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## Sociological Effects of Wind Farms in Maine

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Sociological Implications of Wind Farms in Maine  
The complex study of the cost of our newest energy technology

by

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Honors Thesis

Science, Technology and Society Program

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## INTRODUCTION

All over Maine, large white structures are popping up, towering over Maine's tree lines and mountaintops. The structures are wind turbines, designed to use the natural energy of the wind to generate. The hope, promise, and logic surrounding windmills is immense. Windmills harness naturally occurring energy and turn it into something that society can use to run our complicated lives. While the ideal of wind farms sounds perfect, the reality is that wind turbines are far from being an energy source that has no costs beyond the financial. Wind farms in Maine are tearing apart communities, destroying picturesque ridgelines, and disrupting habitat patterns. However, many factors play a part in why the social effects have been so drastic in Maine. With proper legislation, logical processes, a master Maine plan, and the necessity to take time in the implementations, wind farms could be a much smaller cost to Maine. While social costs are extensive, wind farms have also brought extensive economic gains to Maine as a whole and many individual communities. Ultimately, it is necessary for Maine to think seriously about wind power. The energy that New England turbines produce is much less than predicted and much less than places in the Midwest. It is clear to everyone that society is currently in an energy crisis, but wind farms in Maine may be a greater cost to society than they are a solution to the energy problem.

Renewable Energy is everywhere in today's conversations, news reports, and politics. The reality of global warming is finally permeating our society and now enough people have become concerned for the worry to change to action. The truth about what human pollution has done is shocking. Before the industrial revolution, we had a 280 parts per million(ppm) concentration of carbon dioxide in our atmosphere. In 2005, the concentration had increased to 375 ppm (Lauber 2005). That increase will continue to grow exponentially if we as a society do

not do something about it. Scientists predict that if that number increases over 500 ppm, we will experience major natural disasters (Lauber 2005). In order to cut down on carbon emissions, it is necessary that we begin to live more responsibly in our everyday lives, but also try to find new ways to power our growing society that do not have as costly effects on our atmosphere.

One of the largest contributors to carbon production is the burning of oil for both transportation and energy. Our society's widespread dependence on oil, coal, and natural gas contributes extensively to our societies' pollution. Furthermore, for Maine, dependence on oil is a dependence on the economies and resources of other states. Having such a dependence on another state or country is dangerous for political, economic, and social reasons (Lauber 2005). This dependence on a resource so vitally important to our current lifestyles weakens our county's political and economic stability. Renewable energy sources have the attractive trait that they are available domestically and for Maine, it is a type of energy that we can produce in our own backyards. This shift to renewable resources could create a more advantageous position for Maine by providing a product for Maine to use for itself and sell to others. However, renewable energy is often seen as 'free' energy because in essence you are capturing the energy from the sun, wind, or water- resources that exist already. Unfortunately, this attitude is not correct because extensive amounts of energy go into creating and running windmills, solar panels, etc. Without a doubt, the shift to renewable energy is a necessary shift away from oil dependence. We must, though, realize that many costs accompany this seemingly free energy. The trend toward renewable energy is a highly complex issue, and we must think carefully about what renewable energy methods make the most sense.

Renewable power has emerged in the last decade as the most viable alternative for our oil dependence. Denmark and Germany quickly committed to producing their power in renewable ways. The change was very rapid, and has made them models for many in the renewable energy movement. Denmark and Germany supported the transition with public policy that addressed potential problems. This is a step that Maine largely skipped over. General society took a long time to accept the global warming and energy crisis. This made the need to limit carbon emissions extreme. The major issue with this need for extremity is that citizens, companies, and governments may be jumping in so quickly that they miss extremely important factors that are associated with the change. If speed becomes more important than implementing power correctly, society as a whole will suffer from dramatic changes. Furthermore, the statistics on power output that scientists claimed wind turbines could bring, may be untrue for many reasons. In his book about the switch to renewable power in the 21st century, Volkmar Lauber makes the point that governments must create policies that "support renewable power development and expansion at a reasonable cost to society" (Lauber 2005). It is important that we take the energy crisis and think about it both logically and methodically so that we do not create a different crisis in the future. This thesis aims to explore the question of what is a "reasonable cost to society." I will focus on the state of Maine, and how wind energy affects individuals and communities. To determine the effects, I delved into newspaper articles and governmental documents, I interviewed people who live near the wind farms, and I interviewed people who help construct the turbines. I compiled information on the advantages, disadvantages, and power output of the wind farms to explore if the rewards truly do outweigh the problems that wind farms bring in Maine. The following chapters will question what kind of

policies Maine has in place, and critically explore whether Maine is incorporating wind power rapidly, intelligently, or both.

