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Public Perceptions of Wind Energy in Vermont:  
The Role of Physical, Social, and Environmental Parameters  
in the Vermont Wind Energy Debate

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## Abstract

This research examines how proximity to wind farms influences public perceptions of wind energy in Vermont. Despite overall public support for wind energy in Vermont, opposition to specific utility-scale wind energy facilities arises, commonly by those people living adjacent to the site of the proposed development. Often, the NIMBY explanation is used to characterize the geographic schism that emerges. Under this explanation, it is theorized that the closer an individual is in proximity to a wind farm, the greater their opposition or negative attitudes towards it will be, referred to as the 'proximity hypothesis.' A questionnaire was developed to determine what influence proximity has on public perceptions of wind energy in Vermont. Results indicate that the majority of respondents support wind energy; further, distance to Georgia Mountain Community Wind farm was not found to influence attitudes towards wind energy. Further, environmental and political factors shape local perceptions of wind energy. As Vermont transitions to a local, renewable energy system, managing public perception and addressing municipal concerns towards wind energy will become increasingly important. While tradeoffs are inherent with any energy-generation facility, utility-scale wind energy facilities will increasingly expand to locations that Vermont communities value for aesthetic or environmental reasons; consequently, a degree of public resistance is unavoidable. Thus, decision-making that engages individuals from different interests in Vermont is necessary to determine the future of wind energy in Vermont.

**Keywords:** Wind energy, Vermont, proximity hypothesis, questionnaire

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## Table of Contents

<b>Introduction.....</b>	<b>4</b>
<b>Literature Review .....</b>	<b>7</b>
Introduction.....	7
Renewable Electricity Generation in Vermont.....	10
Wind Energy in Vermont.....	11
Wind Energy Debate in Vermont.....	14
Review of the Wind Energy Debate & the Proximity Hypothesis.....	19
<b>Goals and Objectives.....</b>	<b>24</b>
<b>Methods.....</b>	<b>24</b>
Questionnaire Design.....	24
Study Area.....	26
Data Collection.....	28
Data Analysis.....	29
<b>Results.....</b>	<b>30</b>
Participant Details.....	30
Attitudes towards Wind Energy.....	32
Section 248 Process.....	36
Perceived Costs of Ridgeline Development.....	38
Additional Results.....	41
<b>Discussion.....</b>	<b>45</b>
Proximity to GMCW.....	45
Section 248 Process.....	46
Perceived Costs of Ridgeline Development.....	48
<b>Conclusion.....</b>	<b>50</b>
<b>Literature Cited.....</b>	<b>52</b>
<b>Appendices.....</b>	<b>58</b>
Appendix I. Pilot Questionnaire.....	58
Appendix II. Final Questionnaire.....	60
Appendix III. Map of Study Area .....	62
Appendix IV. Map of Study Area with the Distribution of Questionnaire Respondents.....	63
Appendix V. Municipalities Where Questionnaires were Administrated.....	64
Appendix VI. Supplementary Results.....	65

## **Introduction**

Burlington, Vermont is recognized as the home of the University of Vermont, Ben & Jerry's, Phish, and Bernie Sander's political career. Socially conscious policies and a natural environment defined by its proximity to Lake Champlain and views of the Adirondack Mountains also boost the city's reputation. As of 2014, another distinction the city earned, which warranted both national and international attention, was the designation of the first American city to generate 100 percent of its electricity from renewable resources (Woodard, 2016). About fourteen miles north of Burlington, four wind turbines on top of Georgia Mountain, Georgia Mountain Community Wind Farm (GMCW) helped the city to achieve this milestone (Burlington Electric Department, n.d.; Woodard, 2016).

Comparable to Burlington's efforts, the State of Vermont government has established ambitious renewable energy goals. Vermont's 2011 Comprehensive Energy Plan provides recommendations about how Vermont can achieve a goal that 90 percent of energy needs across all sectors of the Vermont economy sourced from renewable resources by 2050 (Vermont Department of Public Service, 2011). Further, pursuant to Act 56 of 2015, a Renewable Energy Standard (RES) for Vermont electric utilities was established, requiring that renewable energy must provide 75 percent of the retail electric utility's annual sales by 2032 (General Assembly of the State of Vermont, 2015; Vermont Department of Public Service, 2016). To achieve these goals, in-state renewable electricity generation is expected to play an integral role, expanding to the heating and transportation sector (Vermont Department of Public Service, 2016).

As wind is one of the most plentiful renewable energy resources available within the state, in-state wind energy facilities will be essential to the state achieving its renewable energy goals set forth by the Comprehensive Energy Plan and General Assembly of the State of

Vermont (Vermont Department of Public Service, 2016). Electricity-generation from wind provides benefits; however, it also results in costs to the surrounding region (Vermont Department of Public Service, 2016). As with any energy-generation facility, tradeoffs exist with the deployment of wind energy technologies, which has impacts on the landscape, ecosystem, and local municipalities (Vermont Department of Public Service, 2016). Increasingly, these impacts are and will continue to affect the surrounding communities as generation technologies are deployed near or at the site of consumption (Vermont Department of Public Service, 2016). Because of the paradigm shift to distributed energy production within Vermont's electricity sector, many municipalities, interest groups, and individuals have expressed their opposition to the development of utility-scale wind energy facilities in Vermont.

This opposition impedes the development of utility-scale wind energy facilities in the state and consequently, “commercial wind power development in Vermont has lagged behind other states (Prescott, 2012, 656).” In the past two decades, utility-scale wind energy facilities have been proposed in approximately twenty Vermont towns, but only five of the proposals have been approved (AWEO, 2017). Most recently, in the towns of Windham and Grafton, the local population voted in November 2016 against a proposal to build Vermont's largest utility-scale wind energy facility, which would have included twenty-four wind turbines (Weiss-Tisman, 2016). Vermont's Governor, Phil Scott, is also a vocal critic of the future development of utility-scale wind facilities within the state. During his campaign, Governor Scott promised a moratorium on ridgeline wind development and expressed the desire to give towns more say over where turbines are built (Seelye, 2016; Weiss-Tisman, 2016). Central to his opposition are the costs associated with the deployment of wind energy facilities, as highlighted in a January 2017 Vermont Public Radio (VPR) interview on *Vermont Edition*: “I am not supportive of destroying

our ridgelines. I am not supportive of wind development on our ridgelines. As I said, it doesn't mean I am anti-wind. It means I am anti-ridgeline development" (Scott, 2017).

In contrast to this opposition, public opinion polls show that a majority of the Vermont population continues to favor wind energy development on the state-level (Castleton Polling Institute, 2013; Dobbs, 2016). This divide between support for wind energy on the general level and opposition to its local application constitutes the basis of the wind energy debate in Vermont. This research aims to explore this geographic schism and the role proximity to wind farms plays in public perceptions of wind energy. I undertook this exploration with a questionnaire that I administered to residents of towns in Chittenden and Franklin Counties, surrounding Georgia Mountain Community Wind Farm (GMCW). I used information gathered from the questionnaire to assess the influence of public perceptions on wind energy and wind farms in Vermont.

## Literature Review

### Introduction

Virtually every aspect of human civilization- life, transportation, heating, light, and food production- has been and is dependent on energy (Healy, 1976; IPCC, 2011). As with ecological systems, humankind obtains their useful energy from energy flows from the sun, constituting the basis of human existence (Healy, 1976). Using this solar energy, human social systems have devised mechanisms for accessing energy and distributing it among its population (Healy, 1976). At the advent of the industrial revolution, human society transitioned to utilizing stored solar energy in the form of fossil fuels; ancient plants and microorganisms transformed over millions of years, resulting in changed chemical structures to solid (coal), liquid (crude oil), and gaseous hydrocarbons (natural gas) stored underground in rock formations (Braun, 2014; IPCC, 2011). As a means of fueling growth and industrialization, society combusted these hydrocarbons, which converts the hydrocarbon's carbon atoms back into carbon dioxide and then releases the carbon dioxide into the atmosphere (Braun, 2014; IPCC, 2011). As a result, modern industrial activities have increased the carbon dioxide concentration in the atmosphere from 280 parts per million to over 400 parts per million in the last 150 year, contributing to the changes in the earth's climate (IPCC, 2014).

The Earth's climate depends on the functions of a natural "greenhouse effect" (IPCC, 2014). This effect is the result of heat-trapping gases, commonly referred to as greenhouse gases such as carbon dioxide, water vapor, methane, and nitrous oxide, which absorb heat radiated from the Earth's surface and lower atmosphere and then radiates much of that energy back toward the surface (IPCC, 2014). Natural and anthropogenic substances and processes have the potential to alter this effect are the physical drivers of changes in the global climatic system

(IPCC, 2014). At the current time, global atmospheric concentrations of greenhouse gases are at unprecedented levels relative to the past 800,000 years (IPCC, 2014). The cause of the observed changes in the climate system has been attributed to increased concentrations of carbon dioxide due to anthropogenic sources (IPCC, 2014). This increase has been connected to the combustion of fossil fuels, primarily from the energy sector, which currently makes up 85 percent of the primary energy used globally and accounts for approximately 55 percent of all anthropogenic greenhouse gas emissions (Braun, 2014; IPCC, 2011).

To avoid the adverse impacts of climate change, the energy sector must fundamentally change the way electricity is produced and consumed to transition to a less carbon-intensive system (IPCC, 2011). Renewable energy technologies offer a mitigation strategy, capable of supplying electricity, thermal and mechanical energy, and fuels for multiple energy service needs (IPCC, 2011). Renewable energy consists of energy sources that are produced by natural resources- sunlight, wind, water, and geothermal heat- and are consumed at a harvest rate at or below its natural regeneration rate (Lund, 2010). Most renewable energy technologies have low specific emissions of carbon dioxide relative to fossil fuels (IPCC, 2011). This characteristic of renewable energy makes it useful for mitigating climate change and has contributed to the growth of the renewable energy sector globally (IPCC, 2011); as of 2016, renewable energy sources were the world's fastest-growing energy sources (U.S. Energy Information Administration, 2016a).

Wind energy is recognized to be one form of renewable energy with a high potential to fulfill future energy needs, specifically within the electricity sector (Klick, 2010). Since early recorded history, societies have harnessed wind energy through technological advancements, spreading from Persia to the surrounding areas in the Middle East, and eventually to European

countries in 1,000 A.D. (Leung, 2012; U.S. Department of Energy, n.d.). The development of wind energy for large-scale electricity production was stimulated during the 1970s oil crisis in the developed world and emerged as one of the foremost renewable energy technologies (Leung, 2012; U.S. Department of Energy, n.d.). During the last few decades, policies to promote wind energy deployment, such as the feed-in tariff policy in Denmark and Germany and Production Tax Credit (PTC) in the United States, have led to the rapid growth and development of the wind energy market (Leung, 2012; Wiser, 2016). To date, wind power is the fastest-growing source of new electricity supply and the largest source of new renewable power generation added in the United States since 2000, stimulated by improvements in the cost and efficiency of wind power technologies (Fischlein, 2010; Wiser, 2016). According to the U.S. Department of Energy's 2015 Wind Technologies Market Report (2016), "wind power represented the largest source of U.S. electric-generating capacity additions in 2015." The rapid increase of annual wind power capacity in the United States is projected to continue in the near future, due in part to a five-year extension on the Production Tax Credit in 2015 (Wiser, 2016).

