Why wind? The social, economic, and environmental impacts of wind farms in the North Country

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# TABLE OF CONTENTS

EXECUTIVE SUMMARY ........................................................................................................................................... 3

PROBLEM DEFINITION .................................................................................................................................................. 5
  TRADITIONAL ENERGY SOURCES ............................................................................................................................... 5
  SWITCHING TO RENEWABLE ENERGY .......................................................................................................................... 7
  INDUSTRIAL WIND POWER ........................................................................................................................................... 9
  BIODIVERSITY EFFECTS OF INDUSTRIAL WIND POWER ......................................................................................... 10
  SOCIAL AND HEALTH EFFECTS ................................................................................................................................. 11
  CASE STUDY SUMMARIES ............................................................................................................................................ 12

METHODS ........................................................................................................................................................................ 14

IDENTIFICATION OF STAKEHOLDERS ....................................................................................................................... 18
  CAPE VINCENT ............................................................................................................................................................... 18
    Residents ................................................................................................................................................................. 18
    Government ............................................................................................................................................................. 20
    Corporations ......................................................................................................................................................... 20
    Environment .......................................................................................................................................................... 22
  LEWIS COUNTY ............................................................................................................................................................ 24
    Residents ................................................................................................................................................................. 24
    Government ............................................................................................................................................................. 26
    Corporations ......................................................................................................................................................... 27
    Environment .......................................................................................................................................................... 27

GOVERNMENTAL ISSUES ............................................................................................................................................... 29
  FEDERAL ........................................................................................................................................................................ 29
  STATE ......................................................................................................................................................................... 30
  LOCAL ......................................................................................................................................................................... 31

DEVELOPMENT OF SOLUTIONS TO THE PROBLEM ................................................................................................... 34
  PARAMETERIZING SOLUTIONS .................................................................................................................................. 34
  IDENTIFICATION AND EVALUATION OF POTENTIAL SOLUTIONS .......................................................................... 34
  IDENTIFICATION OF FEASIBLE SOLUTIONS .............................................................................................................. 36
  IDENTIFICATION OF BEST SOLUTION ...................................................................................................................... 37

IMPLEMENTATION PLAN ................................................................................................................................................ 39

EASE OF IMPLEMENTATION ....................................................................................................................................... 43

CONCLUSIONS ................................................................................................................................................................. 49

ACKNOWLEDGEMENTS .................................................................................................................................................. 51

LITERATURE CITED ....................................................................................................................................................... 53

APPENDICES ................................................................................................................................................................. 57
  APPENDIX A. COPY OF SURVEY INSTRUMENTS .......................................................................................................... 57
  APPENDIX B. COPY OF INTERVIEW INSTRUMENTS ....................................................................................................... 65
  APPENDIX C. COPY OF PERSONS INTERVIEWED ......................................................................................................... 66
EXECUTIVE SUMMARY

We aimed to examine energy production in the United States, specifically in upstate New York. We investigated wind energy, a growing form of renewable energy and predicted how we thought it could contribute to our overall energy usage in the future. We focused on the various biological, environmental, social, and economic effects of wind farms in general and in relation to two wind farms in New York. Our two focal industrial wind farms were the successful Maple Ridge Wind Farm in the towns of Martinsburg, Watson, Lowville, and Harrisburg, NY, and the proposed Cape Vincent wind farm in Cape Vincent, NY. Unfortunately, in February the Cape Vincent project was cancelled, which provided us with a successful and failed project comparison. While examining the Cape Vincent Wind Farm, we observed the nearby Wolfe Island wind farm and noticed important effects that we included in our discussion.

Cape Vincent, Maple Ridge, and Wolfe Island varied in their positive and negative effects, but from this evaluation, we defined what we consider the best solution to renewable energy implementation today. To realize the perspective of a variety of stakeholders, we personally interviewed five people with different opinions on the wind farms. These interviews ranged from interactions with government stakeholders (New York State Department of Environmental Conservation biologist and Martinsburg town supervisor) to businesses/non-profit stakeholders (former Wind Power Ethics Group chairperson and a current Maple Ridge dairy farmer). We also distributed surveys to evaluate public opinion from resident stakeholders living near the two wind farms. Built into our surveys were questions gauged to determine the respondent's level of environmental awareness, which we could compare with his/her answers about renewable energy and specific feelings about the wind farms.
We then looked at the level of governmental support for wind farms at various levels. Wind energy has been supported at the federal level through federal policies, especially positive tax credits. At the state level, New York has set high goals to make wind energy a larger portion of its energy portfolio in the upcoming years. And lastly at the town government level, wind farms must be approved and supported by local politicians in order to become successful in the town.

After looking at all these various aspects of wind farm implementation in two locations in New York, we developed the best solution for further implementation of renewable energies. We suggested five potential strategies ranging from restricting energy production to the individual level (i.e., everyone must produce their own energy) to incorporating energy caps in order to reduce energy usage overall, to continuing with industrial wind production but with accompanying stipulations. We determined that the best and most feasible solution was this last suggestion of continuing industrial wind production with stipulations, which we formulated to address the problems we observed with the two wind farms we studied. With our guidelines, the new timescale for the proposal, evaluation, and construction time phases of building a wind farm will take a total of five years. The evaluation phase will include extensive environmental surveying and increased public awareness campaigns. We believe that our proposed solution can be implemented today and is a smart decision for reducing the negative environmental, social, economic, and health issues relating to industrial wind farms today. With regards to New York’s current system for constructing wind farms, our system will incur only slight increases in implementation effort while providing superior benefits for all stakeholders.
PROBLEM DEFINITION

The issue we are investigating is the impact of large-scale wind turbine facilities in New York State. Traditional energy sources, the two most dominant being oil and coal, have led to a vast amount of negative environmental and health impacts today, stemming from the increase of global carbon emissions. As a result of problems relating to fossil fuels, alternative energy sources must be implemented nationwide to decrease our dependence on fossil fuels. As wind is a growing section of the renewable energy portfolio, we focused on industrial wind power in New York State. When looking at wind power, one must consider the resulting biological, social, and economic effects from the construction and implementation of the turbines.

Traditional Energy Sources

As a society, we consume an incredible amount of energy today. In the past 25 years, the global energy requirement has increased from 6,700 MtoE (million tons oil equivalent) to 10,200 MtoE as a result of high energy usage and an increasing population (Ghose 2009). World consumption of electrical energy is predicted to rise from 472 quadrillion Btu (British thermal unit) in 2006 to 552 quadrillion Btu in 2015 and 678 quadrillion Btu in 2030 (Saidur et al 2010). In order to be able to accommodate this consumption of energy, we must have enough energy to consume. Currently, the most widely used forms of energy come from fossil fuels, consisting of coal, oil (crude oil, oil sands, and oil shale), and natural gas (non-conventional gas and conventional natural gas) (Verbruggen and Marchohi 2010). However, problems with continuations of the use of fossil fuels as our primary energy source abound. First are the negative effects that result as an outcome from the burning of fossil fuels. In 2008, 30 billion tons of carbon dioxide were emitted from fossil fuel combustion; this rate has doubled since 1970 (Hook and Tang 2013). Rising carbon dioxide levels lead to climate change, which can
produce negative environmental consequences, such as bleaching and destruction of coral reefs, animal habitat shifts or fragmentation, or the spread of invasive species (Saidur et al 2010; Hall 1996). In addition to these impacts negatively affecting biological systems, human health will also be affected; as climate change increases, so will the occurrence of natural disasters and sea level rise, and people living on the coast will be subject to a greater amount of flooding and severe storms.

A second reason continuing with fossil fuel use is detrimental is the idea that we cannot continue to consume fossil fuel resources at our current rate because we will soon run out of these resources. One of the arguments supporting the depletion of fossil fuels is termed Peak Oil. The Peak Oil theory was developed by many geologists, the most famous of which is Hubbert, who created Hubbert’s curve in 1956 that predicted the oil peak. Even though this prediction was specific for the US, the US’s production is very similar to the global average and so the curve can be extended to a worldwide view (Verbruggen and Marchohi 2010). Peak Oil concerns the extraction of oil and stipulates that society has passed the peak of oil (petroleum refined from crude oil) production. Peak of production has been passed when half or more of the total has been taken, which is the “midpoint of depletion.” Peak Oil states that the peak of oil discovery was passed in the 1960s and that since 1981, the world has been consuming more oil than what is stored in our found reserves. As the gap widens between production and consumption, great international tension will occur as a result of division and ownership of the remaining oil sources (ASPO 2008).

Furthermore, estimates of remaining resources today are generated by the producing countries, which may have incentive to report their numbers as unrealistically high. The largest and most accessible sedimentary areas have already been explored completely, so further
withdrawals will have to come from smaller areas, costing more to extract (Verbruggen and Marchohi 2010). In addition to this depletion of oil, predictions state that gas and coal reserves can only sustain us for 67 and 190 years (Ghose 2009). If we want to have an energy source for our grandchildren, then we must start using less fossil fuels and more renewable energy.