Looking back to the Industrial Revolution, hydroelectric dams in Maine made the state a booming milling and mining region. The dams kept people employed throughout the depression, while other states floundered. Hydroelectric dams even powered extensive trolley lines, making travel and trade extremely accessible for Mainers. However, the dams all over Maine are now slowly being removed due to the tremendous impact they had on Maine's ecology and wildlife. Additionally, in the construction of several dams to create more regulated water power, towns such as Flagstaff drowned (MPBN). With many new discoveries and trends in society, we often learn about our mistakes after the fact, when it is too late. Water-power was extremely popular, but then decreased in popularity because the environmental cost simply was not worth the economic gains. My goal, as someone who is looking to go into engineering design, is to look at the other side of the issues. I hope to look at the sociological drawbacks, and discover if there is a way to use our wind energy technology just as effectively, while taking the time to be aware of, and try to minimize, the social effects. Or do the social drawbacks of wind farms outweigh the benefits we get in power? I hope to inform public policy surrounding the approval of wind farm permits and show the necessity of careful planning and extensive community negotiations. I also hope to educate Mainers, who are both for and against wind power, on the many social aspects of Maine wind farms.

The many sides of the debate on Maine windmills create a picture that is extremely complicated. There is clearly not one solution to the problems that have arisen in the last ten

years. The rural communities most directly affected by the wind farms are benefitting economically. However, from my interviews, I found that individuals in many of the communities I studied feel that their quality of life has tremendously decreased at a cost that is absolutely not worth it. My findings show that the greatest problems are with noise, deception and lies from the companies commissioning the wind farms, the desire for speedy implementation resulting in a complete lack of policy, and the harm to Maine's wildlife and scenery. Many individuals feel that while they are advocates of wind power, the changes have not been worth it because the power and energy output has not been what companies claimed. This raises the social question of whether the dramatic changes and costs to people's lives are worth it. Is this change in fact decreasing the need for a dependence on oil and fossil fuels? While there may not be a right answer to this question, there absolutely are ways to address the problems that arise in wind farm implementations. Maine legislators must hold the commissioning companies more responsible for the lives they affect. I concluded in my research that the need for speed in the proposals and construction of the wind farms must disappear, and appropriate research and community engagement must be required by law. Along with requiring environmental impact statements, the government needs to require personal impact statements and accurate representations of the energy that will be produced. In order to assure that the information given is accurate, the government needs to take the time and invest the money to assure that the commissioning company is telling the truth on all counts, and that it has spoken with the community at length. Finally, legislation must be passed determining a minimum distance windmills must be away from homes. Many researchers will claim that the distance must be a little over two miles away. All of these steps may take more time, but it is essential to



start doing this the right way in order to maximize both energy production and community and personal health.

For my thesis, I chose three distinct wind farms to research and talk with community members about. The three wind farms are Kibby, Fox Island, and Bull Hill. Each is unique in its size, commissioning company, location, and nature of the surrounding community. In trying to work towards a solution for better wind farm implementation, it is important to look at different wind farms to see if one company has a strategy that worked better than another. Of the three farms I studied, Bull Hill is by far the most well-liked wind farm. It could be because the residents of the areas around Bull Hill are all seasonal campers who live permanently somewhere else and are therefore not around enough to voice their complaints, or that it is a relatively new farm and so people are not witnessing the negative effects yet. However, looking at the strategies employed in their commission and construction, it seems that the company First Wind constructed Bull Hill wind farm smarter and more carefully than the other two case studies.

Kibby Wind Farm is a large, 44-turbine development on Kibby Mountain in the Boundary Mountain Range of Franklin County, Maine. Construction on the project began in the Fall of 2007, and the turbines began to spin in the fall of 2010 (TransCanada A). The wind farm was proposed by, and is owned by, TransCanada, the large Canadian-based company that is known mainly for their extensive networks of natural gas pipelines. The Kibby wind farm is composed of Vestas V-90 turbines and collectively produce 132 MW of power, enough to supply the needs of about 13,000 average American homes. With the completion of the Kibby mountain construction, it became the largest wind farm in all of New England (TransCanada A). The

construction of the Kibby Wind Farm invigorated the community economically, but is very controversial because many community members feel that TransCanada 'bought' the support of Maine groups and lied to the public about their plans. Other community members love the economic boost and large amounts of energy the farm produces. A theme that continues to appear in many complaints of the Kibby Wind Farm is that Maine policy makers rushed to approve the project, and as a result, it has permanently altered the Boundary Mountains, one of the greatest nature areas in Maine.