Public support for wind energy is critical for the industry's continued growth and development (Klick, 2010; Vermont Department of Public Service, 2016). Despite public support for wind power in general, public opposition to its local application can hinder wind energy developments, often by those people living adjacent to the site of the proposed development (Firestone, 2005; Klick, 2008). The Not In My Backyard (NIMBY) explanation is often used by developers, policymakers, and the media to interpret the geographic schism that arises (Wolsink, 2012). Under this explanation, it is theorized that the closer an individual is in proximity to a wind farm, the greater their opposition or negative attitudes towards it will be (Dear, 1992; Swofford, 2010), referred to as the 'proximity hypothesis (Devine-Wright, 2005a).'

However, academic literature rejects the NIMBY explanation as it is too simplistic to explain oppositional arguments because it neglects the socioeconomic, environmental, and political factors that influence attitudes towards wind energy (Devine-Wright, 2005a). This research will further address this phenomenon in the Vermont context, as Vermonters address the role of utility-scale wind energy facilities in the state’s electricity portfolio and future.

### **Renewable Electricity Generation in Vermont**

Within the United States, the federal government outlines broad energy policy for the American energy system, whereas states shape the electric utilities and relative use of different energy sources through state statutes (Fischlein, 2010). Thus, states have historically been the focal point of the electricity system in the United States (Fischlein, 2010). At the time, virtually all the in-state electricity generation within Vermont is sourced using renewable sources, primarily from hydroelectric power, followed by biomass, wind, and solar resources (U.S. Energy Information Administration, 2016b). However, in 2015, in-state generation provided less than two-fifths of the electricity consumed in Vermont (U.S. Energy Information Administration, 2016b). Increasingly, Vermont’s electricity is coming from the New England electric grid and Canada following the closure of Vermont Yankee Nuclear Plant in 2014 because Vermont’s electric utilities own little generating capacity (U.S. Energy Information Administration, 2016b). In combination, “nearly 60 percent of the power supplied for purposes of Vermont end-use consumption currently comes from renewable resources, before Renewable Energy Credits sales” (Vermont Department of Public Service, 2016).

The development of in-state renewable technologies will contribute to the achievement of the goals set by the Legislature and the goals and recommendations put forth in the 2011 and

2016 Comprehensive Energy Plans (Vermont Department of Public Service, 2016). The 2011 Comprehensive Energy Plan established that 90 percent renewable energy goal across all sectors by 2050 (Vermont Department of Public Service, 2011). As codified by Act 56 in 2015, 75% of all retail electric sales are to be sourced from renewable resources in 2032 (General Assembly of the State of Vermont, 2015). This statute established the United States' first integrated Renewable Energy Standard, requiring that 55 percent of total retail sales in 2017 will be from renewable energy, rising 4 percent every 3 years to reach 75 percent in 2032 (General Assembly of the State of Vermont, 2015; U.S. Energy Information Administration, 2016b). Additionally, 10 percent of that power must come from new, distributed generators smaller than 5 MW connected to Vermont's distribution grid (General Assembly of the State of Vermont, 2015; U.S. Energy Information Administration, 2016b; Vermont Department of Public Service, 2016). The 2016 Comprehensive Energy Plan outlines the development of new renewable energy technologies within the state as vital towards achieving these interim and overall goals (Vermont Department of Public Service, 2016). In the 2017-2018 legislative session, a bill (S.51) was introduced to the Vermont Senate, which "proposes to establish a statutory goal that, by 2050, 90 percent of Vermont's total energy consumption be from renewable energy" (Bray, 2017); that is, the bill seeks to establish statutory requirements for the quantity of renewable energy used by all energy sectors in Vermont.

### **Wind Energy in Vermont**

Vermont was an earlier innovator in the wind energy industry, serving as the site of a 1940s attempt to harness wind energy for electricity (Vermont Department of Public Service, 2002). Located on "Grandpa's Knob" near Rutland, the 1.25 MW Smith-Putnam wind turbine

erected in 1941 was the first megawatt wind turbine built and connected to the power grid in Castleton; the turbine was later abandoned in 1945 (Vermont Department of Public Service, 2002). It was not until 1997 when the first utility-scale wind facility in Vermont was complete, referred to as the Searsburg facility owned by Green Mountain Power Corporation (Vermont Department of Public Service, 2002). These projects, among other developments within the state, have contributed to the evolution of the wind energy industry in Vermont (Vermont Department of Public Service, 2002; Vermont Department of Public Service, 2016).

Wind energy is one of the most plentiful renewable energy resources available within the State of Vermont (The Regulatory Assistance Project, 2013). Several studies have shown that Vermont's wind resource is abundant enough to meet a significant portion of the state's electric power needs (Vermont Department of Public Service, 2002), as depicted in a recent studies by the United States Department of Energy and National Renewable Energy Laboratory. These studies contend that the technical potential for the development of wind resources in Vermont is about 6,000 MW of electric generation when all possible locations with suitable wind regimes are taken into account (The Regulatory Assistance Project, 2013).

In general, these locations are concentrated at the state's higher elevations, often on the ridges of the Green Mountains that define the state's topography (Vermont Department of Public Service, 2012). As shown in wind resource assessments of Vermont, the strength and persistence of wind is associated with elevation, such that the highest-grade wind resources persist in the higher elevation regions of Vermont, generally those areas over 2,500 feet in elevation (Vermont Department of Public Service, 2012; Prescott, 2012; Vermont Environmental Research Associates, Inc., 2003). Thus, the higher elevation of the Green Mountain ridges provide

considerable technical potential for the development of wind resources (Vermont Environmental Research Associates, Inc., 2003; Vermont Department of Public Service, 2016).

In Vermont, approximately 6 percent of the electricity consumed in 2015 was sourced from in-state, utility-scale wind energy facilities (Vermont Department of Public Service, 2016). Since the Searsburg development, utility-scale wind farms in Sheffield, Lowell, and Milton have been completed in 2011 and 2012 respectively (Vermont Department of Public Service, 2016). An additional utility-scale wind facility, the Deerfield Wind project, in the towns of Searsburg and Readsboro has gone through the permitting process at the federal and state level, and once complete, will consist of fifteen, 2 MW wind turbines (Avangrid Renewables, n.d.). Cumulatively, the capacity of these facilities is 149 MW and account for over 300 GWh of annual production (Vermont Department of Public Service, 2016).

Vermont's Comprehensive Energy Plans and statutes acknowledge Vermont's abundant wind resource and the potential for utilizing wind resources to meet the state's renewable energy goals (Vermont Department of Public Service, 2011; Vermont Department of Public Service, 2016). As Vermont progresses in achieving its mandated energy goals, the development of in-state wind projects will continue as recommended under the 2016 CEP (Vermont Department of Public Service, 2016). Within the plan, the Vermont Department of Public Service emphasizes the importance the development of in-state wind projects to achieve the state's renewable energy goals, with a focus on small- and medium- scale and community-directed projects (Vermont Department of Public Service, 2016). For large, utility-scale projects, it is recommended that development should be permitted if there are broad socio-economic and environmental benefits to Vermonters (Vermont Department of Public Service, 2016).

At the time, the amount of deployed wind farms in Vermont is far less than potential development sites, as potential sites are eliminated once various qualifications are considered, including environmental, aesthetic, and technical constraints (Vermont Department of Public Service, 2016). Technological developments within the wind energy industry may enable wind farms within the state to be sited in locations that were previously considered to have marginal wind resources, indicating that wind farms in Vermont are no longer restricted to higher elevations ridgelines (U.S. Energy Information Administration, 2016; Vermont Department of Public Service, 2016).

### **Wind Energy Debate in Vermont**

International research indicates that wind energy has high public approval ratings in comparison to conventional energy resources (Devine-Wright, 2004a; Graham, 2009; Wolsink, 2000) with the United States following this trend (Klick, 2008). In general, the American public favors the use of renewable energy production to provide domestic energy needs, typically giving renewable sources 70 to 80 percent support in public opinion polls (Funk, 2016; Jacobs, 2013; Klick, 2008). Vermont is no exception to this trend; the majority of Vermonters continue to favor wind energy development on the state-level (Castleton Polling Institute, 2013; Dobbs, 2016). A 2013 poll conducted by the Castleton Polling Institute at Castleton University found that 66 percent of Vermonters supported building wind turbines within the state, specifically along the state's ridgelines (Castleton Polling Institute, 2013). More recently, a 2016 poll jointly conducted by the Castleton Polling Institute and Vermont Public Radio found that 56 percent of Vermonters would support the development of large wind farms in their communities (Dobbs, 2016).

However, the lack of in-state commercial wind energy facilities in Vermont is due in part to the strong opposition that arises to its local application. Despite public support for wind power in general, the opposition that arises pertaining to commercial wind energy facilities can delay or block development. The opposition often comes from those people living adjacent to the site of the proposed development (Firestone, 2005; Klick, 2008). When developers propose commercial wind farms in Vermont, these proposals are highly contentious, indicating that commercial wind energy is not as socially acceptable as survey results suggest (Dobbs, 2016; Warren, 2010; Weiss-Tisman, 2015); often, public polling data neglects to provide insights into the motives underlying support or opposition to wind energy (White, 2014). Within the past two decades, utility-scale wind energy facilities have been proposed in a multitude of Vermont towns, including East Haven, Londonderry, Manchester, Windham, and Grafton, but have either been abandoned by developers or rejected by the Vermont Public Service Board (PSB) (Miles, 2008; Weiss-Tisman, 2015).

The tradeoffs associated with commercial electric-generation technologies are inherent in the geographic schism that arises in the wind energy debate. The conventional energy paradigm in the United States emphasizes centralized generation, consisting of large-scale generation facilities that are located far away from end-users and connected to a network of high-voltage transmissions lines (U.S. Environmental Protection Agency, 2017a; Virginia Tech, 2007); this energy paradigm has contributed immensely to anthropogenic climate change (IPCC, 2011). The spatial remoteness associated with centralized generation has resulted in a psychological distance between people and energy generation (Warren, 2010), which has recently been challenged by the increase of renewable energy generation (Devine-Wright, 2005b). In contrast with the conventional paradigm, the emerging, local energy paradigm emphasizes locating the source

near or at the end-user, that is, locating the technologies that generate electricity at or near where it will ultimately be consumed (U.S. Environmental Protection Agency, 2017b; Virginia Tech, 2007). Because of this energy paradigm shift, the impacts associated with electricity-generation have diffused and are more apparent to the end-consumers (Vermont Department of Public Service, 2016; Warren, 2010).