**Switching to Renewable Energy**

Renewable energy is a developing field today as nonrenewable energy reserves are diminishing worldwide (Ghose 2009). As of 2012, only about 9% of energy use in the US came from renewable energy, including hydropower, solar, geothermal, wind, and biomass. The remaining energy sources are petroleum (36%), natural gas (27%), coal (18%), and nuclear electric power (8%) (US Department of Energy 2013). Renewable energy contributes to the primary energy user sources, including transportation, industrial, residential and commercial, and electric power, with the greatest proportion being used for electric power. The US Energy Information Administration states that changes in fuel and type of energy normally occur slowly, and even though renewable energy is only currently a small percentage of the energy portfolio, its role has been increasing (US Department of Energy 2013). Advantages of using renewable over nonrenewable energy include lower pollution like greenhouse gases produced, more affordable energy, and local economic growth (Renewable Energy 2014). Disadvantages of renewables are also evident though (Table 1). For every energy source there are pros and cons, but we believe wind has the most positives and least negatives for our focal area.
Table 1. Pros (positive impacts) and cons (negative impacts) of various renewable energy sources (SEAI 2014).

<table>
<thead>
<tr>
<th>Pros</th>
<th>Solar</th>
<th>Hydropower</th>
<th>Geothermal</th>
<th>Biomass</th>
</tr>
</thead>
<tbody>
<tr>
<td>No air or water pollution</td>
<td>Pollution free during operation</td>
<td>Low production costs</td>
<td>Zero carbon emission</td>
<td>Available all over the world</td>
</tr>
<tr>
<td>Relatively cheap to build</td>
<td>Unlimited supply</td>
<td>Offers recreational benefits such as fishing</td>
<td>Resource will not run out</td>
<td>Cleans up waste products</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cons</th>
<th>Solar</th>
<th>Hydropower</th>
<th>Geothermal</th>
<th>Biomass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loud within close proximity to turbines</td>
<td>Large capital costs</td>
<td>Dams interrupt migration routes</td>
<td>Best supply limited to certain areas of the world</td>
<td>Can lead to deforestation</td>
</tr>
<tr>
<td>Disrupts scenery</td>
<td>Intermittency (not efficient in high cloud cover or in high latitudes during winter).</td>
<td>May need to relocate people to build dams</td>
<td>High construction costs</td>
<td>Burning emits carbon</td>
</tr>
<tr>
<td>Hazard to flying animals</td>
<td>Batteries not environmentally friendly</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

New York is one of the states that could make great strides in wind energy in the upcoming years. Currently, renewable resources account for about 11% of the energy that New York uses for transportation, heating, industry, and electric power. New York has listed as a goal to have 30% of its energy by 2015 be provided by renewable sources (Renewable Energy 2014). New York is ranked 12th in the nation for installed wind generation capacity by the American Wind Energy Association and is the 15th windiest state (NYSDEC 2014). However, the National Renewable Energy Lab stated that New York’s wind reserve has the potential to fill over half of the state’s energy needs. As of the spring of 2012, 18 wind energy projects are operating in New York with over 1,400 Megawatts of capacity. This capacity accounts for about 2% of electric power available from generation facilities in New York and power to more than
300,000 homes. Twenty projects were pending for New York in the spring of 2012 (NYSDEC 2014). Due to this rapid planned expansion, the impact of wind farms in New York must be discussed in order to determine if wind farms are the best form of renewable energy for the state and on a larger scale, for the country. In order to examine the impacts of wind farms, we must first discuss industrial wind farms.

**Industrial Wind Power**

Industrial wind farms consist of a large number of turbines in an area and require a large amount of infrastructure. In order to build a wind farm in a certain area, a company must develop land leases with individual landowners. Through a land lease, a resident will agree to the building of a turbine on his property. Compensation will be provided to the landowners by the company and will vary in amount and duration (The Wind Coalition 2014). Once leases are developed with townspeople, construction can begin. When we interviewed Bill Burke, a part-time worker at Maple Ridge Wind Farm, we learned all about the different components.

Turbines can vary in size, but they all consist of a base, tower, blades, and a Nacelle. The Nacelle is the part of the turbine that attaches the blades to the tower and holds the generator. In order to best catch the wind, there are sensors in the Nacelle that turn the head of the turbine in the direction of the wind. The turning of the blades by wind activates the gearbox which excites the generator and produces energy. Energy from a turbine is then distributed through aboveground or underground power lines to a substation, which distributes the energy out to different sources in “the grid.” Material for the blades, tower, and generator must be hauled to a site in trucks from overseas or different parts of the country. If the site is rurally located, access
roads must be created to transport the materials from one place to another\(^1\). When considering wind farms on this large of a scale, their biological impacts must also be considered.

**Biodiversity Effects of Industrial Wind Power**

One of the most important impacts of wind farms can be studied through the conservation biology discipline. How are these turbines affecting the habitat and species around them? Wind turbines can have multiple effects including direct injury or mortality of certain species and habitat fragmentation. First, the direct injury or mortality of bird and bat species is a significant outcome of wind turbines. Bird collisions per year range from 0 collisions/turbine to 30 collisions/turbine due to the lighting, blade speed, size, and height of the turbines. For most species, collisions are insignificant, but if turbines are located in places like major migration routes, they can have more of an effect. Bat collisions, similarly, may not be extremely consequential as a whole, but again it depends on the turbine placement (Kuvlesky et al 2007).

A second significant outcome of wind farms is habitat degradation and fragmentation. Turbines may be placed in the middle of an animal’s habitat, thus dividing its habitat into smaller, isolated pieces (fragmentating it). When organizing pre-construction studies for wind turbines, the New York State Department of Environmental Conservation (NYSDEC) is most concerned with habitat fragmentation. This concern stems from the fact that the group cannot base its science on birds and bats that directly hit turbines, as there is no way to accurately calculate exactly how many animals were hit by turbines. Facilities built to store or relocate the energy produced from the wind turbines can affect animals in the ways of power line collisions, can provide access for exotic plant invasions, create barriers to animal dispersal, lead to vehicle collisions, and disrupt animal behavior (Kuvlesky et al 2007). In addition to the biological

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\(^1\) Personal Interview 24 March 2014
problems associated with wind turbines, there are potential social and health impacts to be considered.

**Social and Health Effects**

There are a multitude of social and health concerns related to the building and implementation of wind turbines. These concerns range from visual impact to shadow flicker issues to noise issues. Some people dislike the view of the turbines and believe turbines are destroying the landscape of the area in which the turbines are placed\(^2\). Shadow flicker is the idea that when the blades of the turbine come in front of the sun at a certain time, it creates a shadow that appears and then disappears on the ground by the turbine as the blades turn. Sound from the turbines may be noticed by community members and could cause sleep disturbance or annoyance (Roberts and Roberts 2013). When interviewing Sarah Boss, the former chairperson of Cape Vincent’s Wind Power Ethics Group LLC, she mentioned Nina Pierpont. Nina Pierpont is a doctor from near Malone, NY, where there is a wind farm. Pierpont has written a book on what she coins “wind turbine syndrome,” that lists many of the ill effects of wind turbines on people’s health. She has treated patients with dizziness who could not stay in their houses by the turbines because they had such severe reactions (Boss, personal communication\(^3\)). Research has shown that the presence of wind turbine sound is associated with annoyance, and a theory is that reported health effects are just manifestations of the annoyance stemming from the turbines (Roberts and Roberts 2013). In addition to these biological, social, and health impacts, economic impacts will be discussed later in our paper. To examine all of these impacts specifically, we focused on two wind farms in the North Country.

\(^2\) Survey Results
\(^3\) Personal Interview 12 April 2014
Case Study Summaries

Originally, our focus was on the proposed Cape Vincent Wind Farm. Ms. Boss informed us that town meetings began in March of 2006 when the wind farm was first proposed. Ninety-six turbines were proposed by the company Acciona Wind Energy USA and 175 by British Petroleum (BP) Wind Energy (Boss, personal communication4). The project was stalled for a variety of reasons, and in 2012, BP took over Acciona’s wind farm (Lee 2012). However, this past February, BP terminated the project after it could not find a buyer (Lee 2014). After Cape Vincent was terminated, we wanted to find a successful wind farm with which to compare Cape Vincent, so we found the Maple Ridge Wind Farm. Mr. Burke told us all about this successful project. Maple Ridge Wind Farm is located in the towns of Watson, Harrisburg, Martinsburg, and Lowville, NY. The system is 12 miles long by 3 miles wide and has 198 turbines, which each provide 1.65 MW (megawattts) of energy/year. One of these turbines can power 500 homes/year, and the total power produced by Maple Ridge provides energy for 2% of residential homes in New York State (Bill Burke, personal communication5). Overall, then, using these results and all of the biological, environmental, economic, social, and health concerns mentioned above, we must analyze the positives and negatives of both wind farms and ideas for renewable resources in the future. Where should wind be implemented in New York State? What other form of renewable energy should be implemented where wind cannot? We aimed to answer these questions in our study.

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4 Personal Interview 12 April 2014
5 Personal Interview 24 March 2014
Figure 1. Map of study locations.
METHODS

To investigate wind farms, we aimed to determine the opinions of as many of the groups involved with the project as possible. We used 3 approaches: 1. Initial background research, 2. Interviewing important stakeholders in the Maple Ridge or Cape Vincent wind farm conflicts, and 3. Surveying residents from Maple Ridge and Cape Vincent.