Image 1: Kibby Wind Farm is a 44-turbine farm located on Kibby Mountain in the Boundary Mountain Range near Eustis, Maine. Construction on the project began in 2007, and the turbines began to spin in 2010. The main concerns with Kibby are the habitat destruction and destruction of the mountain range's beauty.

In the commission, construction, and operation of Kibby, TransCanada put many millions of dollars into the economy of Maine through paychecks, taxes, gifts to the town of Eustis, and grant money for research. Some see this influx of money as an incredible opportunity for Maine, while others view it as a bribe from the large company, TransCanada, that does not care about Maine and only wants a profit. Regardless of which side of the story you believe, the

most important lessons to take from the construction and operation of Kibby are the reoccurring themes seen in all the problems it has faced. The largest two themes are the lack of policy and the speed of implementation. The Maine Wind Energy Act, passed in 2003, encouraged wind energy in the state of Maine and expedited the process of approving and constructing wind farms in locations "most compatible with existing patterns of development and resource values when considered broadly at the landscape level" (Maine Government). This act brought many improvements, and placed a large priority on renewable energy, which is extremely important in today's energy crisis and dependence on foreign oil. Simultaneously though, it encouraged companies and communities to build wind farms at a rapid pace to try to meet Governor John Baldacci's goals of future wind energy. Baldacci claims that, "the Task Force wasn't solely concerned with growing wind power. The members were dedicated to finding a framework that allowed for development while also protecting Maine's treasured and unique scenic and natural resources. In addition, the Task Force developed regulations that take into account public health and safety, and put into place rules that strengthen the oversight of wind power developments" (Baldacci 2010). While Baldacci's radio address states that the task force was cognizant of these factors, he never explains in it exactly how they are cognizant. In the wording of the legislation, it is extremely ambiguous as to where these most compatible places are. The lessons that can be taken from the many flaws and successes of Kibby are that wind farms have the ability not only to power thousands of houses, but also stimulate struggling economies in huge ways. At the same time, the Maine government does not have strict policies in place to ensure there is sufficient research into a potential wind farm location before construction begins. Policies must be unambiguous and standardized to address wildlife, safety, tourism, and community concerns before the project is able to gain approval.

The next wind farm, Fox Island Wind, is located on a privately owned property on Vinalhaven, a small Maine island community. In island locations, electric rates can range from two to seven times the national average, depending on how far the energy needs to be transported. The cost of transmission to Vinalhaven is 13 cents per kilowatt-hour, much higher than the mainland transmission rate of 1.2 cents. Therefore, Vinalhaven felt that they could benefit greatly from producing their own electricity. Wind power also seemed to be an excellent option for the Fox Islands because they are a location where coastal wind is extremely prevalent. Furthermore, wind energy could potentially make the islands self sufficient, rather than dependent on energy from the mainland. In turn, this had the potential to lower electric rates substantially for the islands. Unfortunately, there is currently no effective way to store power created by wind turbines. This means that when the turbines spin at night, a time when people use smaller amounts of electricity, any excess power is lost. In addition, wind is not a constant enough resource for the island to depend fully on the Vinalhaven wind farm for power. Some days, the wind barely blows, and therefore the energy must come from the mainland. The potential for Fox Island Wind seemed extremely positive in terms of energy dependence, but the reality is much more bleak.



Image 2: Fox Island Wind Farm is a small, 3-turbine farm on the island of Vinalhaven. It is locally owned by the Fox Island Electric Cooperative, but has faced many legal battles regarding sound ordinances since it began operation in 2010. The power output is not what people expected and the location near several homes posed many health issues regarding excessive noise.