In Vermont, many municipalities, interest groups, and individuals have expressed their opposition to the development of commercial wind farms in response to these impacts. In general, arguments on each side of the debate focus on the externalities associated with one of the two energy paradigms. Those in favor of wind energy are primarily focused on global and national impacts of centralized generation, whereas arguments against wind energy hone in on its local and regional impacts (Warren, 2005; Prescott, 2012). The difficult nature of this global/local dynamic is exacerbated by the fact that the macro- benefits of wind energy are often abstract and the impacts of climate change are diffuse, long-term, and uncertain, whereas the micro-level impacts of wind farms are local, immediate, and clearly manifest themselves (Firestone, 2005; Warren, 2005).

This distinction between macro and micro considerations offers an explanation of the wind energy debate in Vermont. Proponents of wind energy in Vermont focus on the macro considerations for increasing Vermont's wind power generation (Pitkin IV, 2013). Central to their arguments are the negative externalities associated with the conventional energy paradigm based on fossil-fuel consumption and the potential for wind energy-based electricity production to curb these externalities, as wind energy does not emit greenhouse gases and other pollutants into the atmosphere (Pitkin IV, 2013). Following this, proponents of wind energy contend that the global environmental benefits of wind energy outweigh individual projects' localized

environmental impact (Pitkin IV, 2013; Seelye, 2016; Swofford, 2010; Vermont Department of Public Service, 2016). Thus, Vermont should support the deployment of wind farms at the state-level as the macro environmental benefits outweigh micro considerations (Pitkin IV, 2013; Seelye, 2016).

In contrast, opponents to wind energy in Vermont are often not opposed to wind power in general, but contend that the merits of wind energy in Vermont are contentious once the local externalities of wind farms are considered (Prescott, 2012). In general, their arguments focus on the potential adverse impacts to the state's ridgelines, wildlife, rural identity, visual landscape, and economy, and potential health consequences from the turbines (Pitkin IV, 2013; Seelye, 2016; Vermont Department of Public Service, 2016). At the core of their arguments are the Green Mountains and undeveloped ridgelines that contributes to the rural cultural identity of the state and maintains rare natural communities, indicating that rather than the "NIMBY" (Not In My Backyard) explanation, their arguments reflect the aesthetic and environmental value of ridgelines in Vermont (Pitkin IV, 2013; Prescott, 2012). Further, economic issues come into play. The lack of development has an aesthetic appeal for local residents and tourists, which constitutes a vital industry for the state economy (Pitkin IV, 2013; Prescott, 2012). Additionally, concerns pertaining to the wealth gap between the developers and the communities with proposed and existing wind farms as "...relatively poor towns find themselves overwhelmed financially, culturally, and legally by the out-of-state corporations espousing values very different from their own (Prescott, 2012, 684)."

Another point of contention in the Vermont wind energy debate is over the centralized model in place to site wind energy facilities. Under the section 248 process, pursuant 30 V.S.A. § 248, the Vermont State Government holds the siting authority instead of local planning or zoning

authorities (Pitkin IV, 2013; Prescott, 2012; White, 2014). After considering statutory criteria, the PSB must find that the proposed project promotes the general good of the state based on an objective and holistic analysis for a Certificate of Public Good, the permit for electric generation projects, to be issued (Department of Public Service, 2016; Prescott, 2012). According to Prescott (2012), the significant regulatory power wielded by the PSB is meant “to promote a rational and efficient public utility system from a statewide perspective, rather than letting purely local interests predominate” (p.659).

Contention over the section 248 process forms as independent, expert analysis in necessary to provide pre-filed evidence to the PSB, giving rise to concern that the section 248 is too technical and expensive for effective citizen participation (Prescott, 2012; Vermont Department for Public Service, 2016). Further, under the section 248 process, towns’ decisions and opposition to wind farm proposals are not legally binding. However, their support or disapproval of a project is included in the PSB analysis through local planning and zoning restrictions, but does not play a determinative role (Prescott, 2012). Vermont towns have taken measures to address their opposition to commercial wind power in explicit terms through Town Plans; that is, the Town Plan explicitly discourages the future development of wind farms as highlighted in the Londonderry Town Plan (Town of Londonderry Select Board, 2012; Prescott, 2012).

On a statewide level, the Vermont legislature addressed sentiment for greater local control in the section 248 process during the 2016 session. Act 174 (An act relating to the improving the siting of energy projects) was crafted to grant municipalities substantial deference in proceedings before the PSB if the municipality developed energy plans in compliance with Vermont’s energy goals and are approved by the Department for Public Service (General

Assembly of the State of Vermont, 2016). This piece of legislation provides a process to address the frustration of Vermont municipalities over the lack of local influence in the section 248 process, but the final decision on wind energy facilities remains with the PSB (Weiss-Tisman, 2016). In other cases, the developer may choose to respect the town's opposition to wind farms and either abandon the project during the section 248 process or before petitions could be filed, as highlighted in Londonderry, Windham, and Grafton (Prescott, 2012; Weiss-Tisman, 2016).

### **Review of the Wind Energy Debate & the Proximity Hypothesis**

The most frequently used characterization for the geographic schism that arises regarding wind energy is the NIMBY explanation. This refers to the theory that a negative relationship exists between general and local support for wind energy; that is, individuals favor wind energy on an abstract level but object to its application on the local scale (Devine-Wright, 2005a). Following this, it is theorized that the closer an individual is in proximity to a wind farm, the greater their opposition or negative attitudes towards it will be (Dear, 1992; Swofford, 2010), referred to as the 'proximity hypothesis (Devine-Wright, 2005a).' The proximity hypothesis has been investigated in several international studies, and to date, results show variability in its validity (Devine-Wright, 2005a). Swofford et al. (2010) found in Texas that an inverse relationship between proximity and positive attitudes exists, whereby those individuals in the closest proximity to the wind farm have the most negative attitudes towards wind energy relative to other groups living at greater distances from the wind farm. Comparable findings were found regarding respondents' willingness to support wind farms at various spatial scales (Swofford, 2010). In California, Thayer et al. (1987) observed that respondents with the most negative

attitudes to the Altamont Pass Wind Energy Development were those who were the closest to it and most familiar with the specific environment of Altamont.

van der Horst (2007) found that on aggregate, negative attitudes to proposed projects generally had some correlation to proximity. However, this relation may vary according to the local context and ‘value’ of the land, indicating that the overall context of the wind farm potentially has a greater influence on attitudes towards wind energy than proximity alone (van der Horst, 2007). This is supported in the research done by Jones et al. (2010) in which opposition in the United Kingdom was not solely determined by spatial proximity to a proposed development, but rather the extent to which an individual’s viewshed included a proposed wind farm. Thus, their results indicate that the anticipated visibility of development influences general attitudes towards the development, indicating that more visible sites are met with more negative attitudes (Jones, 2010).

In contrast, studies often indicate that individuals living closest to wind farms hold the most positive attitudes towards wind energy. In Scotland and Ireland, Warren et al. (2005) found a reverse spatial effect for public perceptions regarding existing wind farms, described as an ‘inverse NIMBY’ effect. Where NIMBY-ism did occur, it was more pronounced in relation to proposed wind farms based on their perceived negative externalities (Warren, 2005). Comparable results were found by Brauholtz (2003) in Scotland, where people living in closest proximity to a wind farm had more positive attitudes towards wind energy, even as they more frequently saw the wind farms.

In the academic literature, the NIMBY explanation has been criticized on the grounds that it is inadequate as a sole explanation for such opposition as it oversimplifies and generalizes the wind energy debate and fails to account for the plethora of social factors that may influence

an individual's attitude towards wind energy (Bell, 2005; Devine-Wright, 2005a; Krohn, 1999; Wolsink, 2012). Instead of solely depending on the NIMBY explanation, a broad range of factors relating to the site and institutional and local context contribute to one's attitude towards a specific wind farm (Graham, 2009). Overall, Devine-Wright (2005a) found that attempts to prove the proximity hypothesis have largely been unsuccessful; that is, those living in the closest proximity to wind farm do not seem to have the most negative attitudes towards wind energy. In contrast, most empirical studies have resulted in a positive relation in which individuals who support local wind energy development also favor wind farm development nationally (Devine-Wright, 2005a).

In contrast with the NIMBY explanation, Devine-Wright (2009) offered an alternative explanation based on the socially constructed, symbolic attributes of places, providing "evidence that local opposition may be founded upon place attachment (Devine-Wright, 2010, 278)." Place attachment, defined as "the process of attaching oneself to a place and a product of this process (Devine-Wright, 2009, 427)," arises from the value and emotional connections individuals associate with a place (Devine-Wright, 2009). Disruptions to these places may arise due to natural or anthropogenic causes, resulting in "feelings of grief or loss, disruption to social networks, and diverse coping responses, including denial of change (Devine-Wright, 2010, 272)." Regarding wind energy developments specifically, Devine-Wright's research (2010) suggests that a stronger place attachment to the place of a wind farm corresponds with negative attitudes to the project and oppositional behavior. Oppositional behaviors to wind farms also forms following the nature/industry symbolic contradiction; that is, when 'natural' places valued for their aesthetic and restorative qualities are faced with changes that are interpreted to be 'industrial' or 'technological' in nature (Devine-Wright, 2010).

Bell et al. (2005) propose two additional explanations for the emergence of this geographic discrepancy. They refer to it as the ‘social gap,’ that is the gap between high public support for wind energy expressed in opinion surveys and the low success rate achieved in planning applications for wind power developments. First, the *democratic deficit* explanation suggests that while opinion polls show the majority of people are in favor of wind power, specific wind farm decisions are controlled by those who are the most motivated to be involved in the planning process, which in general, is the minority opposition (Bell, 2005). Thus, the will of the majority is often not reflected in the planning process, resulting in a reduced chance of success (Bell, 2005). Warren et al. (2005) support this explanation in their research, where they found that the media gave a disproportionate emphasis to the vocal minority that opposes wind power during the planning phase while ignoring the silent, contented majority. Second, the *qualified support* explanation suggests that most of the individuals who support wind energy do not support it without qualification and find that there should be general limits and controls on wind energy development (Bell, 2005). Additionally, many public opinion surveys do not give respondents the opportunity to enter qualifications (Bell, 2005). Therefore, in situations where it appears that individuals have a discrepancy in attitudes, they are in fact following their general principle (of qualified support) in that particular case (Bell, 2005).