Our first approach consisted of background research on our topic. Research occurred when we were first learning about wind farms, so we looked for general information and biological consequences of the turbines. To first get an idea of how average residents felt, we looked to online forums where residents voiced their concerns over debate topics (Morelli 2010; Wiley 2013). From this information and academic papers, we started to form our outline, determine the stakeholders, and decide who we wanted to interview.

Our second approach consisted of interviewing important stakeholders in the two wind farm projects. A copy of these people and questions we asked them can be found in Appendix C and B respectively. We interviewed a total of 5 people. While looking at the Maple Ridge wind farm, we called the Maple Ridge wind farm and set up an interview and then traveled to Lowville on Monday, March 24th, 2014. We ate at Lloyd’s of Lowville, a local diner, and interviewed the cook there. Then we went to the Maple Ridge wind farm and listened to a presentation by Bill Burke, a farmer who has turbines on his property and works part-time for the wind farm. Mr. Burke gave us a video to watch, called “Tapping Maple Ridge,” that compared the wind energy to maple sugaring and helped us understand the background of wind energy in Lowville. We drove around some of the wind turbines and took pictures. To further our knowledge of the Maple Ridge wind farm, we conducted a phone interview on Thursday April
17th with Terry Thisse, the town supervisor of Martinsburg, one of the towns in which the turbines are located. We had found Mr. Thisse’s name from an online article discussing the Maple Ridge wind farm.

To examine the conflict in Cape Vincent, we found contact information for groups attending a special meeting (called “Article 10”) focused on BP filing for an application in order to begin building the wind farm (Wiley 2013). We initially contacted Fred Munk, who was an NYSDEC Acting Natural Resource Supervisor at the meeting. He recommended we talk to Irene Mazzocchi, a senior wildlife biologist at the NYSDEC who was directly involved with the Cape Vincent wildlife monitoring. We interviewed Ms. Mazzocchi in Edwards, NY on Sunday, April 6th. We also contacted Sarah Boss of the Wind Power Ethics Group that was at the Article 10 application meeting and interviewed her in Cape Vincent on Saturday, April 12th. While we were in Cape Vincent, we took pictures of the Wolfe Island turbines, which were very noticeable from the town. Lastly, Kendra interviewed a St. Lawrence University student who is a Cape Vincent resident, Cynthia Bryan, in Canton, NY on Wednesday, April 16th. We also e-mailed British Petroleum and Mr. Urban Hirschey, the Cape Vincent town supervisor, but neither of them responded to us.

Our third approach involved surveying 200 residents, 100 from Cape Vincent and 100 from the Greater Lowville area of Lowville, Martinsburg, Watson, or Harrisburg. A copy of our survey instruments can be found in Appendix A. Results from our surveys can be found in Tables 2-5. The largest group of stakeholders is composed of the residents of Cape Vincent and Lowville, who could be directly influenced by the construction of wind turbines in their area. To ensure that we addressed the concerns of all stakeholders in our solution, we needed to determine the opinions of residents in Cape Vincent and Lowville with regards to both broad opinions
about renewable energy and wind power specifically in their town. We used stratified random sampling to select 100 residents from the Cape Vincent area and 100 residents from the Lowville area using public land records and Geographic Information Service’s ArcMap Version 10.1. We found all of the citizens in these two areas and then used the Geospatial Modelling Environment Version 0.7.2.1. and specifically the tool “r.sample” to randomly select 200 residents from these two areas. To increase the survey response rate, we included an incentive to complete the survey, in which the participant would be put into a raffle to win a $50 gift card of their choice to Stewarts, Price Chopper, or Nice n Easy. After submitting our survey to the International Review Board at St. Lawrence University, we gained approval (Project # 2014-15). The survey we distributed aimed at determining the public’s reaction to the Cape Vincent proposed wind farm and the Maple Ridge wind farm. These surveys gauged residents’ reactions to the debate through guiding questions. In addition, we want to determine the residents’ levels of environmental awareness and see how this awareness affects their opinions on the wind farms. In order to assess their environmental affinity, we asked them questions from the New Environmental Paradigm (Dunlap et al. 2000).

Table 2. Maple Ridge- response to the question “what is the best energy source for the environment?”

<table>
<thead>
<tr>
<th></th>
<th>Wind</th>
<th>Solar</th>
<th>Geothermal</th>
<th>Natural Gas</th>
<th>Hydropower</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td>17.65%</td>
<td>52.94%</td>
<td>5.88%</td>
<td>23.53%</td>
<td>0%</td>
<td>17</td>
</tr>
</tbody>
</table>

Table 3. Cape Vincent- response to the question “what is the best energy source for the environment?”

<table>
<thead>
<tr>
<th></th>
<th>Wind</th>
<th>Solar</th>
<th>Geothermal</th>
<th>Natural Gas</th>
<th>Hydropower</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td>13.64%</td>
<td>54.55%</td>
<td>4.55%</td>
<td>13.64%</td>
<td>13.64%</td>
<td>22</td>
</tr>
</tbody>
</table>
### Table 4. Maple Ridge survey question results

<table>
<thead>
<tr>
<th>Question</th>
<th>SD</th>
<th>MD</th>
<th>U</th>
<th>MA</th>
<th>SA</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was very informed about the Maple Ridge Wind Farm during its construction.</td>
<td>0%</td>
<td>5.26%</td>
<td>21.05%</td>
<td>47.37%</td>
<td>26.32%</td>
<td>19</td>
</tr>
<tr>
<td>The Maple Ridge Wind Farm poses a significant environmental threat.</td>
<td>52.63%</td>
<td>31.58%</td>
<td>10.53%</td>
<td>5.26%</td>
<td>0%</td>
<td>19</td>
</tr>
<tr>
<td>The Maple Ridge Wind Farm gave/is giving me personal financial returns.</td>
<td>68.42%</td>
<td>10.53%</td>
<td>5.26%</td>
<td>10.53%</td>
<td>5.26%</td>
<td>19</td>
</tr>
<tr>
<td>The Maple Ridge Wind Farm provided financial returns/economic growth for my town.</td>
<td>10.53%</td>
<td>15.79%</td>
<td>0%</td>
<td>26.32%</td>
<td>47.37%</td>
<td>19</td>
</tr>
<tr>
<td>Harnessing the power of wind for energy is good for the environment.</td>
<td>0%</td>
<td>5.26%</td>
<td>0%</td>
<td>36.84%</td>
<td>57.89%</td>
<td>19</td>
</tr>
</tbody>
</table>

### Table 5. Cape Vincent survey question results

<table>
<thead>
<tr>
<th>Question</th>
<th>SD</th>
<th>MD</th>
<th>U</th>
<th>MA</th>
<th>SA</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was very informed about the Cape Vincent Wind Farm during its construction.</td>
<td>12.5%</td>
<td>16.67%</td>
<td>12.5%</td>
<td>20.83%</td>
<td>37.5%</td>
<td>24</td>
</tr>
<tr>
<td>The Cape Vincent Wind Farm poses a significant environmental threat.</td>
<td>8.33%</td>
<td>8.33%</td>
<td>12.5%</td>
<td>29.17%</td>
<td>41.67%</td>
<td>24</td>
</tr>
<tr>
<td>The Cape Vincent Wind Farm gave/is giving me personal financial returns.</td>
<td>75%</td>
<td>0%</td>
<td>12.5%</td>
<td>4.17%</td>
<td>8.33%</td>
<td>24</td>
</tr>
<tr>
<td>The Cape Vincent Wind Farm provided financial returns/economic growth for my town.</td>
<td>29.17%</td>
<td>4.17%</td>
<td>29.17%</td>
<td>12.5%</td>
<td>25%</td>
<td>24</td>
</tr>
<tr>
<td>Harnessing the power of wind for energy is good for the environment.</td>
<td>17.39%</td>
<td>17.39%</td>
<td>13.04%</td>
<td>26.09%</td>
<td>26.09%</td>
<td>23</td>
</tr>
</tbody>
</table>
IDENTIFICATION OF STAKEHOLDERS

Stakeholders

A stakeholder is an individual person, a group of people, or an entity that has a particular interest in an issue because she/he/it is affected by this issue (Merriam-Webster 2014). In upstate New York, there are many groups that are stakeholders in wind farm development because they will be significantly affected by the presence or absence of wind farms. In both Cape Vincent and Lewis county, we found that there were four major categories into which stakeholders could be grouped: landowners, the government, corporations, and the environment. While both locations had similar stakeholder categories, the effects of wind farms on these groups and the issues each group were passionate about varied considerably. In the following we identify the stakeholders in the wind farm debate in upstate New York first by their location and then by their category. Later we discuss the unique viewpoints these stakeholders hold based on the mechanism by which wind farms affect their community.

Cape Vincent Residents

Individuals or groups of individuals who would live near wind turbines constitute the largest category of stakeholders in the wind energy debate in Cape Vincent. In general, residents have the potential to benefit monetarily by wind farm development because wind companies pay residents in order to place turbines on their property (Burke, personal communication). Taxes on the wind farm would also provide additional income for the town to spend on schools and other public spaces (Richards 2013). Overall, some people believed the economic benefits from the wind farm would have been positive (Table 5).