In 2001, members of the Fox Island communities started to research the possibility of constructing wind turbines through the Fox Islands Electric Cooperative. Two residents of Vinalhaven were convinced to lease their land for the turbines. Soon after, the University of Massachusetts Renewable Energy Research Laboratory began to help the Cooperative complete a three-year study of the wind at Vinalhaven. Seven years later, in 2008, The Island Institute, a Maine nonprofit organization located in Rockland became involved with the project. Their primary role was to create an economic analysis with a financial model of how the island community could finance a wind project and the effect the project could have on island electric rates. The solution of how to finance the project was to find a tax equity investor and then later, once the farm was operating, to sell both power and renewable energy credits to the mainland. The electric cooperative research team was a non-profit business, so they created a for-profit Fox

Island Wind LLC in order to take advantage of the tax credits available for renewable energy projects from the federal government. (Project Background 2008) George Baker, a Swan's Island Electric Cooperative board member and faculty member at Harvard Business School, became the first CEO of Fox Island Wind LLC. Additionally, the Island Institute funded a logistical feasibility analysis, an environmental study, and a visual impact simulation for the proposed windmills on Vinalhaven. The plethora of studies concluded that the wind turbines could be built for \$12-14 million, with minimal negative impacts on birds, wetlands, and rare plants. Furthermore, the economic analysis claimed that power rates would be lowered by 2-4 cents per kilowatt-hour for the first ten years and 4-8 cents for the next ten years (Project Background 2008).

With the conclusion of these studies, the Fox Island Wind LLC (FIW) was well on their way to constructing the windmills. The citizens of the islands voted yes on the project almost unanimously, 382-5. Before construction began, FIW and the Island Institute funded further environmental studies, completed federal and state permits, and found financing for insurance and operational costs (Project Background 2008). The company Cianbro constructed the three windmills on the leased private property. Cianbro used barges to transport all the materials to Vinalhaven. Cianbro representatives claim that due to the small size of the island, and the importance of tourism in their community, the company "worked closely with the community to mitigate any impacts that arose as it related to the project" (Cianbro). The construction of the windmills, and the commercial start on December 1, 2010 were well supported by the community, as seen by the overwhelming vote and the reported 500 islanders who showed up for the grand opening (Fox Island Wind). Fox Island Wind Farm is unique because it was proposed

and constructed by the community, and hypothetically, the energy generated directly benefits the community by decreasing energy costs. However, the projected result of the project was very different from today's reality. Homeowners living near the windmills on Vinalhaven are extremely upset because they feel they were deceived; they were told to expect something much different than what they got. You will hear from Art Lindgren, a neighbor of the wind farm, later in this paper and see the immense effect these wind farms had. Neighbors of the wind farm, such as Art, cannot stand the constant noise, and as a result, several years of court battles between the community and Fox Island Wind Corporation commenced. As a result of the court fees and the unpredictability of wind as a source, the cost of energy has actually increased for community members rather than decreased in relation to the electricity cost trends on the mainland. Fox Island Wind farm taught valuable lessons about implementing wind farms. It is necessary to have them distant from homes in order to ensure a healthy community, and it is vital to have honest communication from the start between governmental parties, wind farm operators, and community members.

Finally, the third wind farm explored for this thesis was the Bull Hill wind farm. Bull Hill seems to be a model for successful wind farm construction in Maine. The 19-turbine wind farm dodges many of the typical complaints of large scale wind farms, yet produces 34 MW of power, enough to power about 34,000 homes. First Wind, the company that built and owns the Bull Hill wind farm, did a lot of things right in the process of proposing and building the wind farm. First Wind used its knowledge of Maine, its lessons from previous wind farms, and its awareness of the problems wind farms pose in order to build a wind farm that has received very little

opposition from Mainers-- an impressive feat. First Wind is a company based out of Boston that has grown tremendously with the increasing popularity of wind energy. In their growth they seem to have learned a lot and are implementing the lessons they learned about proximity to towns, disruption of loved landscapes, coexisting with the environment, and economic feasibility.