Despite the rejection of the NIMBY explanation among academic research, the explanation persists among developers and policymakers (Wolsink, 2012). As the local population and their cumulative attitudes towards wind developments can often sway decision-making, understanding how the public perceives wind energy and why individuals accept or resist wind energy facilities is crucial for the successful implementation of wind energy in the future (Graham, 2009; Klick, 2009; Swofford, 2010). Given Vermont’s renewable energy goals,

research to expand the understanding of perceptions of wind energy in Vermont is of conceptual and practical importance and can provide insights into the current state of renewable energy development in Vermont (Devine-Wright, 2009). This research also serves as a preliminary investigation into the proximity hypothesis and public perceptions of wind energy in Vermont; to date, no research on this topic has been reported in the Vermont context.

## **Goals and Objectives**

This research will serve to examine the Vermont wind energy debate, utilizing quantitative methods, to provide a greater understanding of the geographic schism that appears with wind energy. The goal of this research is to determine what influence proximity has on public perceptions of wind energy in Vermont. To achieve this goal, the project objectives include:

- 1) Identify general attitudes towards wind energy in Vermont.
- 2) Determine the relationship between proximity to Georgia Mountain Community Wind farm and perceptions of wind energy in Chittenden County and Franklin County.
- 3) Assess the implications of the results and explore how the results fit into the broader wind energy debate in Vermont.

## **Methods**

### **Questionnaire Design**

To achieve the goal of this research, a questionnaire was developed to assess perceptions of wind energy in Vermont. I found this to be the most appropriate technique to gauge perceptions associated with wind energy from the respondents and quantify the results. In previous research on public perceptions of wind energy, similar quantitative methods were utilized to sample residents residing at varying physical distances to the wind farm (Devine-Wright, 2004; Devine-Wright 2009).

A pilot questionnaire (see Appendix 1) was developed in December 2016 based on questions from a previous study conducted in Texas by Swofford et al. (2009). Questions were divided into three categories: general attitudes towards wind energy, attitudes associated with the

wind energy debate in Vermont, and demographic information about respondents. The pilot questionnaire was tested with 15 residents from New York, ranging from college students to senior citizens. Overall, feedback on the survey design and question wording was positive. Most changes to the draft questionnaire either pertained to wording choice to clarify what the question was asking or the options under the question. An additional demographic question was added. Following this phase, a final questionnaire was developed (see Appendix 2).

The first category of questions measured the respondents' awareness of renewable energy and wind energy and attitudes of wind energy based on the perceived benefits and drawbacks of wind energy addressed prior. The first question in the questionnaire used a 5-point Likert scale ranging from "Not at all knowledgeable to Very knowledgeable" to ask the participants how knowledgeable they would consider themselves to be about renewable energy and wind energy. The second question in this category used a 6-point Likert scale from "Strongly Disagree to strongly Agree" and included a "No Opinion" option. These questions were included to assess how informed the respondent was in renewable and wind energy.

The second category of questions specifically pertained to the wind energy debate in Vermont and sought to ascertain attitudes regarding wind turbine visibility, support for wind farms on varying scales, the section 248 process, and local vs. global benefits. Most questions in this category used a 6-point Likert scale from "Strongly Disagree to Strongly Agree" and included a "No Opinion" option. Of specific relevance to this research were two questions in this category which aimed to determine if the construction of GMCW influenced attitudes towards wind energy. Question 2 asked the respondent their general attitude about wind energy before GMCW was constructed and was followed by Question 6, which asked the respondent their general attitude about wind energy now that GMCW exists. Question 6 was also included to use

for the analysis of proximity hypothesis in which it will determine if there is a relationship between the respondent's general attitude towards wind energy and their distance to GMCW. Along with these questions, two questions asked the respondent to circle all the options that applied and one question asked the respondent to rank a list of values 1-4 based on their importance to the respondent.

Lastly, the third category addresses the demographic characteristics of the respondent, which included: age, gender, political affiliation, and zip code. The age ranges were based on the Pew Research Center work called, "The Generations Defined," to separate the sample into the Millennial Generation, Generation X, the Baby Boom Generation, and the Silent Generation (Pew Research Center, 2016). Notably, the question that asked the respondent their zip code also asked the respondent to place a X on a map of their approximate home location; this was done to determine their distance to the identified wind farm. The map used was the, "Vermont Official Road Map & Guide to Vermont Attractions," which was published by the Vermont Department of Tourism and Marketing and the Vermont Attractions Association. Copies of the map were available for free in the Dudley H. Davis Center on the University of Vermont campus.

## **Study Area**

At the time of this research, a total of four utility-scale wind farms were operating in Vermont. For this research, GMCW, a four-turbine, 10 MW utility-scale wind farm, was the sole wind farm of focus. GMCW is located in the towns of Georgia, Vermont in Franklin County and Milton, Vermont, in Chittenden County. Thus, the study area for this research was defined as Chittenden County, Vermont, and Franklin County, Vermont (see Appendix 3).

GMCW began operations in December 2012 and remains the sole commercial-scale wind farm in Chittenden and Franklin Counties. This wind farm was chosen based on its proximity to the University of Vermont (UVM). Georgia Mountain is approximately 33 km (14 miles) from UVM, making it the closest wind farm in Vermont to the university. This was more convenient for me as I administered the survey to the surrounding population. Further, the wind farm was chosen due to the size of the population surrounding it compared to the other wind farms in Vermont. Chittenden County, Vermont, is the most populous and most densely populated county in the state, with 156,545 residents at the 2010 U.S. Census (U.S. Census Bureau, n.d.a). Of the 156,545 residents, approximately 125,231 residents are over the age of 18. At the 2010 U.S. Census, Franklin County, Vermont, had 47,746 of which 35,957 were over the age of 18 (U.S. Census Bureau, n.d.b). Further demographic data for each county is shown in Table 1 below.

Table 1. Demographic data for Chittenden and Franklin Counties, Vermont based on the 2010 U.S. Census.

County	Total Population	Total Population over the age of 18	Total Female Population over the age of 18	Population between ages of 18-34	Population between ages of 35-50	Population between ages of 51-69	Population Over the age of 70
Chittenden	156,545	125,231	65,010	44,789	34,347	34,023	12,076
Franklin	47,746	35,957	18,324	9,118	11,738	11,215	3,868

## Data Collection

The questionnaires were administered to residents of Chittenden and Franklin Counties by hand in January and February 2017. To administer the questionnaire and collect responses, I drove to municipalities the study area (see Appendix V). Within each municipality, I found public spaces to administer the questionnaire where I presumed most of the people would be residents of either county. These spaces included the U.S. Post Offices in Milton, Fairfax, South Burlington, Underhill, and Essex, the St. Albans Shopping Center in St. Albans, and the Burlington Farmers Market at the UVM Davis Center in Burlington.

Participants were selected according to the quota sampling method. Quotas were established for gender and age based on the 2010 U.S. Census data on the total population of Chittenden and Franklin Counties, Vermont (See Table 2).

Table 2. Quotas based on the 2010 U.S. Census Data.

Population 18+ in Chittenden and Franklin Counties	Percentage of population that is Female	Percentage of population between ages of 18-34	Percentage of Population that is between ages of 35-50	Percentage of population between ages of 51-69	Percentage of population between ages of 70
161,188	51.7	33.8	28.6	28.01	9.9

As each questionnaire was distributed by hand, face-to-face contact was made with each respondent. This enabled me to explain my role and the purpose of the research. Once the respondent completed the questionnaire and placed an X on the map, a label, either a number or letter, was placed adjacent to the X that corresponded to the label on the questionnaire. Each X was then entered into ArcGIS to generate a map of the distribution of questionnaire respondents (see Appendix 4). This was done to determine the approximate distance (in km) from the

respondent's home and GMCW to later correspond with respondent's distance from GMCW with their questionnaire responses.

### **Data Analysis**

Once completed questionnaires were collected, I entered the responses into Excel Spreadsheet. The data was then transferred into JMP Pro 13 to perform data analysis, as detailed in the following section. The statistical analyses performed include: regression analysis, generalized linear model, summary statistics, and contingency tables.

## Results

### Participant Details

In total, 101 questionnaires were received (see Table 3). First, 51.5 percent of respondents identified as male, followed by females (49%); none of the respondents identified with a different gender identity. The largest age range in the sample was the 51 to 69 range (40.6%), followed by the 35 to 50 range (26.7%), 18 to 34 range (23.8%), and 70 or older range (8.9%), respectively. Lastly, the largest political affiliation identification was democrat (39.2%), followed by Independent (33.3%), Other (16.7%), and Republican (6.9%), respectively. Additionally, 3 respondents did not respond to this question.

Table 3. Demographic make-up of the sample population.

		n	% of Sample
Gender	Female	49	48.5
	Male	52	51.5
Age	18 to 34	24	23.8
	35 to 50	27	26.7
	51 to 69	41	40.6
	70 or older	9	8.9
Political Affiliation	Democrat	40	39.2
	Independent	34	33.3
	No Response	3	2.9
	Other	17	16.7
	Republican	7	6.9

Table 4. Quotas based on the 2010 U.S. Census Data compared to the composition of the sample.

	Percentage of population that is Female	Percentage of population between ages of 18-34	Percentage of Population that is between ages of 35-50	Percentage of population between ages of 51-69	Percentage of population between ages of 70
Quota	51.7	33.8	28.6	28.01	9.9
Sample	48.5	23.8	26.7	40.6	8.9

In all, the sample largely represents the demographics of Chittenden and Franklin Counties, combined (see Table 4). However, the two quotas that were distinct from the sample were the population between the ages of 18 to 34 (Millennials) and the population between the ages of 51-69 (Baby Boomers). This is notable in terms of voter turnout and political participation. Despite representing the largest group of living Americans and the second largest group of the nation’s electorate, Millennials often are less likely to vote than older generations (Fry, 2016). In contrast, the Silent Generation (Over the age of 70) and Baby Boomers represent the largest percent of eligible voter turnout, with 72 percent and 69 percent voter turnout, respectively (Fry, 2016).

According to Swofford et al. (2010), “a survey questionnaire is capable of obtaining only a snapshot of what public attitudes appear to be” (p. 2518). A limitation of the quota sampling method is there are no means of knowing to what extent the sample is biased or the opinions expressed do or do not reflect the overall population as the sole responses will come from those who are accessible and willing to complete the questionnaire (Davies, 2014). As I was administering the questionnaire, about five individuals per day would either ignore me completely or refuse to complete the questionnaire once they learned of the topic. Overall, this

results in approximately 1 in 4 individuals disregarding the questionnaire based on the topic, contributing to the potential a respondent bias. An additional limitation is the size and representativeness of the sample. Following the sampling method used, this sample is not representative of Vermonters or residents of Chittenden and Franklin Counties. Rather, the data is solely represents the perceptions of Vermonters included in the sample.

