | Somewhat Disagree | Unsure | Somewhat Agree | Strongly Agree |

**16. To what extent do you agree or disagree that you received adequate information about the wind power development near your community before it was built?**

| ◻ | ◻ | ◻ | ◻ | ◻ |
|---|---|---|---|---|
| Strongly Disagree | Somewhat Disagree | Unsure | Somewhat Agree | Strongly Agree |

**17. Have you received information about wind energy development from the following sources? *Please check YES or NO for each of the following.***

| <u>**Yes**</u> | <u>**No**</u> | |
|---|---|---|
| ◻ | ◻ | Attended an informational public meeting |
| ◻ | ◻ | From city or county government officials |
| ◻ | ◻ | From the television or radio news |
| ◻ | ◻ | From the local newspaper |
| ◻ | ◻ | From the wind developer's website |
| ◻ | ◻ | From a friend, neighbor, or family member |
| ◻ | ◻ | From a government agency's informational website |
| ◻ | ◻ | From a billboard |
| ◻ | ◻ | Other (*Please specify*): |

**18. If given the choice, would you have voted for or against the wind power development that has occurred near your community?**

◻ Vote For
◻ Vote Against

**19. Following are several statements regarding general environmental beliefs. To what extent do you agree or disagree with the following statements?** ***Please place an 'x' in the box corresponding to your answer.***

| | Strongly Disagree | Somewhat Disagree | Unsure | Somewhat Agree | Strongly Agree |
|---|---|---|---|---|---|
| We are approaching the limit of the number of people the earth can support. | □ | □ | □ | □ | □ |
| Humans have the right to modify the natural environment to suit their needs. | □ | □ | □ | □ | □ |
| When humans interfere with nature it often produces disastrous consequences. | □ | □ | □ | □ | □ |
| Human ingenuity will insure that we do NOT make the earth unlivable. | □ | □ | □ | □ | □ |
| Humans are severely abusing the environment. | □ | □ | □ | □ | □ |
| The earth has plenty of natural resources if we just learn how to develop them. | □ | □ | □ | □ | □ |
| The so-called "ecological crisis" facing humankind has been greatly exaggerated. | □ | □ | □ | □ | □ |
| The earth is like a spaceship with very limited room and resources. | □ | □ | □ | □ | □ |
| The balance of nature is very delicate and easily upset. | □ | □ | □ | □ | □ |
| If things continue on their present course, we will soon experience a major ecological catastrophe. | □ | □ | □ | □ | □ |

**20. Many government policies are designed to protect the environment, but some of these policies can be costly to corporations and other businesses. Which of the following best represents your general opinion? Environmental regulations in the U.S...**

| ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|
| Are Excessively Strong | Are Too Strong, but Not Excessive | Are About Right | Need to be Somewhat Stronger | Need to be a Lot Stronger |

**21. Do you generally support or oppose the following proposals?** ***Please place an 'x' in the box corresponding to your answer.***

| | Strongly Support | Moderately Support | Neutral | Moderately Oppose | Strongly Oppose |
|---|---|---|---|---|---|
| Setting higher emissions and pollution standards for business and industry | ☐ | ☐ | ☐ | ☐ | ☐ |
| Spending more government money on developing solar and wind power | ☐ | ☐ | ☐ | ☐ | ☐ |
| Spending government money to develop alternate sources of fuel for automobiles | ☐ | ☐ | ☐ | ☐ | ☐ |
| Imposing mandatory controls on carbon dioxide emissions and other greenhouse gases | ☐ | ☐ | ☐ | ☐ | ☐ |
| Opening up more land owned by the federal government for oil and gas exploration | ☐ | ☐ | ☐ | ☐ | ☐ |
| More strongly enforcing existing federal environmental regulations | ☐ | ☐ | ☐ | ☐ | ☐ |
| Setting higher emissions standards for automobiles | ☐ | ☐ | ☐ | ☐ | ☐ |
| Expanding the use of nuclear energy | ☐ | ☐ | ☐ | ☐ | ☐ |