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6 Interview 24 March 2014
For those residents who were not selected to lease land for turbines, however, the effects were often negative. Many residents thought wind turbines would be aesthetically displeasing or would negatively affect their health due to the stress caused by noise or by shadow flicker. Residents were also concerned that the loss of beauty and the potential health risks caused by the turbines would decrease property values (Boss, personal communication7). In general, residents who could lease land for a turbine generally approved of wind energy because the monetary benefits outweighed any negatives, whereas residents who would have to live near turbines but would personally gain no money were against wind energy development.

Cape Vincent presents a unique situation because it is has shores on both Lake Ontario and the 1000 islands portion of the St. Lawrence River (Fig. 1). This location is attractive to many people, often more wealthy than the average resident of nearby areas, who own seasonal vacation homes along the water. Therefore, the category of Cape Vincent residents can be further split into two subcategories: seasonal residents and year-round residents. Generally, year-round residents approved of wind energy because monetary benefits outweighed aesthetic loss. According to Cynthia Bryan, a lifelong resident of Cape Vincent, many year-round residents of Cape Vincent hold occupations in the retail or agricultural sectors, which often have highly variable profit margins. Due financial instability, many year-round residents were pleased with the land leases they had been offered by the wind companies because it offered an additional source of income. Some year-round residents believed the turbines would be additionally beneficial because the turbines would occupy recently abandoned farmland and prevent the land from being wasted (Bryan, personal communication8). Seasonal residents, however, disapproved

7 Interview 12 April 2014
8 Personal Interview 16 April 2014
of wind development because they did not wish the natural landscape to be tarnished and did not need the extra income that could be provided from leasing land for the turbines.\(^9\)

**Government**
Several governmental groups have a stake in wind energy development in Cape Vincent. At the federal scale, the U.S. government has been pushing for the development of renewable energy (including wind), and thus supported the wind project in Cape Vincent. At the state level, New York politicians had promised constituents that by 2015, thirty percent of energy would come from renewables and were thus deeply interested in promoting energy projects like the wind project in Cape Vincent (Associated Renewables 2014). The statewide push for renewable energy development impacted government groups such as the NYSDEC, which was encouraged to grant permits for industrialized turbine development even when there was evidence that areas like Cape Vincent were important bird migration zones (Mazzocchi, personal communication\(^{10}\)). At the local level, town board members were also generally pro-wind, as four out of the five board members had contracts to be paid by BP for allowing turbines on their land (Boss, personal communication\(^{11}\)).

**Corporations**
A second group of stakeholders in Cape Vincent consisted of business owners and other corporations. The businesses with the largest stake in wind development were the companies that wanted to profit from building the wind farm in Cape Vincent. While many companies developed plans and attempted the permitting process, the most recent company to propose a project was British Petroleum (BP). If BP had succeeded in its attempts to build the wind farm,

\(^9\) Survey results  
\(^{10}\) Personal Interview 6 April 2014  
\(^{11}\) Personal Interview 12 April 2014
BP could have made millions of dollars from producing highly demanded electricity. If construction of BP’s wind farm had occurred, businesses such as restaurants and hotels in the area would have temporarily benefited because of the additional demand for food and housing the construction workers would have needed. Additionally, local construction-material suppliers would have benefitted from the increased demand for basic material such as gravel and concrete (Thisse, personal communication\textsuperscript{12}). Financial benefits to local businesses from wind farm-related sales could have totaled tens of millions of dollars (Iberdrola Renewables 2007).

Other corporations in the area generally believed the impact of the wind farm would have been negative. One major corporation against the wind farm was the Wind Power Ethics Group LLC, a group of angry and worried residents who joined together to form a corporation for the purpose of collecting donations and hiring attorneys to fight BP in court (Boss, personal communication\textsuperscript{13}). Residents joined this group for a variety of reasons. Many of the initial members joined because they were angered by the BP’s lack of transparency over land leases. Members believed the wind company had approached certain people, such as the members of the town board, before members of the general public were aware that a wind farm was even being proposed in Cape Vincent. Thus, members felt that BP was manipulating the town board and that there was not nearly enough discourse between residents and the local government before the wind farm was “forced right down the throats” of residents who did not have land leases (Boss, personal communication\textsuperscript{14}).

Other members of the Wind Power Ethics board joined because they were worried about the health effects of the wind turbines. Ms. Boss, for example, was concerned about the effect

\textsuperscript{12} Phone Interview 17 April 2014
\textsuperscript{13} Personal Interview 12 April 2014
\textsuperscript{14} Personal Interview 12 April 2014
shadow flicker would have had on her grandson, who had migraines which could be triggered by flickering light. Other residents were concerned about constantly hearing the noise from the rotating turbine blades. Health-concerned members concentrated on attempting to change zoning laws in the town to keep turbines far away from roads and homes (Boss, personal communication\(^\text{15}\)). Overall, the corporations stakeholder group consisted of people highly polarized in opinion over the proposed wind farm in Cape Vincent.

**Environment**

One of the most underrepresented stakeholders, both across the world and in Cape Vincent, is the environment. Wind farms cause habitat degradation, and pose a physical threat to flying animals that could potentially hit the turbines and become fatally wounded (Summary 2007). The most publicly recognized environmental stakeholder often consists of large raptors, such as bald eagles (*Haliaeetus leucocephalus*), golden eagles (*Aquila chrysaetos*), and various large hawks who are in danger of hitting the blades of the turbines. Cape Vincent is listed by the National Audubon Society as an Important Bird Area (IBA), meaning that the area is considered vital for the protection of bird species diversity (van Haaren and Fthenakis 2011; Audubon 2014). Members of the Onondaga Audubon Society were particularly concerned for eagles, especially after learning in January of 2014 that the federal government increased the lifespan of eagle take permits in the U.S.A from five to thirty years. The change in law allowed wind companies to delay permit renewals by twenty-five more years, meaning that the federal government has less power to shut down wind farms if the turbines become a serious hazard to eagles (Booker 2014). Of the Cape Vincent residents who recognized the environmental impacts of wind farms, many

\(^{15}\) Personal Interview 12 April 2014
listed collisions between large birds and turbines as a concern\textsuperscript{16}. Overall environmental awareness of Cape Vincent citizens was relatively high, too; the average score of environmental awareness, discovered by our surveys, was 53, with a standard deviation of 10. This scale ranks participants from between 15 and 75, with the high numbers correlating to the more environmentally aware. Thus, one can see that residents are in upper range of that spectrum\textsuperscript{17}.

All other environmental impacts were much less recognized in Cape Vincent. According to Irene Mazzochi, a wildlife biologist for the NYSDEC, bats might be negatively affected by turbines because the change in air pressure around turbines may cause bats’ chests to collapse, which causes immediate death. This is particularly important in Cape Vincent because a hibernaculum for the endangered Indiana bat (\textit{Myotis sodalis}) is located nearby in Watertown (Fig. 1), and bats migrating to and from this hibernaculum could be killed by the turbines. Additionally, grassland birds living in the fields where turbines would be located would experience habitat fragmentation as access roads cut into their foraging and migration areas. Maintenance work to keep the area under the turbines accessible and clear of trees could also damage habitat, possibly destroying nesting areas for grassland birds. Blanding’s turtles (\textit{Emydoidea blandingii}), a threatened species in NY, would also experience habitat fragmentation because wind turbines were planned to be built directly adjacent to critical wetland habitat. The presence of access roads would interrupt the turtle’s dispersal routes, and traffic along the roads would increase the potential for collisions between vehicles and turtles. Overwintering birds, waterfowl, and migratory birds, which are present in above-average density due to Cape Vincent’s location along the river, would also be impacted if they collided with turbines or their habitat was degraded. Of special concern in Cape Vincent is the short-eared owl

\textsuperscript{16} Survey results
\textsuperscript{17} Survey results
(Asio flammeus), an endangered owl in NY known to have at least four roost sites directly in the area planned to be developed by BP for the wind farm (Mazzocchi, personal communication\textsuperscript{18}).

**Lewis County**

**Residents**

Unlike in Cape Vincent, the residents of Lewis County had a very different response to the idea of a wind project in their community. Firstly, Lewis County residents are almost entirely year-round residents\textsuperscript{19}. Most are farmers or small business owners who have low annual incomes. When Iberdrola Renewables, one of the owners of the Maple Ridge Wind Farm, offered Lewis county residents money in exchange for land to build and operate its turbines, most residents agreed that the financial benefits outweighed the aesthetic costs of the turbines. Today 74 different farms host turbines, with only 10\% of these farms holding over four turbines each. Residents hosting turbines agree that turbines are spaced out well throughout the community, and are pleased to receive a portion of the proceeds from the electricity generated on their land every three months in addition to the income generated from land leases. Mr. Burke considers wind his “third crop” and insists the six turbines on his land are the “the best cow[s] in the barn” because turbines provide such steady income. Residents hosting turbines are also pleased because their property values have increased due to the income provided by the turbines. Even residents who neighbor someone hosting a turbine receive benefits, as anyone who lives within 3500 ft. of a turbine receives a stipend between $500-$1500 dollars a year\textsuperscript{20}.