**Attitudes towards Wind Energy**

The following section depicts the attitudes towards wind energy and relationship between the general attitude towards wind energy and distance to GMCW. Questions 2 and 6 addressed the general attitudes towards wind energy before and after the construction of GMCW. Question 6, which addressed the general attitude towards wind energy after the construction of GMCW, was also used to test the proximity hypothesis. Overall, results (see Table 5) indicate the majority of the sample (52.5%) currently holds a positive attitude toward wind energy now that GMCW exists. This is less than the number of respondents who had a positive attitude towards wind energy prior to GMCW (62.4%), constituting a 10 percent decrease. A small proportion of respondents (5%) held negative attitudes of wind energy prior to the GMCW, which increased following the construction of GMCW to 12.9 percent.

Table 5. General Attitude towards wind energy before and after GMCW was built.

	Very Negative	Negative	Neutral	Positive	Very Positive	No Opinion	Total
Before	0	5	25	42	21	7	100
After	1	12	32	31	22	1	99

The bivariate analysis indicates that a positive relationship exists between distance from GMCW and positive attitudes towards wind energy (see Chart 1). Following this, proximity seems to have some influence on general attitudes towards wind energy when no other variables are considered. However, once all other variables are considered and neutral respondents are removed from the sample, distance is no longer significant (see Table 9); that is, distance did not have an influence on respondent's attitudes. The only variable that was found to be significant in explaining general attitudes towards wind energy is if the respondent identified as a republican; thus, identifying as a republican is associated with more negative attitudes towards wind energy. None of the other demographic variables were found to be significant. McFadden's pseudo-R<sup>2</sup> for this model is 0.225.

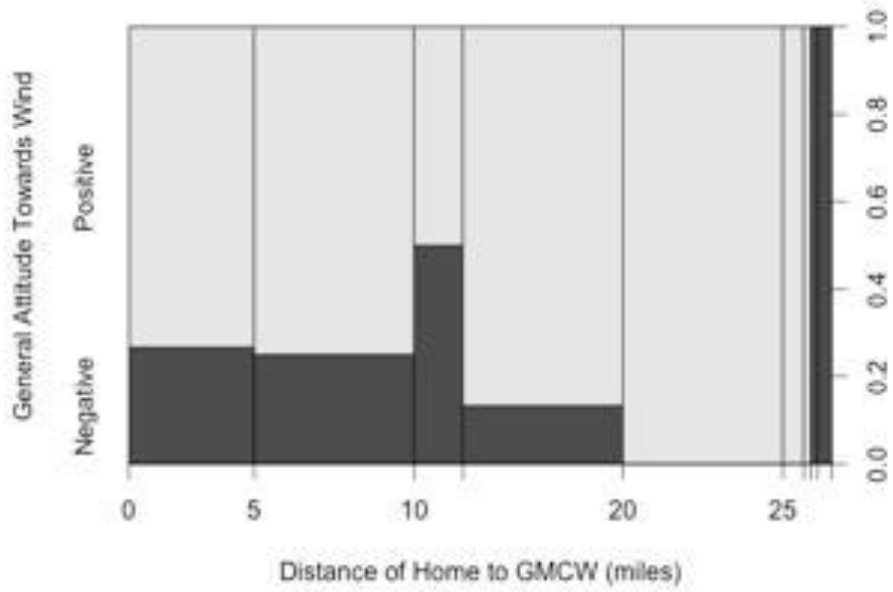


Figure 1. Bivariate analysis between attitude towards wind energy following the construction of GMCW and distance.

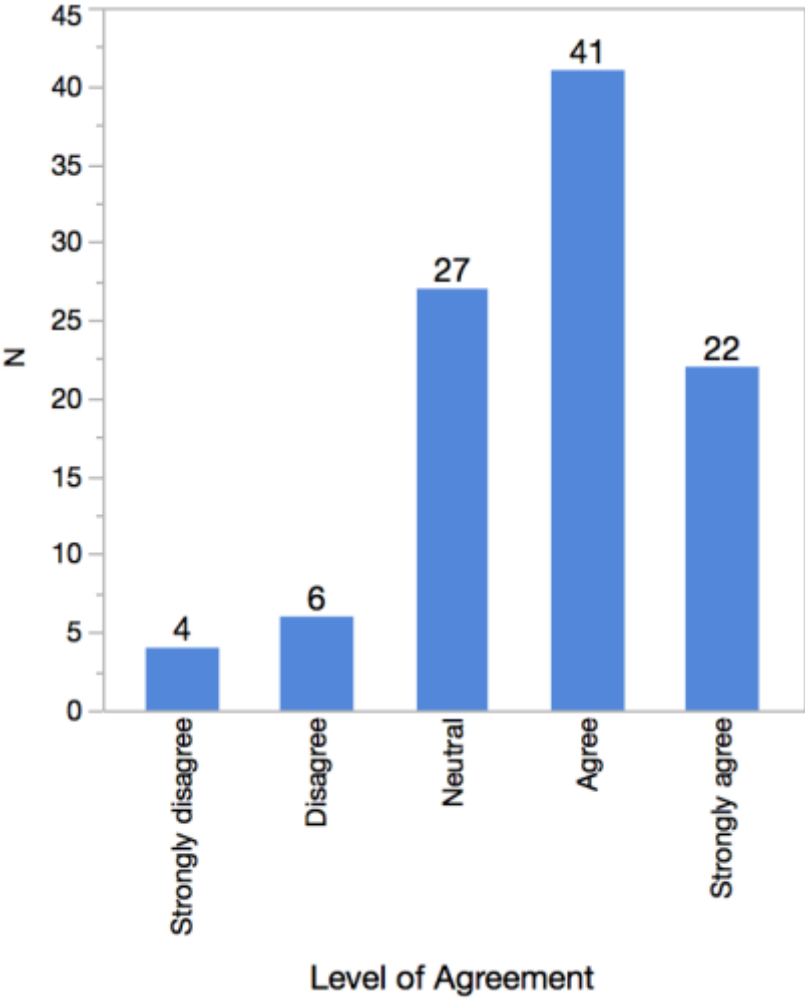
Table 6. Linear Regression Model for distance and all variables. [Note: Reference level for political affiliation is “Democrat.” Significance:  $p < 0.001$  \*\*\*;  $p < 0.001$  \*\*;  $p < 0.05$  \*].

	Estimate	Std Error	t value	Pr(> t )
Intercept	0.8904	0.2199	4.048	0.0002***
Age- 35 to 50	0.0554	0.1293	0.3977	0.6924
Age- 51 to 69	0.127	0.1373	0.9245	0.3593
Age- 70 or older	0.1317	0.2081	0.6327	0.5295
Gender-Male	-0.025	0.1003	-0.2496	0.8038
Distance	0.0059	0.0076	0.7777	0.4401
Political-Affiliation-Independent	-0.0329	0.1221	-0.2694	0.07886
Political Affiliation- No Response	0.1661	0.2993	0.555	0.5812
Political Affiliation- Other	-0.2152	0.1347	-1.5982	0.1157
Political Affiliation- Republican	-0.6045	0.239	-2.5295	0.0143*
Urban/Rural-Rural	-0.1564	0.1727	-0.906	0.3689

## **Section 248 Process**

Question 8 addressed the controversy towards the section 248 process with the statement: *Local communities should make the final decision on wind farms within their communities rather than this authority resting with the Public Service Board.* Results (see Chart 2) from this section indicate that the majority of the respondents (62.4%) agree that local communities, rather than the Public Service Board, should make the final decisions on wind farms within their communities. In contrast, 9.9 percent of respondents disagreed with this statement. A limitation of the question structure is that it could lead to a respondent bias towards local control.

Chart 1. Level of agreement with the section 248 statement.



## **Ridgeline Development for Wind Farms**

Question 6 addressed the scale in which the respondent would be willing to support wind farms. For this question, the options were as followed: Within my community; Within sight of my property; On ridgelines within Vermont; Within Vermont; Within the United States; and I do not support wind farms. The following section depicts respondents' attitudes towards supporting wind farms on ridgelines within Vermont. For the section, two geographic areas were specified: The Greater Burlington Area and Rural Area. The Greater Burlington Area includes Burlington, South Burlington, and Winooski and the Rural Area includes all other municipalities a part of the study.

Results indicate that about 36 percent of the sample would be supportive of wind farms on ridgelines within Vermont (see Table 13). However, this support varies based on the respondent's' geographic location. The left-tailed Fisher's exact test yields a significant ( $p=0.0121$ ) result and the 2-Tail Fisher's exact test yields a significant ( $p=0.0178$ ) result, indicating that the respondents in the Greater Burlington Area are more likely to support wind farms on ridgelines within Vermont than those in the Rural Area (see Chart 3). To test this result further, I ran a general linear model testing the support for ridgeline wind development as a function of age, gender, political party, distance and this rural versus GBA distinction. The results of the model (Table 14) support the results from the bivariate analysis suggesting, even after controlling for co-variates, that respondents from the Greater Burlington Area are most likely to support ridgeline wind than their rural counterparts. McFadden's pseudo- $R^2$  for this model is 0.095.

Table 7. Respondents' willingness to support wind farms on ridgelines within Vermont, separated by respondent's geographic area.

	Does not support	Does Support	Total
Greater Burlington Area	5	10	15
Rural Area	56	26	82
Total	61	36	97

Chart 2. Bivariate analysis between respondents' willingness to support wind farms on ridgelines within Vermont and respondents' geographic area.

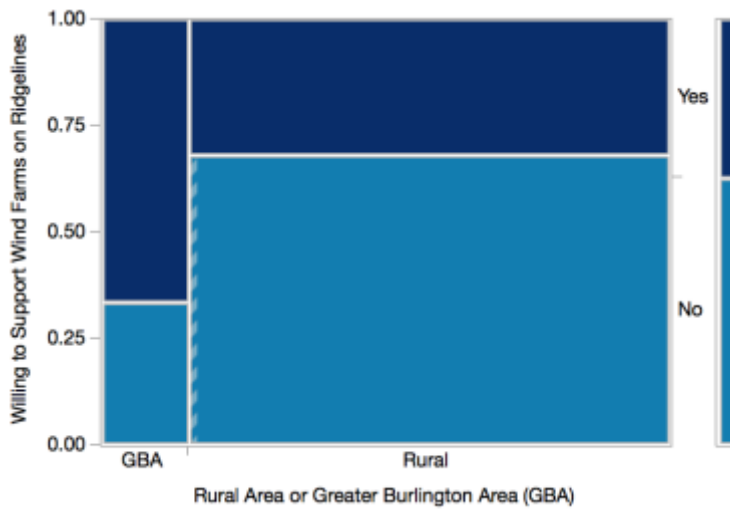


Table 8. General linear model fit for support for ridgeline wind development. [Note: Reference level for political affiliation is “Democrat.” Significance:  $p < 0.001$  \*\*\*;  $p < 0.001$  \*\*;  $p < 0.05$  \*].