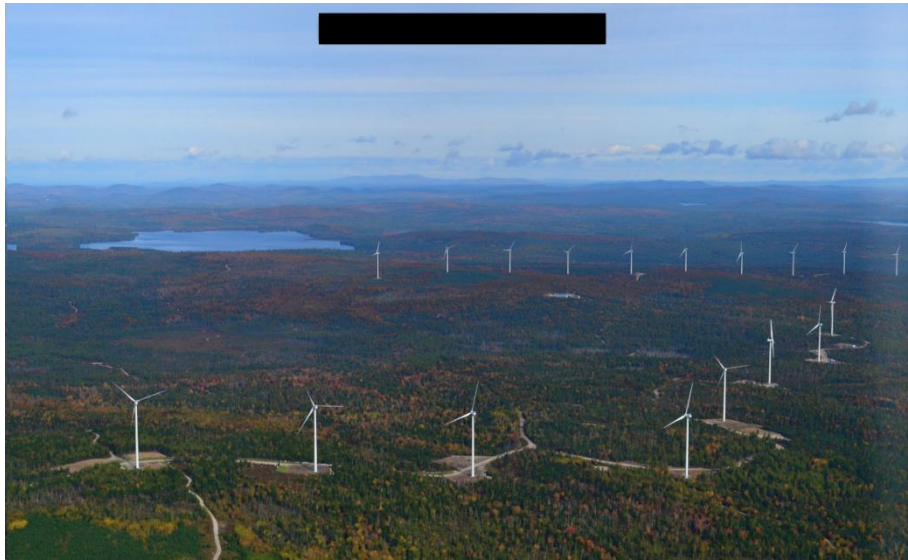


Image 3: The Bull Hill 19-turbine wind farm dodges many of the typical complaints of large scale wind farms, yet produces 34 MW of power, enough to supply the needs of about 34,000 homes. First Wind, the company that built and owns the Bull Hill Wind Farm, did a lot of things right in the process of proposing and building the wind farm such as letting the community see the site and constructing the turbines far from homes.

Bull Hill's wind farm development was a \$76 million project. Much of the energy produced from the 19 wind turbines is transmitted to Massachusetts via the Bangor Hydro-Electric Corporation's Line 66, and is sold to NStar, a Massachusetts utility company (Wood 2012). The agreement between First Wind and NStar provides energy to Maine and a low cost source of energy to Massachusetts consumers. The contract between the two companies holds for



fifteen years and is projected to save ratepayers a net \$57 million (Levesque 2012). Wind farms in Maine are producing energy for both Maine and states that have large energy demands, but no land to build on, such as Massachusetts and Connecticut. Dave Fowler points out that this makes wind an export as important as blueberries and lobster are for Maine (Curtis 2012). Therefore, the wind energy produced in Township 16 at Bull Hill enhances the economic health of the state of Maine. It seems that one large aspect to the success of Bull Hill is that First Wind is an extremely responsive organization, and is willing to adjust their plan to satisfy a community. They are aware of the problems that come with wind farms, and rather than trying to hide their past mistakes, they shine light upon them and learn from them. In the construction of the Bull Hill wind farm, they capitalized on many of these lessons.

Bull Hill wind farm has been in operation since October 31, 2012 and seems to be a success. The largest complaints or concerns of the turbines were the effect they would have on the wildlife and the majestic view of the Hancock area. First Wind did a good job researching the effects of the wildlife, and minimizing both of those problems as much as they could by lowering the height of the windmills. The chief executive of First Wind claims that it is important to meet the community in the middle, and at Bull Hill, First Wind did just that. Also, Bull Hill is in a wetland area, and there were many concerns about the construction process disrupting these wetlands permanently. Tom Reed, of the large Maine contracting company Reed and Reed, told me that due to this concern, the company constructed very temporary bridges to have as minimal of an impact as they could on the area. Although the turbines do not experience as strong wind gusts because the turbines are lower down, they do receive steady winds. The turbines are 311

feet tall, but the surrounding hills range from 280-624 feet tall, and because of the topography of the region, the windmills are hard to spot from the road (Wood 2012). Since the opening of the wind farm, the turbines have produced enough power for 16,800 homes (First Wind). The project has invigorated Hancock County economically through both taxes and extra community benefit sums. Hancock County, and the town of Eastbrook will receive a total of 240,000 dollars annually for 20 years in these community benefit funds (Levesque 2012). All in all, it seems that the process taken to research, build, and operate Bull Hill wind farm should be replicated in other wind farm projects in Maine.

As you will see in the following chapters that discuss the many problematic aspects of wind farms, almost all the issues relate to the location of the wind farm, the care taken in researching the many facets of the project, the lack of communicating with the nearby communities, and the underlying issue that wind farms may not be as incredible as they seem. Adjusting legal policies, general attitudes of these core issues, and eliminating ignorance of renewable energy will enhance the development of renewable power in a major way. The theme of these issues is compromise. The shift to new types of energy is absolutely a change. Change is hard because generally, people oppose drastic changes in their lifestyles. Furthermore, it is hard both to accept and admit when society is wrong or has made mistakes. In the case of renewable energy, and in particular wind, society as a whole needs to be able to experiment in an educated manner yet be able to admit when we are wrong. We must constructively look at our mistakes and our goals and find solutions that can solve problems without creating drastic new issues.