\textsuperscript{18} Personal Interview 6 April 2014
\textsuperscript{19} Survey results
\textsuperscript{20} Personal Interview 24 March
Even if individual residents did not personally benefit from land leases, many recognized the economic benefit the wind project would have on local schools, businesses, and other public spaces (Thisse, personal communication\textsuperscript{21}). Residents generally agreed that the 400 temporary jobs and 50 permanent jobs provided by Maple Ridge delivered a much-needed economic boost for Lewis County, both through employment and through the support the extra workers provided to local business by purchasing food, housing, and construction materials. Residents were pleased that local schools received, and are still receiving, large sums of money from taxes to the wind farm. For example, the schools of Lowville receive $3.5 million dollars a year and now have some of the best technology in the state (Burke, personal communication\textsuperscript{22}). Overall, 89\% of Lewis County residents generally supported Maple Ridge\textsuperscript{23}.

Only a small, unorganized group of residents believed Maple Ridge was having a negative impact on Lewis county (Boss, personal communication\textsuperscript{24}). The top concerns usually related to subsidies, environmental impacts, or health topics. For example, some disapproving residents believed that Maple Ridge was too subsidized by the federal government, and were concerned that wind farms like Maple Ridge were contributing to America’s national debt. Other residents were upset about the collisions between turbine blades and flying animals\textsuperscript{25}. Lastly, some residents had concerns about the health impacts of turbines. For example, one resident was angry that oil had leaked from a malfunctioning turbine into her well and poisoned her drinking water supply\textsuperscript{26}. Additionally, Mr. Thisse mentioned that he could hear the noise emitted from the rotating blades of the turbines from up to half a mile away on quiet days, an impact that upset

\textsuperscript{21} Phone Interview 17 April 2014  
\textsuperscript{22} Personal Interview 24 March 2014  
\textsuperscript{23} Survey results  
\textsuperscript{24} Personal Interview 12 April 2014  
\textsuperscript{25} Survey results  
\textsuperscript{26} Survey results
some residents (Thisse, personal communication\textsuperscript{27}). Mr. Burke contradicted Mr. Thisse’s findings about noise, saying that turbines hum between 40-45 decibels, which is considered “very quite” according to New York State legal standards (Burke, personal communication\textsuperscript{28}).

Interesting, no surveys or interviewees mentioned concerns over shadow-flicker. Even with the multiple types of concerns residents had about wind farms, residents of Lewis County were still overwhelmingly in support of wind farms for their community.

**Government**

Government stakeholders were similar between Lewis County and Cape Vincent. The same federal and state laws that encouraged renewable energy development applied to both areas. Thus, the government was usually considered a pro-wind stakeholder. Because the project in Lewis County was one of the first in upstate New York, even possible opposition groups such as the NYSDEC had not yet constructed applicable permitting guidelines and thus did not resist wind development in any expressible way (Mazzocchi, personal communication\textsuperscript{29}). The town boards of the four towns in which Maple Ridge is located had little trouble approving the wind farm, since each town negotiated deals to receive large sums of money annually from taxes on the wind farm. These taxes supported expensive projects like outfitting each classroom in Lowville with a smartboard, building a highway garage in Martinsburg, and widening roads throughout Lewis County. In Martinsburg, taxes for residents were recently reduced to 2005 levels due to the extra income provided by the wind farms. Thus, all levels of government

\textsuperscript{27} Phone Interview 17 April 2014  
\textsuperscript{28} Personal Interview 24 March 2014  
\textsuperscript{29} Personal Interview 6 April
supported, or at least did not oppose, the construction of the Maple Ridge Wind Farm (Thisse, personal communication30).

**Corporations**
Agriculture dominates the business sector in Lewis County. Businesses such as dairy farms and maple producers held a stake in the project because they provided almost all of the land on which the turbines would be built. Seen as a “third crop”, wind energy was widely accepted among farmers as a form of additional income that was highly appreciated for its stability. Farmers and maple producers often felt that wind energy aligned with their ideals, as both farming, sugaring, and harvesting wind were sustainable according to their viewpoint (Ttweak 2007). Local restaurants and motels were also in favor of the development because the hundreds of temporary construction workers in the area kept their businesses full (Thisse, personal communication31). Overall, all the businesses we interviewed or learned about were in favor of wind energy in their area (Burke, personal communication; Thisse, personal communication32; and Ttweak 2007).

**Environment**
The environment, as a stakeholder, was even less recognized in Lewis County than it was in Cape Vincent. Without the proximity of the Great Lakes or a major river, migrating birds and waterfowl were not nearly as big of a concern in Lewis County as in Cape Vincent. Maple Ridge is not identified as an Important Bird Area (IBA) by the National Audubon Society (van Haaren and Fthenakis 2011). Grassland birds and the raptors which hunt these birds, however, were

30 Phone Interview 17 April 2014
31 Phone Interview 17 April 2014
32 Personal Interview 24 March, phone interview 17 April 2014
found in high densities in Lewis County and were threatened by habitat degradation and turbine collisions. An ongoing post-construction study at Maple Ridge, however, has repeatedly concluded that impacts to birds and bats are low. For example, the Maple Ridge study states that “bird carcasses that were found during the study included no species listed in state or federal endangered species lists, and only one raptor, an American kestrel [was found]” (Iberdrola Renewables 2007). No endangered bat species were reported (dead or alive) during the study, and only “hoary bats, with smaller numbers of silver-haired, little brown, red and other relatively common bat species” were found dead (Iberdrola Renewables 2007). The death of any organism is generally considered a negative impact on the environment; however, one must remember that all energy sources directly or indirectly kill organisms (Hall 1996). While turbines at Maple Ridge do kill some organisms, the turbines also prevent the emission of 450,000 tons of carbon and 3.4 tons of sulfur dioxide annually that would have been emitted if the same amount of energy was generated with traditional fossil fuels (Burke, personal communication33). Since carbon emissions contribute to climate change and sulfur dioxide contributes to acid rain, we argue that the Maple Ridge Wind Farm has an overall positive impact on the environment.

33 Personal Interview 24 March 2014
GOVERNMENTAL ISSUES

In order for wind projects to be successful in upstate New York, federal, state, and local governments must have aligned policies and ideologies about the benefits of wind energy. In general, most governmental agencies are officially pro-wind, but if one level fails to uphold its policy, the entire governmental system currently in place to support the construction of wind farms can fail. In the following we will describe the contributions of federal, state, and local governments which significantly affect wind energy policy. We will then provide examples of a situation in which each level of government failed to uphold its wind policy and show how each failure impacted wind farm development in the region.

Federal

Wind energy in America is supported by federal policies aimed at reducing nationwide dependence on foreign energy, boosting America’s overall economic growth, and combating global climate change (The White House 2014). One main duty of the federal government is to ensure that energy is affordable, abundant, and that it promotes the U.S. economy. Thus, the federal government has a policy goal to make 20% of the energy consumed in America come from renewable sources by 2013. The Obama administration, in particular, believes that wind energy fits the goals of the federal policy (AWEA 2013). In order to promote the development of wind energy, the federal government has a combination of policies in place. Some of the most important policies are the tax credits given to energy companies who develop wind farms.

Federal tax policy is the main driver of wind energy development. Two types of tax credits, called Production Tax Credits (PTC) and Investment Tax Credits (ITC), are the most important for supporting American wind farms. PTCs give wind companies a few cents in tax credits per unit of electricity produced through renewable energy technology. ITCs reduce
federal taxes on wind companies if wind companies invest in renewable energy projects (AWEA 2013). Without these tax credits, wind farm proposals that are approved for development are often shelved. For example, the 2014 Congress has not renewed federal tax credits that expired at the end of 2013, so wind farm projects across the country are on hold because there is insecurity about their financial stability (AWEA 2013). The proposed Roaring Brook wind development, which would be located next to the Maple Ridge Wind farm in Martinsburg, has been entirely approved but is currently on hold because of economic instability caused by the tax credit expiration (Thisse, personal communication34). Without tax credits and economically stable environments, projects like Roaring Brook and others across the U.S. ill not continue to be built in the fashion we are accustomed to today.

State

New York has a forward thinking policy to support renewable energy in comparison to the rest of the U.S.A. For example, the state policy is to have 30% of energy come from renewable sources by 2015 – a goal much higher than the federal standard (Associated Renewable 2014). One policy that the New York state legislature enacted which promotes investment in renewable energy is that of “Empire Zones.” Empire zones are areas of the state recognized as needing aid in order to promote economic growth. In these zones, companies (such as wind power companies) can apply for loans, grants, tax credits, and other forms of financial assistance to spur job creation (Empire State Development 2010). One of the reasons that the Maple Ridge project was proposed and constructed in only a few years was because it received aid under the Empire Zone legislation, and because federal tax credits had been renewed. The

34 Phone Interview 17 April 2014
combination of sources for financial aid had encouraged Iberdrola Renewables to construct Maple Ridge and begin producing renewable energy quickly (Burke, personal communication35).