**22. Which of the following statements comes closest to your views about global warming and climate change?**

- ☐ Global warming is a very serious problem and should be one of the highest priorities for government action
- ☐ Global warming is serious but does not need to be a high priority for action right now
- ☐ Global warming is not a serious problem and can be addressed years from now if and when it becomes necessary
- ☐ Global warming does not exist at all

*To enable us to compare the responses of residents with similar or different characteristics, in this section we ask you to provide some information about yourself and your household. Please indicate the appropriate answer or fill in the appropriate information for each question. As with all your answers, the information that you provide will remain completely confidential.*

**23. What is your gender?**

☐ Female ☐ Male

**24. In what year were you born? (enter 4-digit birth year; for example, 1976)**

☐

**25. What is the highest level of education you have completed?**

- ☐ Some high school
- ☐ High school graduate/GED
- ☐ Some college or associate's degree
- ☐ College graduate (Bachelor's degree)
- ☐ Post graduate degree (Master's/PhD)

**26. How long have you lived in this community?**

| ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|
| Less than one year | One to two years | Between two and five years | Between six and ten years | More than ten years |

**27. How many people currently live in your household?**

☐

**28. Are any of those currently living in your household under the age of 18?**

☐ Yes ☐ No

**29. How do you describe your political views?**

| ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|
| Very Conservative | Moderately Conservative | Moderate | Moderately Liberal | Very Liberal |

**30. What is your religious affiliation, if any?**

☐ Buddhist
☐ Catholic
☐ Jewish
☐ Hindu
☐ Muslim
☐ Protestant (e.g., Baptist, Episcopalian, Lutheran, Methodist, etc.)
☐ Latter-Day Saint
☐ None
☐ Other religious faith not listed above: __________

**31. Which of the following best approximates your total pre-tax annual household income?**

☐ $0-$24,999
☐ $25,000-$49,999
☐ $50,000-$74,999
☐ $75,000-$99,999
☐ $100,000-$124,999
☐ $125,000-$149,999
☐ $150,000-$199,999
☐ $200,000 or more

***Thank you for your cooperation! Please feel free to use any available space in this questionnaire or in a separate letter to tell us any additional information or share other comments.***

***Once you have completed the questionnaire please seal it in the envelope provided, put it in the enclosed plastic bag, and place it on your outside doorknob so we can retrieve it.***

# APPENDIX I

## NOTES ON QUESTION DEVELOPMENT FOR FIVE-COMMUNITY DROP-OFF/PICK-UP SURVEY

Notes on question development for five-community drop-off/pick-up survey
"Perspectives on Energy Development in [County Name]"

In designing our survey a number of sources were consulted either as a guide or, anticipating comparisons, as a source of questions for the survey questionnaire.

Survey question sources included the following:

CNN Nuclear Power Survey. Conducted by Opinion Research Corporation in March 19-20 2011. Abbreviated: CNN 2011.

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). Measuring endorsement of the new ecological paradigm: A revised NEP scale. Journal of Social Issues, 56(3), 425-442. Abbreviated: Dunlap et al. 2000.

Gallup Poll Social Series: Environment. American's Split on Energy vs. Environment. March 8-11 2012. Abbreviated: Gallup 2012.

ICPSR Poll number 23443. Conducted by Inter-University Consortium for Political and Social Research for CBS/New York Times Monthly Poll April 2007. Abbreviated: CBS/NYT 2007.

MIT Energy Survey. Knowledge Network survey conducted for Stephen Ansolabehere at Massachusetts Institute of Technology in June 28, 2002. Abbreviated: MIT 2002.

MIT Energy Survey. Knowledge Network survey conducted for American Clean Skies Foundation in January 29, 2008. Abbreviated: MIT 2008.

Wind Energy Public Perception Survey. Conducted by Jeffery Swofford with the Texas Christian University Wind Research Initiative in 2009. Abbreviated: Swofford 2009.

The question number corresponds to the mail survey questionnaire (appendix 1a). Modifications to the question or response scale are noted below.

Question 1: Same wording as in MIT 2002.

Question 2: Same wording as in MIT 2002.

Question 3-6: Same wording in questions as in CBS/NYT 2007. Expanded scale from 3-item (good, bad, don't know) to 5-item (Strongly disapprove-Strongly approve).