## **THE NEGATIVE EFFECTS OF SPEEDY DECISIONS AND MONEY**

Maine is a very large state with a comparatively small population. It is a state with many viable areas for wind farms due to the many mountains, ridgelines, and miles of coastline. Maine is said to have "the most wind potential in New England," (Parker 2008) and is therefore developing quickly. In addition, in 2007, Governor John Baldacci established a task force for wind power development to give recommendations and goals to the state of Maine. The official goal, stated in The Maine Wind Energy Act of 2009, is to have 2,000 MW of wind power by this year, 2015, and 3,000 by 2020 (The Maine Wind Energy Act 2009). To give you an idea of how much energy that is, 1 MW of energy powers 1,000 average American households. That means that Baldacci's goal was to produce enough energy via windmills in Maine to power three million homes by 2020. These goals, and the incentives that went along with them, created a rapid flurry of wind farm construction in Maine in the last ten years. Sections of the Wind Energy Act focused on making the process to approve wind farm permits much quicker. A passage from the act clearly shows this shift: legislation "limit[s] the review period to 185 days for projects in the new expedited zone, which includes all organized communities and much of the fringe area of unorganized townships" (Parker 2008). However, it is nearly impossible to complete the necessary research for the implications of a wind farm in 185 days. This ambitious legislation led to rapid construction of hundreds of windmills all over Maine. Large wind companies took advantage of both renewable energy incentives from the federal government and shortcuts in Maine policy to pass projects through that had not necessarily been carefully thought out. As a result, communities that are now living amongst wind turbines never had the time to understand or protest the project. Furthermore, companies do not spend enough time researching the

appropriate aspects of wind farm developments so that problems occur that could have been predicted with more careful pre-construction research. It is one thing to learn from our mistakes in our own lives, but when we learn from our mistakes in the construction of large-scale wind farms it is a much bigger issue. The solution is simply to slow down, take the time to research, educate the public, and construct the farm properly so that we can effectively, rather than carelessly, capture the wind's energy.

Along with the Maine Wind Energy Act, another large factor in why Maine is an attractive location for wind farms is the economy. Commercial wind farms create an enormous amount of revenue for the state in many different venues. First, in the construction of wind farms, many Maine workers are employed and others are members of companies that are contracted for material goods, engineering expertise, etc. Tom Reed told me that in the past ten years constructing wind farms has become half of the work they do. Additionally, in each town they work in, the company hires local workers to join the major construction project. He does not know the number of employees he has been able to hire, both long and short term, due to the wind farms, but he knows that it is a very large number (Reed 2015). The Task Force on Wind Power Development calculated in 2008 that "permitted projects in Maine have already or will soon contribute more than \$30 million directly to the state's economy in the form of paychecks to construction workers and engineers" (Parker 2008). Also, the rural communities where the wind farms are located benefit in a big way through property tax revenues. Wind farms often cover hundreds of acres of land, and therefore the company must pay the town taxes for each acre that they own. This property tax is usually excess tax because before the wind farm development, the land was owned by the government. Many of these communities can use this tax money to

improve schools, roads, community centers, and so much more. It is clear that Maine is an ideal choice in the eyes of corporations for wind farms due to the desperate economic status of many communities, but the Maine government must be careful not to let rapid construction jump ahead of intelligent policies. The potential gap between action and policy created by the sudden urgency for wind power can be seen in the existing wind farm projects in Maine. The successes and failures of the existent wind farms function to inform Maine how to proceed in a way that can benefit Maine communities more than it hurts them.

Supporters of the Kibby wind farm speak of the immense economic boost that the wind farm provided Franklin County. Many in the region are proud to house the largest wind farm in New England, and feel the economic effects directly. First and foremost, the energy production of Kibby is huge. The 132 MW produced is enough to power over 50,000 average Maine homes (Riner 2008). For a state that previously had no natural gas resources, and therefore depended on imports from other states or countries, Maine immensely benefits from the energy produced at Kibby. Furthermore, the power from Kibby connects with Central Maine's power systems, which in turn sells its energy to other regions of New England. The construction of the Kibby wind farm, along with others in Maine, can turn Maine from being dependent on others for energy to one that can profit from selling energy. The economic benefits of Kibby continue in the form of job creation, tax benefits, and gifts from the commissioning company, TransCanada, to the community. In the three-year construction period of the wind farm, the company hired 315 people just for construction. The thirteen permanent employees still at Kibby are all from Maine, and most are from the surrounding regions of the wind farm (Dunham 2011). I admire the