A second section of the state government that impacts wind development is the NYSDEC. This agency is responsible for determining the environmental impact of wind projects. In theory, the NYSDEC has the power to approve or deny a proposed wind project because only the NYSDEC has the right to grant construction permits for wind project development. With pressure from the federal government to approve wind projects, however, much of the accurate science conducted by the NYSDEC is not given due consideration. For example, in Cape Vincent, the NYSDEC was not funded to conduct its own environmental impacts report. Instead, BP conducted its own study, and found no federally or regionally endangered species in the proposed construction site (Summary 2007). The NYSDEC, in studies conducted for other reasons prior to the proposal, found endangered birds such as short-eared owls in high densities on the very land where the construction was to take place. The NYSDEC workers who had conducted these earlier studies were given little say in the final permitting process, and the permits were granted despite their findings (Mazzocchi, personal communication36). Because BP got its permits regardless of the outcome of NYSDEC research, the NYSDEC failed the stakeholder group composed of endangered birds in Cape Vincent. Luckily for the birds, the Cape Vincent project failed for reasons not due to federal or state legislatures, but due to local governmental ordinances.

Local

In order for a wind project to be constructed, the project owners must have the approval of the town government. This approval is required because resources necessary for construction,

35 Personal Interview 24 March 2014
36 Personal Interview 6 April 2013
such as roads and connections to transmission lines, are owned or influenced by the local government. To get this approval, wind companies pitch their proposals to the town board of the area in which they are trying to build. With the town board’s approval, wind energy companies can use their federal and state tax credits to begin building wind farms.

Maple Ridge and Cape Vincent experienced very different issues when attempting to pass their proposals through the town government (Boss, personal communication). In both situations, the majority of board members were potentially biased towards wind farm development because they had contracts to lease their land for turbines. In Maple Ridge, bias was accepted as an inherent problem with being part of a small town. According to Mr. Thisse, everyone on the town board either was personally benefitting from land leases, or was closely related to someone who was benefitting. Town supervisors addressed this issue with the residents, residents agreed that the conflict of interest was acceptable, and Maple Ridge was built (Thisse, personal communication). In Cape Vincent, wind companies approached board members with land leases before the regular townsfolk became aware that there was even a wind farm proposal. When residents found out about the conflict of interest, they formed anti-wind groups such as the Wind Power Ethics Group. These anti-wind groups raised money to work with lawyers to rezone areas of Cape Vincent as non-industrial, technically forbidding the development of wind farms (Boss, personal communication). With the combination of limited areas to place their turbines, political division in the town over BP’s lack of integrity with the board members, and unfavorable economic conditions, BP closed down wind operations in Cape Vincent. Overall,

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37 Personal Interview 12 April 2013
38 Phone Interview 17 April 2014
39 Personal Interview 12 April 2014
federal, state, and local government policies did not align in Cape Vincent, and without all three in place to support the wind project, it failed.
DEVELOPMENT OF SOLUTIONS TO THE PROBLEM

Parameterizing solutions
In order to solve this renewable energy problem, there are some parameters that must be addressed. The main issue is that energy must be produced in some form in order for people to continue to live modern, technology-dependent lifestyles. It is unrealistic to believe that we can just stop using energy today because life as we know it would not be able to recover from that drastic change. Most likely, a form of renewable energy will have to be utilized, as nonrenewable sources are quickly becoming depleted. We should work to develop these renewable sources before we completely deplete our oil, coal, and natural gas reserves. In addition, with all the environmental problems occurring on the planet today, we need a solution with the smallest environmental footprint. Thus, solutions must include some degree of renewable energy and reduction in (but not complete elimination of) energy use.

Identification and evaluation of potential solutions
There are multiple potential solutions to the problem we are studying. We determined five and ranked them from best to worst below. Solution #1: energy caps, involves implementing energy caps, which is a behavioral change rather than a structural change. Energy caps encompass setting limits on individual and corporate energy usage; if a person or corporation exceeds their “cap,” there will be consequences, such as fees. In this way, the number of wind farms could stay consistent with the level in operation today, because more energy would not be needed to be produced. Energy caps is a radical program that is hard to implement and monitor. However, since this is a behavioral change, it has the potential to last longer than structural changes and reduces our overall environmental footprint since less energy will be used in general. Due to the fundamental change in peoples’ usage, Solution #1 would be
number 1 on our list of potential solutions for ensuring the planet is not further degraded by energy usage.

Solution #2: individual energy, involves encouraging everyone to produce their own energy on an individual scale, either through personal wind turbines, solar panels, or a geothermal system, which is an extremist approach. By an individual scale, we mean that each household would have one turbine, set of solar panels, or geothermal system to support their own household. When interviewing people for this project, we asked many of them what would be the most realistic form of renewable energy in the future. A New York State Department of Environmental Conservation biologist (Mazzocchi, personal communication\textsuperscript{40}), Cape Vincent citizen (Bryan, personal communication\textsuperscript{41}), and former chairperson of Cape Vincent’s Wind Power Ethics Group (Boss, personal communication\textsuperscript{42}) all believed that solar power on an individual level was a positive solution to solving the energy crisis. Reasons for individual solar use by a wide variety of people included decreasing prices due to high quantities of use and direct utilization of generated power. Ms. Mazzocchi, the NYSDEC wildlife biologist, also believed that wind turbines would be most beneficial on an individual level. Energy from wind turbines today cannot be stored, so it goes directly to the grid. However, if people could directly benefit from their own wind turbine on their property, large amounts of infrastructure would not have to be installed, which could decrease many detrimental effects like habitat fragmentation (Mazzocchi, personal communication\textsuperscript{43}). In addition, the majority of survey respondents from both the Maple Ridge area and the Cape Vincent area stated that they felt the best source of energy for the environment was solar (Tables 2 and 3). Negatives of this individual energy

\textsuperscript{40} Personal Interview 6 April 2014
\textsuperscript{41} Personal Interview 16 April 2014
\textsuperscript{42} Personal Interview 12 April 2014
\textsuperscript{43} Personal Interview 6 April 2014
solution include that it is a radical approach that would be difficult to implement on a large scale. What would happen to the existing energy facilities? It would require a large initial cost to set up the systems, and subsidies would probably be required. However, due its self-sufficiency and keeping things local, Solution #2 would be #2 on our list of potential solutions.

Solution #3: wind with stipulations, involves continuing with industrial wind production with special modifications to ensure that it is environmentally sustainable. In this way, we could avoid the problems we noticed from both the Maple Ridge wind farm and the Cape Vincent proposed wind farm to make the best industrial wind farms there could be! On the potential list of solutions, Solution #3 would rank #3 out of 5.

Solution #4: wind like today, involves continuing to expand industrial wind production as it is occurring today. Wind is a viable form of renewable energy which can help us into the future. The issue today is the social effects associated with the implementation of wind farms, especially when the companies are not transparent and are authoritative. Solution #4 would rank #4 on the list out of the 5 potential solutions.

Solution #5: no wind, involves using barely any wind but using he next best form of renewable energy, whatever we have determined that to be. As noted above, the survey respondents from both wind farm areas stated that they believed solar was the best form of energy for the environment, so that is what we propose for this potential solution. The problem with this solution is that solar again might be difficult to implement everywhere; on a positive note, conflict related to wind farms would be avoided. On the list of potential solutions, Solution #5 would probably be the lowest rank of solutions out of the five presented here.

**Identification of feasible solutions**

Feasible solutions would only encompass potential Solution #3: wind with changes, Solution #4: wind like today, and Solution #5: no wind. When examining Solution #1: energy
caps, we would love to see energy caps be implemented in order to reduce our overall energy usage. However, at the rate we are using energy today, it is going to be too difficult to coordinate a widespread movement and make enforcements necessary for energy caps to be effective. A different ideal world would result in everyone having their own energy source on a personal scale, but Solution #2: individual energy, is radical and probably initially too costly to implement today. Individual energy would have to be done in phases, but then people might become angry since some would still be using the grid, while others would have to rely on their own sources. Thus, a large variety of problems would be created by implementing Solution #2: individual energy. Solution #5: no wind would be feasible because we could stop industrial wind production and switch over to something else, potentially solar. The southern US is very sunny, so if solar panels were implemented on a large scale there, they could have the potential to provide as much energy as wind does today. Solution #4: wind like today would be feasible because it is a business-as-usual scenario, which realistically will probably happen in the future. Solution #3: wind with stipulations, would be feasible because it is the business-as-usual scenario with just a few extra stipulations, which would improve the environmental, social, and economic effects of wind farms.