Question 7: Modified from Swofford 2009, changing wording of the original question and expanding response categories.

Question 8: Modified from Slattery 2012, increased response categories from 3-item to 6-item scale. Removed three question choices and added five additional questions.

Question 9: Designed for this survey.

Question 10: Designed for this survey.

Question 11: Designed for this survey.

Question 12: Designed for this survey.

Question 13: Designed for this survey.

Question 14: Designed for this survey.

Question 15: Designed for this survey.

Question 16: Designed for this survey.

Question 17: Designed for this survey.

Question 18: Designed for this survey.

Question 19: Truncated NEP scale from original 15-item scale created by Dunlap et al. 2000.

Question 20: Same wording in MIT 2002 survey.

Question 21: Gallup 2012. Modified response scale from 3 item (Favor, Oppose, Unsure) to 5-item scale strongly support-strongly oppose.

Question 22: Same wording of question in CBS/NYT 2007 survey.

Questions 23-31: Standard demographic questions.

APPENDIX J

PERMISSION TO REPRINT LETTER FOR CHAPTER III

**From:** Academic Books Permissions <mpkbookspermissions@tandf.co.uk>
**Sent:** Friday, August 25, 2017 7:31:25 AM
**To:** Richard Krannich
**Subject:** RE: permission to reprint request

Dear Mr Robertson

**9781138240759 | Our Energy Future, Albrecht RPD | Edn. 1 | Chapter 7**

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VITAE

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## EDUCATION

**Ph.D.** ***Human Dimensions of Ecosystem Service and Management*** **August 2017**

Utah State University | Logan, Utah

Dissertation Topic: Policy Landscapes and Community Impacts of Utility-Scale Wind and Solar Power

Coursework: Advanced Qualitative Methods; Social Statistics II & III; Advanced Survey Techniques; Social Inequality; Natural Resources and Social Development; Public Sociology; Theory of Social Change; Community Theory; Environment, Technology, and Social Change; Research Design; Theoretical Foundations In Human Dimensions of Ecosystem Science & Management, Sustainability Concepts and Measurements.

**M.S.** ***Science, Society, Technology*** **June 2010**

Lund University | Lund, Sweden

Thesis: "Biochar: Possibilities and Potential, Blocks and Barriers of an Eco-Innovation"

Coursework: Geographical Information Systems: An Introduction; Geographical Information Systems: Interdisciplinary Applications; History of Science; Innovation, Energy and Sustainability; Politics of Science and Technology; Human Geography; Environmental Justice; Environmental History; Demography; Science, Entrepreneurship and Innovation.

**B.A.** ***English*** **May 2004**

University of Idaho | Moscow, Idaho

Coursework: Literature; Creative Writing; World Geography; Human Geography; World Prehistory; Meteorology; Physical Geology; Spanish.

## EXPERIENCE

***Research Assistant*** **August 2011 – August 2016**

*Richard Krannich – Professor, Department of Sociology, Social Work & Anthropology and Department of Environment & Society, Utah State University | Logan, UT*

- Designed and implemented a Utah-wide mail, internet survey (1500 sample size) and a 5 community pick-up/drop-off survey (1000 sample size) to understand attitudes of environmental concern and renewable energy
- Conducted interviews with public officials regarding renewable energy development
- Helped design and implemented monthly internet survey of Utah Anglers (5000 sample size) for Utah Department of Wildlife

- Researched social impacts of utility-scale renewable energy, and policy issues driving development
- Wrote and presented results at conferences, and for publication

***Instructor*** **January 2014– May 2015**

*Department of Environment & Society and Department of Sociology, Social Work & Anthropology, Utah State University | Logan, UT*

- Designed and taught undergraduate courses: World Regional Geography (Fall 2014), Sociology 1010 (Spring 2014 & 2015)

***Foreign Affairs Officer*** **November 2010 – August 2011**

*U.S. Dept. of State – Bureau of Oceans, Environment, and Scientific Affairs | Washington, D.C.*

- Assisted science and technology agreements between countries
- Drafted documents, project summaries and researched policy papers
- Wrote memos, speeches, and correspondence
- Solicited for grant applications, facilitated grantee selection and managed grantees