TransCanada Company for keeping the process as local as possible because they are a foreign company that could easily have used their own workers. Furthermore, while some name it as a payoff, TransCanada made agreements with the Maine Audubon and Appalachian Mountain Club to fund wildlife research (Dunham 2011). The negotiations were made because the construction of a large wind farm in a wilderness area has an immense impact on the ecosystem. By giving funds for research, the company is finding a way to try to compensate for the damage they may create. Finally, along with the tremendous amount of money that the company gives the town of Eustis in property taxes, TransCanada also gives \$1,000 per Megawatt to Eustis each year as a gift. Therefore, each year the town receives \$132,000 voluntarily from the company (Dunham 2011). It is no doubt that the county, and in particular the town of Eustis, benefits economically from the Kibby Wind farm.

While some view these economic windfalls as gifts, others view them as bribes, ways for an irresponsible corporation to make millions off of tax incentives given by the federal government for renewable energy. Karen Pease, a woman who lives in Lexington township near the Bigelow mountain range, has been involved with trying to fight the development of wind farms in her area for about six years now. While she does not live near any of the Kibby turbines, she lives on the opposite side of the Bigelow Mountains from them and is very aware of the problems of Kibby. Furthermore, she lives in the middle of the woods of the Lexington townships and has been experiencing the clearing of roads on her hillside making way for new wind turbines. According to Karen, the company that is proposing this wind farm, Iberdrola, has not even told the people of Lexington that they are building a wind farm, nor has it been passed through legislation, yet they are working to make the infrastructure for roads and clearings

already. Because Lexington is a township, they do not have a town government or council, and therefore have no way to collectively voice their opinion or create laws. She claims that the groups she works with, Friends of the Highland Mountains, has asked Iberdrola to hold a meeting explaining the plan for the wind farm and giving the community a chance to ask questions, and Iberdrola declined. Instead, the project manager claims that she wants to meet with community members individually (Pease Interview 2015). This insistence begs the question of why it is better to meet individually. Is the company trying to bribe community members? Or are they giving skewed information and think fewer questions will be asked about it if they are dealing with a small number of people at a time? The incentives are unknown, but it seems that the impression many have of Kibby, that the company is trying to speed through the process and are very bribery based, may have complete merit.

The policies set in place with the Maine Wind Energy Act encourage this kind of fast action on wind farm construction, and could be a place to begin when trying to adjust policies to make communities more comfortable with the addition of wind farms. Another side effect of the expedited wind energy law is that the decisions for approval are done by a small group of people, namely the Land Use Regulation Commission (LURC). LURC is not required to hold a public hearing about potential constructions or expansions unless they get enough response from the public asking for one. The decisions are therefore "one-sided, biased, backroom deals" (Friends of the Boundary Mountains). For example, when TransCanada applied for an expansion of the Kibby farm onto Sisk Mountain, the Friends of the Boundary Mountains group was forced to make a strong push, and eventually a lawsuit, in order to have a voice that could stop the construction (Friends of the Boundary Mountains). It is clear to me that the community needs to

have the ability to have their voice heard without fighting tooth and nail in a courtroom just to have that basic right. It would be beneficial for both sides of the issue to meet through a public hearing so that logical compromises can be made before extensive plans are conceived. Taking the time to give the community a voice and providing an avenue for education is a necessary step in order to ensure that wind farms get the support they need to thrive. The majority of Maine residents are hardworking, busy people, many of whom do not have the time to learn all the pros and cons of wind energy. Both Art Lindgren and Karen Pease expressed their concerns that the vast majority of people only look at the information that is readily available to them. As a society, we all tend to specialize in one area of knowledge, and therefore we trust that authorities in different fields will educate us on pertinent information. Lindgren and Pease both say that they too originally were this way until something triggered them to educate themselves thoroughly about the reasons behind wind power, and the results of wind farms. Somehow, we must allow enough time, and enlist honest professionals on all sides of the issue to educate our communities before we asked them to vote on a wind farm. With something that has an immense impact on both individuals and the character of the town, citizens deserve to be casting an educated vote. Acts that fast-track the process and skip these essential steps are not helping anyone because the quick processes only lead to more complications in the wind farm's future success.