**Identification of best solution**

The best solution that emerges to us is Solution #3: wind with stipulations. Solution #5: no wind is feasible, but wind is an important source of renewable energy that is already growing in the energy sector. It could be difficult to get people off the mindset of wind, especially in New York where wind is rapidly expanding in scope. Potential solution #4, wind like today, is definitely feasible in that we have been implementing it recently, and it has been effective in having positive economic results. However, potential solution #5, wind with stipulations, is a better form of potential solution #4. The eight parameters that we believe should be met in order...
to ensure a successful wind farm in environmental, economic, and social aspects are listed in the following pages.
IMPLEMENTATION PLAN

To successfully implement our optimal plan – wind farms with stipulations- wind companies need to follow an eight-step plan. If wind companies follow this plan, the four stakeholder categories of residents, governments, corporations, and the environment will all experience an increase in the benefits from wind farms. Increased benefits, and the resulting increased satisfaction with wind farms among stakeholder groups, will allow more wind farms to be successfully built and help America reach its renewable energy goals. Our plan employs an adaptive management approach, meaning that the success of each step will be evaluated and that steps may be added or subtracted in the future to ensure our conservation goals are met. Our current seven-step plan is listed below:

1. Reinstall the federal renewable energy tax credit system. Our research showed that Maple Ridge would not have been built if federal renewable energy tax credits had not been awarded as financial incentive for investing in or producing renewable energy. Today, Roaring Brook Wind Farm is on hold due to the lack of available renewable energy credits. Until technology for producing wind energy becomes more efficient, or until the demand for wind energy becomes higher, wind companies need tax credits to remain competitive with fossil fuel energy. We recommend lowering federal subsidies to fossil fuel companies to offset the costs of increased tax credits to wind companies.

2. Plan to build wind farms in windy areas. This step is currently effectively implemented in wind farm development since windy areas are the economically profitable places in which to build wind farms. In the future, wind farms should continue to be located in
only the most windy areas (NREL class III and higher) to ensure that they are energy efficient (Dynamic Maps 2013).

3. **Wind farms approach communities with transparency about the wind farm’s intentions.** Our findings showed that in Cape Vincent, residential stakeholders were particularly angered by BP’s lack of transparency regarding land leases and turbine location plans. We believe that wind companies must hire public relations (PR) officials to present at town meetings *before* land lease contracts are signed. If wind companies want to place turbines on land owned by town government officials, these local officials should abstain from voting on any matters relating to the wind farm. Non-disclosure agreements, embedded in land lease contracts, need to be abolished.

4. **Wind companies develop an in-depth pre-construction plan, which is shared with the community and with the NYSDEC, before construction of the wind farm begins.** Our research showed that residential stakeholder groups would have benefitted not only from an initial town meeting described in step 2, but also from being updated regularly on the wind company’s pre-construction plans. Once the wind company had definitive plans about certain aspects of the proposed wind farm, such as the number of turbines, the parcel of land on which the turbines would be placed, the distance turbines were from homes and roads, etc., plans should be shared via PR teams with residents. After deliberation, residents should sign land leases for their own properties, or neighbor contracts if turbines would be located within 3500 ft. of their home. Our research showed that in Maple Ridge, the signing of neighbor contracts strongly correlated with the overall satisfaction among residents who were not directly hosting turbines.
In both Maple Ridge and Cape Vincent, we found that there was concern about the quality of environmental impact reports conducted by wind farms. We believe that environmental stakeholder groups, such as the NYSDEC, would benefit by being able to control the quality of pre-construction environmental impact studies. To maintain a system of checks and balances on government agencies, we believe that wind companies should be responsible for hiring independent environmental consulting groups to conduct pre-construction studies. The NYSDEC, however, should have the authority to randomly conduct its own environmental impact reports. If the two agencies do not have similar findings, the wind farm should be required to hire a third agency to assess the reasons for differences between the reports. Wind farms should not be approved for construction by town governments until the quality of environmental impacts surveys can be improved.

5. *A town vote should occur.* To ensure that wind companies pay attention to the needs of residential stakeholders, a town vote should occur on whether to allow the wind company to begin construction. Holding a vote would encourage wind farms to uphold steps 2 and 3, because a company that is not transparent about its intentions, bribed local lawmakers with land-lease contracts, and/or was not truthful about environmental impacts would not be approved by residents.

6. *The final wind farm plan needs to minimize both environmental impacts and human health risks.* To avoid unnecessary environmental risk, wind farms should not be built in IBA zones, or any other habitat critical for the survival and reproduction of threatened or endangered species. The number of access roads should be limited to reduce barriers to organism dispersal, behavioral changes, and vehicle-induced mortality. Research should continue to determine the optimal placement of turbines to reduce bird and bat collisions.
Research on creative ideas, such as changing the color of turbines or surrounding turbines with ultrasonic beams to reduce collisions should be funded.

We believe that the potential health risks to people living near turbines needs to be further researched. Studies have not yet been able to disprove that living near turbines can cause adverse health effects such as insomnia and vertigo, and thus people living or about to live near turbines should be aware of the potential risks (Roberts and Roberts 2013). Immediate studies need to re-evaluate the safe distance to live from turbines and this distance, once determined, needs to be implemented in national laws about wind farms.

7. *Conduct post-construction surveys*. After the wind farm has been built, residential, corporate, and governmental satisfaction surveys as well as environmental health surveys should be conducted to ensure that the wind company is doing everything possible to satisfy stakeholders. Results of these surveys should be analyzed during the construction of new wind farms in the area or elsewhere in the country.

8. *Benefits should be publicized*. The social, economic, and environmental benefits of the wind farm need to be publicized throughout the wind farm’s duration. If stakeholders do not realize how they are benefiting from the wind farm, support for wind farms may decrease. The wind farm’s PR team should work to make sure residents are aware about the benefits wind farms provide such as locally produced energy, financial support for schools and public spaces, and a renewable energy source for generations of Americans to use now and in the future.
When the above steps are addressed, we believe that wind farms will have the ability to serve their communities by providing cheap, cleaner energy that will last for generations to come.

**EASE OF IMPLEMENTATION**

We chose to implement potential solution number 5 - building wind farms with stipulations- because we believe that it satisfies the concerns of the most stakeholders while still being practical to implement. In the following section, we will discuss the ease through which our project can be applied in a real world scenario. We will address issues to implementation such as cost, cultural values, health, dislike of change, transparency between stakeholders groups, and failure to reach consensus among stakeholders. We will also provide a sample timeline for wind companies to follow when constructing new wind farms.

The biggest issue concerning most human stakeholders in our solution scenario is the financial cost. We foresee initial costs to national taxpayers increasing slightly, as federal tax credits will have to be renewed. While we hope these costs will be offset by legislation changes to reduce subsidies to fossil fuel companies, we understand that a policy change this dramatic might be difficult to implement. Therefore, our long term goal is to have wind and other renewable energy companies lobby Congress until money used to subsidize fossil fuels is used to subsidize renewable energy instead. Until the lobbyists are successful, we foresee costs to federal taxpayers across the US increasing slightly to fund tax credits for wind companies.

Otherwise, most costs will fall on the wind energy companies as they will need to hire better-qualified environmental consulting staff in order to conduct higher quality pre-construction studies to match studies conducted by the NYSDEC. Wind companies will also
need to hire more/better trained PR staff who specialize in speaking at town meetings, communicating between wind companies and residents in order to ensure transparency about the company’s plans, and publicizing the benefits of wind farms. Public relations staff will need to be trained to conduct and interpret post-construction public opinion surveys to ensure that the wind company is taking actions to maintain the satisfaction of stakeholders.

The initial costs to wind companies stemming from these improvements, however, will eventually be offset as wind power becomes more widely demanded. Once wind energy becomes better utilized because it has more public acceptance, costs of constructing turbines will decrease which will benefit the wind companies. In addition, when wind companies conduct their public relations in ways that address the concerns of as many stakeholders as possible, they will save money they might have lost if projects were cancelled due to lack of public/local government support. For example, if BP had put more money into public relation and environmental protection, its project proposal might have been accepted and the company would not have lost all the money it spent on land leases and project development. Thus, costs for both wind energy companies would eventually even out over time.

All other issues that may arise from our implementation plan are also less severe than the impacts people currently experience from wind farms. Today, many wind farms must struggle against the American ideology of “not in my backyard” (NIMBY), which is the idea that many citizens support cheaper and more accessible energy, as long as the production of this energy source does not negatively affect their local community. With increased PR about the benefits of wind farms to both local communities and to the country as a whole, more people who previously followed the NIMBY philosophy might switch views to accept wind farms into their communities. Likewise, if people are more informed by PR teams about the possible health
impacts of living close to turbines, only people who believe the financial benefits outweigh potential health risks will choose to sign land leases in order to host turbines. Due to increased road and house setback laws, no one with a major concern about health risks will be forced to live close to a turbine. Lastly, if the majority of residents still do not want a wind farm in their area due to NIMBY principles or health concerns, the town vote will prevent wind farms from ever proceeding to the construction phase.

With increased transparency about the economic, environmental, and health impacts of wind farms, stakeholders who inherently dislike change might be more satisfied with their changing environment. Stakeholders will at least have a better sense of why and how their environment is changing, instead of the change just happening without their knowledge. Overall increases in transparency between wind companies, landowners, and local governments will help all of the aforementioned groups because people who understand all aspects of an issue can make a better -informed decision. The construction of each new wind farm would take about 5 years: 1 for the initial proposal development, 2 years to conduct environmental studies and to address the concerns of the public, and 2 years after construction. While there will always be disagreements between groups of people, we believe that implementing the above steps will help stakeholders communicate and create more effective, energy-independent communities. With regards to New York’s current system for constructing wind farms, our system will incur only slight increases in implementation effort while providing superior benefits for all stakeholders.
CONCLUSIONS

Studying these two wind farms in depth has given us a good picture of potential wind production in the future. Evaluating the terminated Cape Vincent wind farm gave us a particularly good perspective on the environmental and social impacts of wind farms. From Cape Vincent, we learned that our solution had to include stricter regulations for environmental surveys conducted by energy companies that are checked randomly by local NYSDEC officials for accuracy. Additionally, energy companies need to focus more on public relations and be sure that all residents and town government members are aware of both the positive and negative impacts of wind farms for their area. Transparency about the energy company’s intentions are vital for healthy, productive communities who wish to be self-sufficient in regards to energy.