***Research Assistant*** **May 2009 – June 2010**

*Astrid Kander – Professor, Department of Economic History, Lund University | Lund, Sweden*

- Assisted with Kander's book, *Power to the People: Energy in Europe over the Last Five Centuries*, analyzing the economic impact of energy systems and transformations
- Searched for source data in archives, journal publications, books, and online databases
- Found suitable illustrations and photos and procured permission to reprint

***Lead Guide*** **May 2004 – August 2007**

*Sundog Expeditions | Deary, Idaho*

- Piloted a wooden dory and inflatable raft down whitewater rivers in ID, OR, and AK
- Responsible for guest safety, entertainment and meals
- Lectured about regional geology, ecology, and cultural history

## PUBLICATIONS AND PRESENTATIONS

- Olson-Hazboun, S., Krannich, R., Robertson, P. "The Influence of Religious Affiliation on Community Views about Environment, ClimateChange, and Renewable Energy in and around the Mormon Culture Region." *Society & Natural Resources*. 2017.

- Olson-Hazboun, S.K., R.S. Krannich and P.G. Robertson. "Public views on wind energy in the Rocky Mountain Region: A distinct attitudinal dimension, visual exposure, and other key predictors." *Energy Research & Social Science*. 2016.

- Krannich, R., Robertson, P., Olson, S. "Renewable Energy in the United States: Trends, Prospects, and Implications for Rural Development." D. Albrecht (ed.), Our Energy Future: Socioeconomic Implications for Rural America. New York: Routledge. 2015.

- Robertson, P., "Wind and Solar Energy in the US: Policy Recommendations for Rural Development." Webinar Presentation for the National Agricultural and Rural Development Policy Center. December 2014.

- Thomas, B and Robertson, P., "The Restoration: A Message of Grand Rescue." *Sunstone*. October 2014.

- Thomas, B. and Robertson, P. "Community Solar Recommendations For Logan, Utah." Poster presentation at the Intermountain Sustainability Summit, Weber State University. March 2014.

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- Krannich, R., Robertson, P., Olson, S. "Wind and Solar Energy in the U.S. - Policy Recommendations for Rural America" NARDP Policy Brief. November 2013.

- Larsen, E., Robertson, P., Krannich, R. "Renewable Energy in Utah: Examining Spatial Variations in Attitudes and Identifying Socially Acceptable Sites for Development." Poster presentation at the 19th International Symposium on Society and Resource Management, June 2013.

- Robertson, P. and Krannich, R. "Renewable Energy: Implications for Rural Development and Rural Policy in the Intermountain West." Rural Connections. June 2013.

- "Public Response to Renewable Energy: Implications for Rural Development and Rural Policy in the Intermountain West." Paper Presentation at the Western Rural Development Center's Our Energy Future Conference, September 2012. Salt Lake City, Utah.

- "Public Reactions to Alternative Energy Systems: A Review and an Agenda for Future Research." Paper presentation at the 18th International Symposium on Society and Resource Management, June 2012. Edmonton, Alberta.

- "Soil Degradation: the Silent Crisis," Paper presentation. Crisis and Capital Conference, Human Ecology and Human Geography Departments, Lund University. May 2009.

## SKILLS, CERTIFICATES & MEMBERSHIPS

- Appointed member of the Renewable Energy and Conservation Advisory Board, an advisory board to Logan City Utility.
- Member of the Bicycling, Pedestrian, Advisory Committee (BPAC), an advisory committee to Cache County Council.
- Member of Bridgerland Audubon Society, Rocky Mountain Elk Foundation, American Whitewater, Trout Unlimited.
- Proficient in OS X, Windows, MS Office, SPSS, and ESRI ArcGIS.
- U.S. Security Clearance: Secret
- Wilderness First Responder. CPR/BLS. Anaphylaxis.
- One semester graduate study at *Fudan University | Shanghai China: Chinese Politics and Diplomacy*. Coursework: Introduction to Chinese; Chinese Politics and Diplomacy; Rural China; Modern Chinese History.

## REFERENCES

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