	Estimate	Std. Error	z value	Pr(> z )
(Intercept)	1.4259	0.9952	1.4327	0.1519
Age 35-50	0.0866	0.6372	0.1358	0.8919
Age 51-69	-0.2286	0.5896	-0.3877	0.6982
Age >70	-1.3456	1.2037	-1.1179	0.2636
Male	-0.0900	0.4633	-0.1943	0.8459
Distance from GMCW	-0.0218	0.0299	-0.7292	0.4659
Independent	-0.2678	0.5362	-0.4995	0.6174
Republican	-1.1518	1.1977	-0.9617	0.3362
Other	-0.0828	0.6675	-0.1241	0.9013
Rural	-1.5838	0.7055	-2.2451	0.0248*

## **Additional Results**

Question 3 (see Table 15) addressed the positive and negative attributes individuals associate with wind energy. First, there are noteworthy findings regarding the perceived environmental qualities of wind energy. A substantial portion of the sample expressed that wind energy is an environmentally-friendly source of energy (81.19 %) and that wind energy reduces greenhouse gas emissions (84.16 %). Regarding aesthetics, near equivalent proportions of the sample were found for respondents who indicated that wind energy is an attractive feature of the landscape (31.68 %) and an unattractive feature of the landscape (27.72 %). In contrast, 41.58 percent of respondents do not agree that wind energy is an unattractive feature of the landscape, while 37.62 percent of the respondents do not agree that wind energy is an attractive feature of the landscape. Lastly, regarding to the negative attributes of wind energy, 44.5 percent of the sample expressed that wind energy creates a noise from the turbines, 35.64 percent expressed that wind energy decreases property values, and 23.76 percent expressed that wind energy is a danger to wildlife.

Table 9. Respondents' attitudes towards general wind energy attributes.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Opinion
Is an environmentally-friendly source of energy	4	5	9	37	45	1
Reduces greenhouse gas emissions	1	2	8	34	51	5
Is an attractive feature of the landscape	15	23	30	20	12	1
Is an unattractive feature of the landscape	19	23	28	12	16	2
Decreases Property Values	5	21	36	30	6	2
Creates a noise from the turbines	4	22	27	37	8	3
Is a danger to wildlife	17	25	31	19	5	3

Question 4 (see Table 16) enabled respondents to indicate where they most often see wind turbines. Nearly the entire sample (91.1 %) has seen wind turbines while driving, while the entire sample has seen wind turbines at some point.

Table 10. Locations wind turbines are most often seen.

	When at home	When at work	When driving	When engaged in outdoor recreation/ activities	When running errands	Never have seen them
N	15	8	92	34	20	0
% of Sample	14.9	7.9	91.1	33.7	19.8	0

Question 5 (see Table 17) let respondents indicate the scales at which they would be willing to support wind energy. A substantial portion of the sample (87.1%) indicated that they would be willing to support wind farms within Vermont, followed by within their community (44.6%) and within the United States (43.6%). An equal portion of the sample (35.6%) expressed support for wind farms within sight of their property and on ridgelines within Vermont.

Table 11. Willingness to support wind farms at various scales.

	Within my community	Within sight of my property	On ridgelines within Vermont	Within Vermont	Within the United States	I do not support wind farms
N	45	36	36	88	44	12
% of Sample	44.6	35.6	35.6	87.1	43.6	11.9

For question 7 (see Table 18), respondents were asked to rank four value groups (Economy and Jobs, Global Climate Change, Local Environment and Wildlife, and Rural Character of Vermont) one to four based on their importance to the individual. The question asked each respondent to use each number only once. However, 24 respondents misinterpreted the question and used numbers more than once and neglected to include other numbers. Thus, results represent how the respondent answered the questions, regardless of the frequency of each number. Overall, results indicate that Global Climate Change received the lowest score, indicating that value group had the greatest importance to the respondents relative to the other groups. Local Environment and Wildlife was ranked second, followed by Economy and Jobs and Rural Character of Vermont, respectively.

Table 12. Scores for the relative importance of each value groups

	Economy and Jobs	Global Climate Change	Local Environment and Wildlife	Rural Character of Vermont
1	31	50	19	16
2	18	21	47	12
3	26	11	22	28
4	22	15	8	41
Average Score	2.4	1.9	2.2	3.0

Results from Question 8 (see Table 19) indicate that 37.62 percent of the sample does not agree that the localized impacts of wind farms outweigh their potential benefits to Vermont, while 23.76 percent of the sample agreed with the statement.

Table 13. Level of agreement with the following statement: “*The localized impacts of wind farms outweigh their potential benefits to Vermont.*”

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
N	7	31	37	20	4

## Discussion

### Proximity to GMCW

The findings of this research support previous research done on support for wind energy, both in and outside of Vermont, in which overall public support for wind energy is present (Castleton Polling Institute, 2013; Klick, 2008; Swofford, 2010). Positive attitudes towards wind energy of the sample compare with past work done on public support for wind energy in Vermont by the Castleton Polling Institute and Vermont Public Radio, finding 66 percent and 56 percent support for wind energy in 2013 and 2016, respectively (Castleton Polling Institute, 2013; Dobbs, 2016).

Distance was not found to have an influence on respondents' attitudes, indicating that the NIMBY explanation is not adequate to explain the Vermont wind energy debate. Results resemble the findings of previous studies (Devine-Wright, 2005a), where proximity was found to have no influence on the respondents' attitudes of wind energy. The NIMBY explanation is too simplistic to explain the negative attitudes and oppositional behavior that arises to wind energy as it neglects the social dynamics that influence attitudes towards wind energy (White, 2014). Thus, by labelling all opposition to wind energy as NIMBY, no distinction is made among the multitude of underlying motivations that influences opposition (Wolsink, 2000). Future explanations of wind energy opposition must expand upon purely physical parameters, such as proximate distance, to account for other social, environmental, and economic parameters that influence public perceptions of wind energy and provide important explanations for negative perceptions (Devine-Wright, 2005a). In Vermont, these other variables, such as attitudes towards the section 248 process and ridgeline development, influence public perceptions of wind energy (Valentine, 2010; Warren, 2010).

## **Section 248 Process**

The first variable that contributes to local opposition in Vermont is the section 248 process. In Vermont, individuals in regions with significant public resistance to wind energy facilities are not against wind energy in general (Krohn, 1999). Rather, opposition arises based upon the interaction with central actors in the planning process and the extent of involvement of local interests (Krohn, 1999). Often, local actors and their interests are not included in the decision-making process to the extent desired, which has an influence on public attitudes in regions with existing and proposed utility-scale wind energy facilities (Krohn, 1999).

The PSB, an independent, three-member, quasi-judicial board, is vested with the authority to make the final decision on proposals for new wind energy facilities through the section 248 process. Results from the questionnaire indicate that the majority of the respondents (62.4%) would prefer that local communities held the authority to make the final decision on wind farms within their communities rather than the PSB. Only 9.9 percent thought local communities should not make the final decision on wind farms within their communities, indicating that they find this authority should remain with the PSB.

These results are noteworthy because it highlights the disconnect between public attitudes towards wind energy siting in Vermont and the way the section 248 process operates. Under the section 248 process, the final approval for wind energy facilities is held by the PSB to promote an objective and holistic analysis of whether a project promotes the public good from a statewide perspective, rather than letting purely local interests predominate (Prescott, 2012). Local attitudes towards a proposed wind energy facility, expressed through a municipal vote or town plan, are not legal binding under the section 248 process (Prescott, 2012); although, towns with energy plans were granted substantial deference in 2016 under Act 174. In contrast, Vermont

communities want more influence in the energy siting process as indicated by survey results, whether it be through their town plans or through greater influence in the section 248 process (White, 2014).

The section 248 was established for a centralized energy system and is now being challenged by the transition to distributed generation energy system (Energy Generation Siting Policy Commission, 2013). Combined with anticipated greater demand for electricity due to the electrification of the transportation and heating sectors and the possibility for further statutory requirements for renewable energy under bill S.51 introduced in the 2017-2018 legislative session, the number of local renewable energy generators in Vermont is expected to increase, thereby increasing the public's interaction with and awareness of electricity-generation facilities (Energy Generation Siting Policy Commission, 2013; White, 2014). Thus, to address the public sentiment towards the increase in renewable energy in Vermont, the section 248 process should be modified to account for the increase in renewable electric generation projects at the local level (Energy Generation Siting Policy Commission, 2013).

It is unclear what greater local participation or autonomy in the siting process would look like with the statutory criteria of Act 248 and without the process becoming too subjective to local interests. One may assume that delegating more authority to municipalities would correspond in a reduction in the overall amount of wind development Vermont as local concerns would transcend other concerns, such as meeting the statewide energy goals and grid reliability (Prescott, 2012; White, 2014). However, the Energy Generation Siting Policy Commission contends that increased public participation and addressing public concerns early in the planning process is integral for deciding where electric generation is best suited in Vermont (Energy Generation Siting Policy Commission, 2013). Thus, if Vermont wishes to site new wind energy

facilities and meet its ambitious renewable goals, the amount of public influence in the siting process should increase, but some limitations on local influence must remain to ensure that the composition of stakeholder groups and interest groups are balanced.

### **Perceived Costs of Ridgeline Development**

Another variable that contributes to oppositional attitudes towards wind energy are the perceived costs of ridgeline wind development. Vermont's ridgelines present attractive wind power sites due to their superior wind quality; however, ridgelines are often among the most ecologically sensitive and beloved areas in the state (Pitkin IV, 2013; Prescott, 2012). Results indicate that 35.6 percent of the sample would be supportive of wind farms on ridgelines within Vermont. However, support for ridgeline wind farms varies with the respondent's location, thus suggesting a divide between the Greater Burlington Area and Rural Area within Vermont in terms of wind farm ridgeline development.

The Greater Burlington Area, consisting of Burlington, South Burlington, and Winooski, was found to be more likely to support wind farms on ridgelines than the Rural Area, consisting of all other municipalities. Despite being more supportive of ridgeline wind farms, ridgeline development for wind energy remains an abstract issue for the Greater Burlington Area. The densely-populated communities in the Greater Burlington Area are the least likely to see proposals for wind energy facilities, especially for facilities on ridgelines due to the absence of ridgelines in these communities. In contrast, the communities in the Rural Area are more likely to see proposals for facilities on ridgelines because these communities are located in or are in closer proximity to the higher elevation areas in Vermont.

An explanation for the lack of support for ridgeline wind farms is Devine-Wright's (2009) proposition that place-protective actions serve as a better psychological explanation for local opposition to wind energy proposals. That is, individuals in the Rural Area attribute certain values and emotional connections to ridgelines; when wind farms are proposed at these sites, oppositional attitudes form as industrial wind energy facilities are perceived to disrupt place attachments towards ridgelines (Devine-Wright, 2009). In Vermont, the place attachment that forms towards the Green Mountain ridgelines are often based on aesthetic appeal, environmental value, and rural identity (Prescott, 2012; White, 2014). While the potential for wind farms on ridgelines has been met by strong opposition in the rural regions of Vermont, many of Vermont's ridgelines have already been altered in some form (National Association of Science Writers, n.d.; Pitkin IV, 2013). Over the past century, the Green Mountains have changed character for economic purposes, such as the development of ski areas, recreation purposes, and other utility purposes (Pitkin IV, 2013). This results in the question of what impact on and uses of Vermont's Green Mountains society deems to be acceptable. Because tradeoffs exist between desirable environmental and social outcomes, decision-making that engages individuals from different interests in Vermont is necessary to decide which land uses to prioritize at the expense of others.