From the Maple Ridge wind farm, we learned about the extensive positive economic impacts that wind farms can have on communities in upstate New York. The wind farm in this area has supported many hardworking, yet financially struggling farmers who overwhelmingly approved of the wind farm development in their towns. Maple Ridge also gave us good insight into the federal, state, and local government’s impact on wind farms and how each level of the government must have aligning policies in order for a project of this magnitude to be successful.

After analyzing these two highly different wind farms, we developed the best implementation plan for future renewable energy. This plan consisted of increased industrial wind output, but with stipulations that helped make the turbines better for the economy, environment, and people. We think our solution is a reasonable expectation for future development because it costs little in addition to what Americans already spend on wind energy, while protecting both people and the environment. Once the negative impacts of wind farms are
reduced through our plan, the relatively clean energy source provided by wind farms will benefit both local populations and the entire globe.
ACKNOWLEDGEMENTS

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APPENDICES

Appendix A. Copy of Survey Instruments
1. Survey questions sent out to Cape Vincent and Greater Lowville area residents

a. Cape Vincent

*Please mail your survey and prize card by April 18, 2014 in order to be entered into the contest drawing.*

Listed below are statements about the terminated Cape Vincent wind farm project, as well as the relationship between humans and the environment. Please indicate the degree to which you agree with each item. Circle the number of your response for each statement using the following scale: 5 = STRONGLY AGREE (SA), 4 = MILDLY AGREE (MA), 3 = UNSURE (U), 2 = MILDLY DISAGREE (MD), OR 1 = STRONGLY DISAGREE (SD).

1. I was very informed about the wind farm in Cape Vincent during its proposal process.
   1 2 3 4 5
   SD MD U MA SA

2. Constructing the Cape Vincent wind farm would have posed a significant environmental threat.
   1 2 3 4 5
   SD MD U MA SA

3. The proposed Cape Vincent wind farm would have *personally* given me financial returns.
   1 2 3 4 5
   SD MD U MA SA

4. The proposed Cape Vincent wind farm would have provided financial returns/economic growth for my town.
   1 2 3 4 5
   SD MD U MA SA

5. We are approaching the limit of the number of people the earth can support.
   1 2 3 4 5
   SD MD U MA SA

6. Humans have the right to modify the natural environment to suit their needs.
   1 2 3 4 5
   SD MD U MA SA
7. When humans interfere with nature, it often produces disastrous consequences.

8. Human ingenuity will insure that we do not make the earth unlivable.

9. Humans are severely abusing the earth.

10. The earth has plenty of natural resources if we just learn how to develop them.

11. Plants and animals have as much right as humans to exist.

12. The balance of nature is strong enough to cope with the impacts of modern industrial nations.

13. Despite our special abilities, humans are still subject to the laws of nature.

14. The so-called "ecological crisis" facing humankind has been greatly exaggerated.

15. The earth is like a spaceship with very limited room and resources.

16. Humans were meant to rule over the rest of nature.
17. The balance of nature is very delicate and easily upset.

18. Humans will eventually learn enough about how nature works to be able to control it.

19. If things continue on their present course, we will soon experience a major environmental catastrophe.

20. Harnessing the power of wind for energy is good for the environment.

Please respond to the following by circling the appropriate bulleted statement.

- **What percentage of energy use in the United States should come from renewable energy?**
  - 0-20%
  - 21-40%
  - 41-60%
  - 61-80%
  - 81-100%

- **What is your highest level of education?**
  - Less than high school
  - High school/GED
  - Some college
  - Undergraduate degree
  - Masters degree
  - Doctoral/Professional degree (MD, JD, PhD, etc.)

- **What is your age?**
  - Under 25
  - 25-35
• What type of resident are you?
  ○ Seasonal
  ○ Year-round

Please rank the following categories.
Rank the following energy sources from BEST (5) to WORST (1) for the environment.
  __Solar
  __Natural Gas
  __Wind
  __Hydropower
  __Geothermal

Rank the following energy sources from “Most economically feasible” (5) to “Least economically feasible” (1)
  __Solar
  __Natural Gas
  __Wind
  __Hydropower
  __Geothermal

Please write a response to the following questions.
  ○ What is your gender?
  ○ Did you support the wind farm completely, with changes or special conditions, or were you not in favor at all? Why?
  ○ Do you have any other comments you’d like to share?

b. Maple Ridge

*Please mail your survey and prize card by April 18, 2014 in order to be entered into the contest drawing.*

Listed below are statements about the terminated Cape Vincent wind farm project, as well as the relationship between humans and the environment. Please indicate the degree to which you agree with each item. Circle the number of your response for each statement using the following scale: 5 = STRONGLY AGREE (SA), 4 = MILDLY AGREE (MA), 3 = UNSURE (U), 2 = MILDLY DISAGREE (MD), OR 1 = STRONGLY DISAGREE (SD).
1. I was very informed about the Maple Ridge Wind Farm during its construction process.

SD MD U MA SA

2. The Maple Ridge Wind Farm poses a significant environmental threat.

SD MD U MA SA

3. The Maple Ridge Wind farm gave/is giving me personal financial returns.

SD MD U MA SA

4. The Maple Ridge Wind farm provided financial returns/economic growth for my town.

SD MD U MA SA

5. We are approaching the limit of the number of people the earth can support.

SD MD U MA SA

6. Humans have the right to modify the natural environment to suit their needs.

SD MD U MA SA

7. When humans interfere with nature, it often produces disastrous consequences.

SD MD U MA SA

8. Human ingenuity will insure that we do not make the earth unlivable.
9. Humans are severely abusing the earth.
1 2 3 4 5
SD MD U MA SA

10. The earth has plenty of natural resources if we just learn how to develop them.
1 2 3 4 5
SD MD U MA SA

11. Plants and animals have as much right as humans to exist.
1 2 3 4 5
SD MD U MA SA

12. The balance of nature is strong enough to cope with the impacts of modern industrial nations.
1 2 3 4 5
SD MD U MA SA

13. Despite our special abilities, humans are still subject to the laws of nature.
1 2 3 4 5
SD MD U MA SA

14. The so-called "ecological crisis" facing humankind has been greatly exaggerated.
1 2 3 4 5
SD MD U MA SA

15. The earth is like a spaceship with very limited room and resources.
1 2 3 4 5
16. Humans were meant to rule over the rest of nature.

17. The balance of nature is very delicate and easily upset.

18. Humans will eventually learn enough about how nature works to be able to control it.

19. If things continue on their present course, we will soon experience a major environmental catastrophe.

20. Harnessing the power of wind for energy is good for the environment.

Please respond to the following by circling the appropriate bulleted statement.

- What percentage of energy use in the United States should come from renewable energy?
  - 0-20%
  - 21-40%
  - 41-60%
  - 61-80%
  - 81-100%

- What is your highest level of education?
  - Less than high school
○ High school/GED
○ Some college
○ Undergraduate degree
○ Masters degree
○ Doctoral/Professional degree (MD, JD, PhD, etc.)

● What is your age?
○ Under 25
○ 25-35
○ 36-44
○ 45-55
○ over 55

● What type of resident are you?
○ Seasonal
○ Year-round

Please rank the following categories.

Rank the following energy sources from BEST (5) to WORST (1) for the environment.

_ Solar
_ Natural Gas
_ Wind
_ Hydropower
_ Geothermal

Rank the following energy sources from “Most economically feasible” (5) to “Least economically feasible” (1)

_ Solar
_ Natural Gas
_ Wind
_ Hydropower
_ Geothermal

Please write a response to the following questions.

○ What is your gender?
○ Do you support the wind farm completely or are you against it? If you had the ability to change certain aspects about the wind farm, would you?
○ Do you have any other comments you’d like to share?
Appendix B. Copy of Interview Instruments

General Energy Use Questions:
What percentage of energy use in America should come from renewable energy? What is the best source of renewable energy?
What do you believe is the best source of energy in terms of environmental impact?
What do you believe is the best source of energy in terms of economic efficiency?

Wind Farm Questions:
How has the wind farm impacted the area, both positively and negatively? Were these impacts different from your initial expectations during the wind farms proposal/development?
Specifically, do you know of any environmental impacts of the wind farm? Social impacts? Economic impacts?
Given your background, what do you think is the biggest strength of this project?
Given your background, what was/is your biggest concern with this project?
Do you think the wind farm is making a significant contribution to energy production? Is wind energy the best form of renewable energy for the town?
What do you know about the Cape Vincent abandoned wind farm project? Did you think it was a good idea to develop a wind farm in Cape Vincent?
Appendix C. Copy of Persons Interviewed

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