## Conclusion

While overall support towards wind energy was found in the sample, distance to GMCW was not found to influence attitudes towards wind energy. Further, environmental and political factors shape the local application of wind energy. Results indicate that Vermonters favor the development of utility-scale wind energy facilities in the state, but disfavor the siting process and potential sites used for such facilities. Consequently, the growing dissatisfaction towards the section 248 process and ridgeline development has the potential to impede the future wind energy developments in Vermont and Vermont's renewable energy goals.

While electricity is only a portion of Vermont's energy portfolio at the time, electricity generated from utility-scale wind farms often prompts substantial public debate (Energy Generation Siting Policy Commission, 2013). As Vermont transitions to a local, renewable energy system, managing public perception towards wind energy will become increasingly important. Local attitudes towards wind energy is not only influential for implementation of a specific project, but also influential for the future wind energy in general (Swofford, 2010). While tradeoffs are inherent with any energy-generation facility, utility-scale wind energy facilities will more and more expand to locations that Vermont communities value for aesthetic or environmental reasons; consequently, a degree of public resistance is unavoidable (Valentine, 2010). Thus, a degree of community commitment to accepting the associated costs is required if utility-scale wind energy facilities will have a future in Vermont (Valentine, 2010).

Due to the nature of the sample, further studies on the wind energy debate in Vermont are needed to provide a more representative understanding of public perceptions towards wind energy in Vermont. Future research should expand upon factors that influence attitudes towards wind energy, including the distinction between attitudes towards proposed and existing facilities

and place attachment towards ridgelines. Future samples should include not only a larger number of participants, but also participants from the different regions of Vermont where utility-scale wind energy facilities are present. Specifically, future research should be done in Southern Vermont and the Northeast Kingdom as most of the existing and proposed utility-scale wind energy facilities are found in these regions of the state. Lastly, future research on the wind energy debate in Vermont should employ qualitative research methods to provide a great in-depth understanding of the parameters that influence attitudes of wind energy. As Devine-Wright (2005a) states, there has been an over-emphasis on research using quantitative research tools. Qualitative methods could be applied to generate a more comprehensive conceptual understanding of perceptions towards wind energy in Vermont.

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# APPENDICES

## Appendix I. Pilot Questionnaire

### Attitudes towards Wind Energy Questionnaire

You have been selected to participate in a survey addressing your opinions of Georgia Mountain Community Wind Farm (GMCW) located in Milton and Georgia, Vermont. Your participation is strictly voluntary and your consent to participate in the research will be recognized by its completion. Your survey response will be treated as strictly confidential and will be used for research purposes as I complete my undergraduate thesis at the University of Vermont.

**1. How knowledgeable would you consider yourself about...**

Place an x in the corresponding box	1. Not at all knowledgeable	2	3	4	5. Very knowledgeable
Renewable energy					
Wind Energy					

**2. What was your general attitude about wind energy before GMCW was built? (Circle one)**

Very negative    Negative    Neutral    Positive    Very positive    No opinion

**3. There are several positive and negative issues related to wind energy. How much do you agree or disagree with the following statements?**

Wind energy...

Place an x in the corresponding box	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Opinion
Decreases Property Values						
Creates a noise from the turbines						
Creates a strobe effect from the turbines						
Is an attractive feature to the landscape						
Is an unattractive feature to the landscape						
Is a danger to wildlife						
Is an environmentally-friendly source of energy						
Allows for multiple land uses						

**4. When do you most often see wind turbines? (Circle all that apply)**

When at home    When engaged in outdoor recreation/ activities    When driving  
 When in town    Never have seen them    Other

**Please Turn Over**

**5. I would be willing to support wind farms....** *(Circle all that apply)*

On my property    Within sight of my property    On ridgelines within Vermont  
Within Vermont    Within my community    I do not support wind farms

**6. What is your general attitude about wind energy now that the wind farm on Georgia Mountain exists?** *(Circle one)*

Very negative    Negative    Neutral    Positive    Very positive    No opinion

**7. Rank the following 1-5 based on their importance to you with 1 being most important.**

- \_\_\_\_\_ The health of the Vermont economy.
- \_\_\_\_\_ The impact climate change will have on the State of Vermont.
- \_\_\_\_\_ The rural character and landscape of Vermont.
- \_\_\_\_\_ The conservation of Vermont's ecosystems and wildlife populations.
- \_\_\_\_\_ The resources used to supply electricity for local utilities.

**8. How much do you agree or disagree with the following statements:** *(Circle one for each)*

*Local communities should make the final decision on wind farms within their communities, rather than this authority resting with the Public Service Board.*

Strongly disagree    Disagree    Neutral    Agree    Strongly agree

*The localized impacts of wind farms outweigh their potential benefits to Vermont.*

Strongly disagree    Disagree    Neutral    Agree    Strongly agree

**9. What is your age?**    18 to 34    35 to 50    51 to 69    70 or older

**10. What is your gender?**    Male    Female    Other

**11. Please list your zip code on the line below. On the following map, please place a X at your approximate home location.** \_\_\_\_\_

**12. Provide any additional comments you feel are important that have not been addressed in this survey in the space provided below.** *(Optional)*

**Thank you for your participation in this research study.**

## Appendix II. Final Questionnaire

### Attitudes towards Wind Energy Questionnaire

You have been selected to participate in a survey addressing your opinions of Georgia Mountain Community Wind Farm (GMCW) located in Milton and Georgia, Vermont. Your participation is strictly voluntary and your consent to participate in the research will be recognized by its completion. Your survey response will be treated as strictly confidential and will be used for research purposes as I complete my undergraduate thesis at the University of Vermont.

**1. How knowledgeable would you consider yourself about...**

<i>Place an x in the corresponding box</i>	1. Not at all knowledgeable	2	3	4	5. Very knowledgeable
Renewable energy					
Wind Energy					

**2. What was your general attitude about wind energy before GMCW was built? (Circle one)**

Very negative    Negative    Neutral    Positive    Very positive    No opinion

**3. There are several positive and negative issues related to wind energy. How much do you agree or disagree with the following statements?**

Wind energy...

<i>Place an x in the corresponding box</i>	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Opinion
Decreases Property Values						
Creates a noise from the turbines						
Is an attractive feature to the landscape						
Is an unattractive feature to the landscape						
Is a danger to wildlife						
Is an environmentally-friendly source of energy						
Reduces greenhouse gas emissions						

**4. When do you most often see wind turbines? (Circle all that apply)**

When at home    When engaged in outdoor recreation/ activities    When driving  
 When at work    When running errands    Never have seen them

**Please Turn Over**

**5. I would be willing to support wind farms....** *(Circle all that apply)*

Within my community    Within sight of my property    On ridgelines within Vermont  
Within Vermont        Within the United States        I do not support wind farms

**6. What is your general attitude about wind energy now that the wind farm on Georgia Mountain exists?** *(Circle one)*

Very negative    Negative    Neutral    Positive    Very positive    No opinion

**7. Rank the following 1-4 based on their importance to you with 1 being most important and 4 being the least important. Please use each number only once.**

\_\_\_\_\_ Economy and jobs.  
\_\_\_\_\_ Global climate change.  
\_\_\_\_\_ Local environment and wildlife.  
\_\_\_\_\_ Rural character of Vermont.

**8. How much do you agree or disagree with the following statements:** *(Circle one for each)*

*Local communities should make the final decision on wind farms within their communities, rather than this authority resting with the Public Service Board.*

Strongly disagree    Disagree    Neutral    Agree    Strongly agree

*The localized impacts of wind farms outweigh their potential benefits to Vermont.*

Strongly disagree    Disagree    Neutral    Agree    Strongly agree

**9. What is your age?**    18 to 34    35 to 50    51 to 69    70 or older

**10. What is your gender?**    Male    Female    Other

**11. What is your political affiliation?**    Democrat    Republican    Independent    Other

**12. Please list your zip code on the line below. On the following map, please place a X at your approximate home location.** \_\_\_\_\_

**13. Provide any additional comments you feel are important that have not been addressed in this survey in the space provided below.** *(Optional)*

**Thank you for your participation in this research study.**

### Appendix III. Map of Study Area

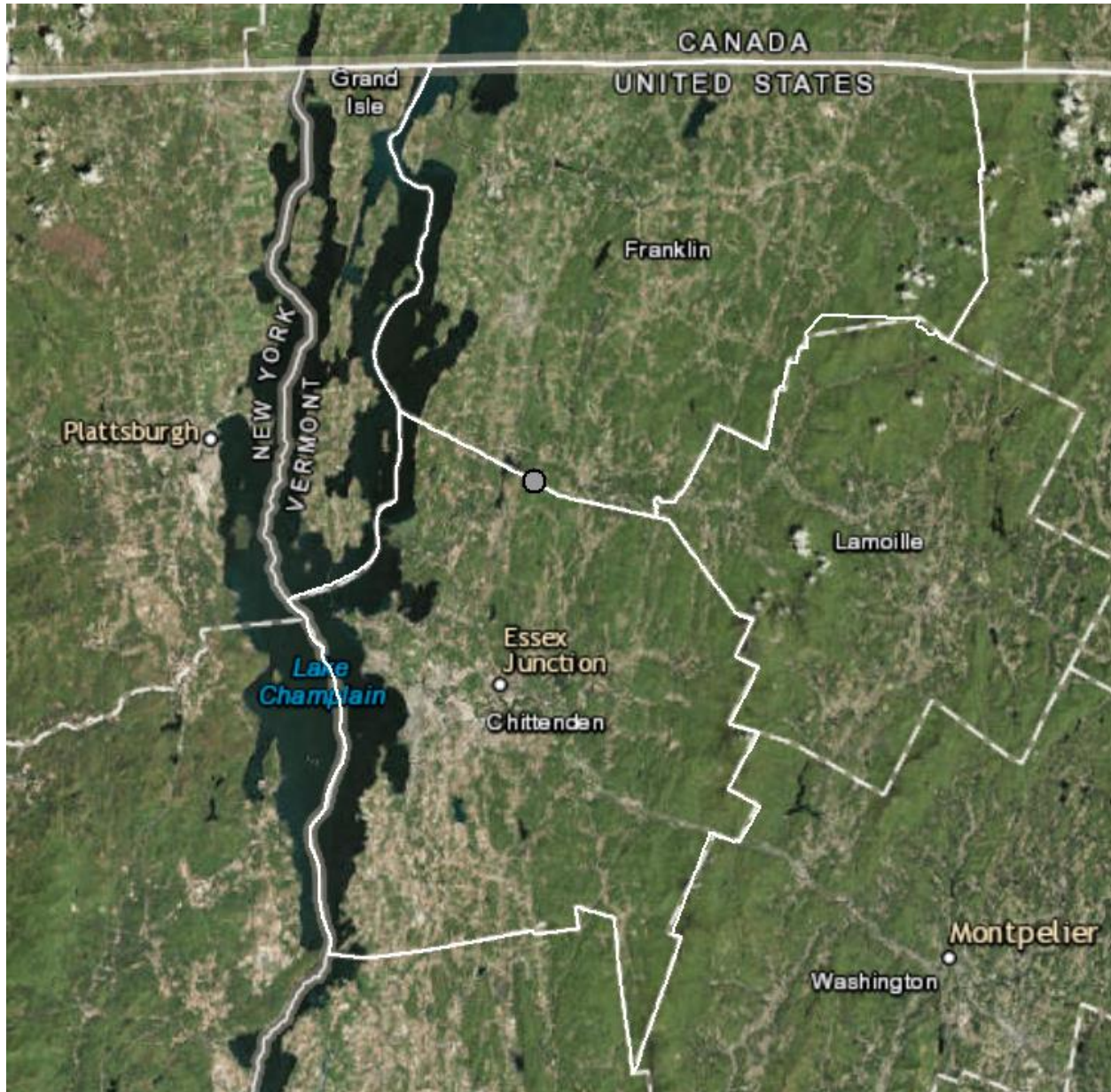


Figure 2. Map of study area used for this research. The study area consisted of Chittenden and Franklin Counties, Vermont. Georgia Mountain is represented by the grey point.

**Appendix IV. Map of Study Area with the Distribution of Questionnaire Respondents**

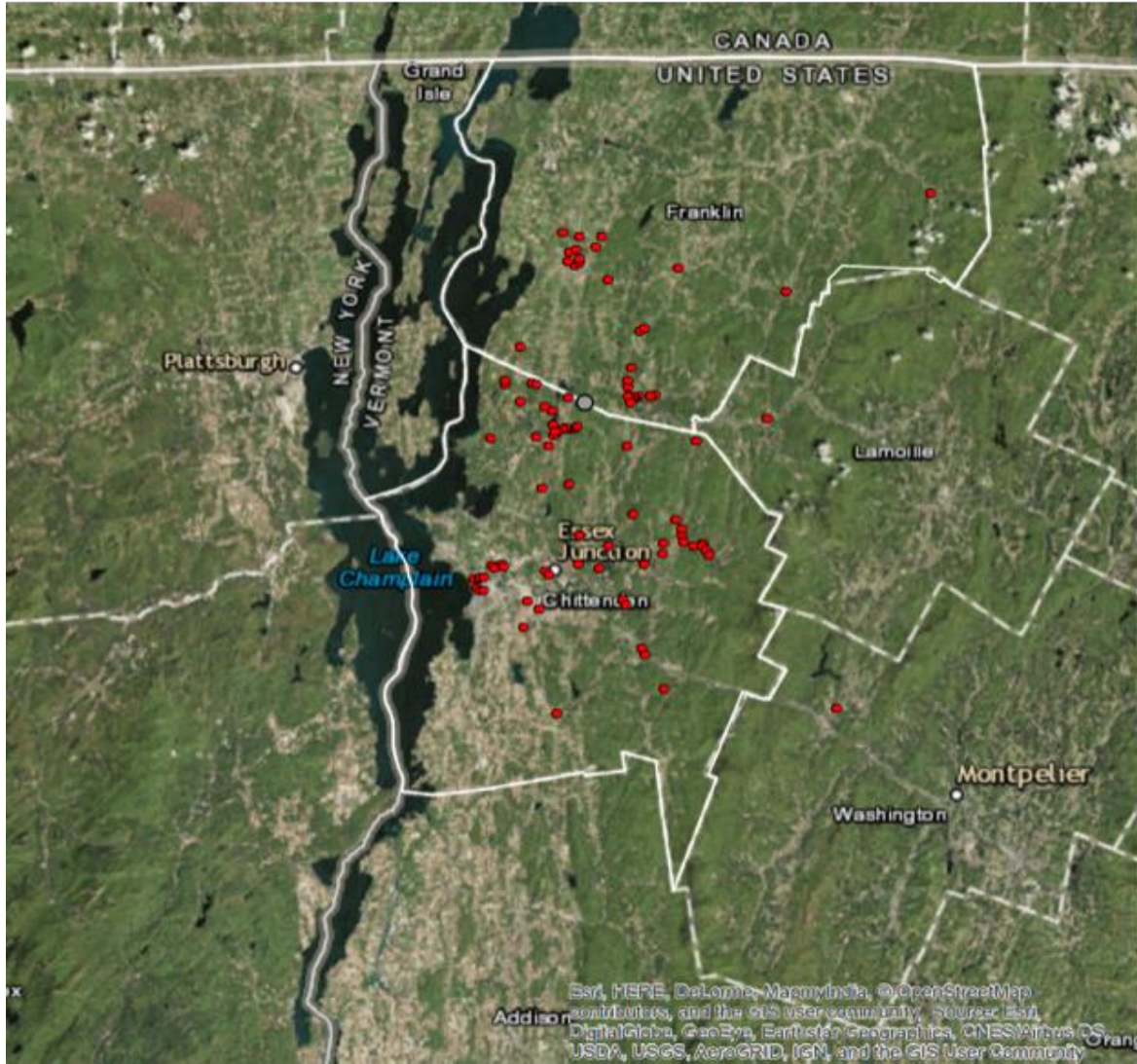


Figure 3. Map of study area used for this research with the distribution of respondents. The study area consisted of Chittenden and Franklin Counties, Vermont; however, one respondent came from Washington County and one respondent came from Lamoille County. Georgia Mountain is represented by the grey point and respondents are represented by the red points.

## Appendix V. Municipalities Where Questionnaires were Administrated

Table 14. Table depicting the municipalities in Chittenden and Franklin Counties, Vermont from which questionnaires were administered.

<b>Date</b>	<b>Municipality</b>	<b>Location Administrated Questionnaire From</b>
1/21/2017	Milton, Vermont	Milton Post Office
1/22/2017	St. Albans, Vermont	Saint Albans Shopping Center
1/28/2017	Underhill, Vermont	Underhill Post Office
1/28/2017	South Burlington, Vermont	South Burlington Post Office
1/28/2017	Burlington, Vermont	Burlington Farmer's Market
2/4/2017	Fairfax, Vermont	Fairfax Post Office
2/4/2017	Milton, Vermont	Milton Post Office
2/8/2017	Fairfax, Vermont	Fairfax Post Office
2/8/2017	Milton, Vermont	Milton Post Office
2/18/2017	Fairfax, Vermont	Fairfax Post Office
2/18/2017	Essex Junction, Vermont	Essex Post Office

## Appendix VI. Supplementary Results

Table 15. General Attitude of respondents towards wind energy after GMCW was built, separated by age.

	Very Negative	Negative	Neutral	Positive	Very Positive	No Opinion	Total
18 to 34	0	3	7	7	7	0	24
35 to 50	0	3	7	8	7	1	26
51 to 69	1	4	15	13	7	0	40
70 or Older	0	2	3	3	1	0	9
Total	1	12	32	31	22	1	99

Table 16. General Attitude of respondents towards wind energy after GMCW was built, separated by gender.

	Very Negative	Negative	Neutral	Positive	Very Positive	No Opinion	Total
Female	1	4	17	16	10	0	48
Male	0	8	15	15	12	1	51
Other	0	0	0	0	0	0	0
Total	1	12	32	31	22	1	99

Table 17. General Attitude of respondents towards wind energy after GMCW was built, separated by political affiliation.

	Very Negative	Negative	Neutral	Positive	Very Positive	No Opinion	Total
Democrat	0	2	15	12	9	1	39
Independent	0	3	11	10	9	1	33
No Response	0	0	1	1	1	0	3
Other	1	4	2	8	2	0	17
Republican	0	3	3	0	1	0	7
Total	1	12	32	31	22	1	99

Table 18. Respondents' level of agreement with the section 248 statement, divided by age.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
18 to 34	1	4	6	8	5	24
35 to 50	2	1	6	12	6	27
51 to 69	1	0	14	19	6	40
70 or Older	0	1	1	6	5	9
Total	4	6	27	41	22	100

Table 19. Respondents' level of agreement with the section 248 statement, divided by gender.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Female	1	3	17	20	8	49
Male	3	3	10	21	14	51
Other	0	0	0	0	0	0
Total	4	6	27	41	22	100

Table 20. Respondents' level of agreement with the section 248 statement, divided by political affiliation.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Democrat	2	3	17	14	4	40
Independent	1	2	5	14	11	33
No Response	1	0	0	1	1	3
Other	0	1	3	10	3	17
Republican	0	0	2	2	3	7
Total	4	6	27	41	22	100

Table 21. Willingness to support wind farms within the respondent’s community separated by the level of agreement with the section 248 process statement (*Local communities should make the final decision on wind farms within their communities rather than this authority resting with the Public Service Board*).

	Agree	Disagree	Neutral	Total
Does Support Wind Farms within Community	21	7	16	44
Does Not Support Wind Farms within Community	38	3	11	52
Total	59	10	44	96

Table 22. Willingness to support wind farms within the respondent’s community separated by their general attitudes towards wind energy.

	Negative	Neutral	Positive	Total
Does Support Wind Farms within Community	0	9	35	44
Does Not Support Wind Farms within Community	13	22	16	51
Total	13	31	51	95

Table 23. Willingness to support wind farms within Vermont separated by their general attitudes towards wind energy.

	Negative	Neutral	Positive	Total
Does Support Wind Farms within Vermont	1	17	40	41
Does Not Support Wind Farms within Vermont	12	16	13	58
Total	13	33	58	99

Table 24. General Attitude towards wind energy separated by if the respondent is able to see wind turbines from their home.

	Negative	Neutral	Positive	Total
Able to See Wind Turbines from Home	4	2	9	15
Unable to See Wind Turbines from Home	9	31	44	84
Total	13	33	53	99

Table 25. General Attitude towards wind energy separated by the level of agreement with the section 248 process statement (*Local communities should make the final decision on wind farms within their communities rather than this authority resting with the Public Service Board*).

	Negative	Neutral	Positive	Total
Agree	10	24	28	62
Disagree	2	2	8	10
Neutral	1	9	16	26
Total	13	33	52	98

Table 26. General Attitude towards wind energy separated by willingness to support wind farms on ridgelines in Vermont.

	Negative	Neutral	Positive	Total
Does Support wind farms on ridgelines within Vermont	0	7	29	36
Does Not Support Wind Farms on ridgelines within Vermont	13	24	22	59
Total	13	31	52	95