Following the theme of speed leading to mistakes, the *Lewiston Sun Journal* published an article that questioned the rashness of many wind farm constructions. The author raised the point that in order to fix global warming, many companies are reaching quickly for solutions that may not even start to fix the problems. The author argues that if we do not manage the amount of demand for electricity, there is no way we can reduce the carbon emissions in the atmosphere



simply by building wind farms (Bien 2007). The incentives that governments give should be for smart thinking and engineering in conservation, not solely for quick implementation of wind farms. For example, "setting wind farms in remote parts of the state is... less efficient than similar projects closer to users" (Bien 2007). Almost all of the wind farms are located in rural communities that do not need the energy that the turbines produce. It is therefore nearly impossible for these people to see benefits of the windmills beyond the economic boosts they provide. If the government took time to analyze all the viable sites in Maine at once, and made policies to address the implications of wind farms, the implementation could be much more successful and accepted while still being energetically efficient.

A third concern expressed by the local community in Eustis after the construction of the Kibby Wind Farm, but once again most likely due to speed of construction and lack of policy, is the safety of the turbines. On January 16, 2013, a fire destroyed the motor box of one of the turbines at Kibby. Turbine fires are very rare, but are very costly and unsafe when they do occur. While the Kibby Wind Farm fire was contained, and did not spread through the forest, it easily could have. The usual causes of turbine fires are lightning strikes or electrical shorts, but in most cases it is impossible to know how to prevent them (Richardson 2013). The turbine fires sparked concern from community members that there was not policy in place to deal with fires at the wind farm. In the case that the fire spreads to the surrounding forest, it is a problem that concerns the whole community. Regardless of the cause of the turbine fire, the concern is with "the process by which these fires are reported to government officials and the public" (Richardson 2013). More investigation into the existing process in place for a fire showed that potential hazards, such as fire, were overlooked in the plans for the Kibby Wind Farm. With the current

policies, TransCanada has the ability to cover up the fire and has no obligation to publish the findings of why the fire occurred. As the policy stands now, the fire is to be dealt with internally, unless the wind farm asks for outside help. Under this setup, the Maine Forest Service would only be notified of a fire if it spread to the forest (Richardson 2013). While this process may sound logical, it lacks a sense of reality. A fire at a place like Kibby would take fighters a long time to get to because it is up on the hillside and ridgeline away from town. Therefore, if they were only notified once the fire started to burn the forest, the damage could be extremely extensive. If, however, the department was notified once a turbine began burning, they could be on site and ready to respond the minute it spread to the nearby forest. Bill Hamilton, the chief forest ranger, said that, "having a more structured notification system in place would make sense" (Richardson 2013). A representative at the Department of Environmental Protection, one of the groups that played a role in approval of the wind farm, said that "it's possible the expedited pace of past wind farm approvals could have led to the issue of turbine fires receiving less attention than it deserved" (Richardson 2013). The speed of approval of the wind farm appears to be a reoccurring problem because at least at the Kibby Wind Farm, the speed resulted in lack of policy in many areas, including safety of the Maine woods and nearby community.

In the construction of the Fox Island wind farm, the concern about speed of construction and deception of the community was also prevalent. The major problem with the implementation of the Fox Island wind farm ultimately comes down to the noise, but it is due to the lack of cooperation between the wind farm and the community developed as a result of a fast-tracked process. In a community wind farm, such as Fox Island, the relationship between the community and the corporation in charge of the power must be an extremely cooperative, honest relationship

that begins well before the wind farm is approved. In 2014, the Maine Superior Court found the DEP guilty of enforcement of regulations on Fox Island Wind, and granted the request of the FIWN that at night the wind farm could not produce more than 42 decibels (National Wind Watch 2014). Additionally, in one study of the project, the director, George Baker, "took pride in speeding the Vinalhaven project past likely objectors" (National Wind Watch 2014). It appears that he is referencing the fundamental issue that residents, and likely objectors, were told that the sound would be nothing more than rustling leaves, and therefore had no reason to object. In later sections, you will hear about this deception in depth through the personal account of Art Lindgren. The fact that Baker is proud of the speed of approval, rather than a great working relationship with the community, is problematic.

On the opposite side of the issue, the First Wind construction project at Bull Hill shows a benefit to the fast tracking process. Maine state law states that when a company expedites the permitting process, they are required to provide community benefit funds (Fuller 2013). As we have already discussed, in the rush to construct wind farms while federal funding was still available, many companies expedited the permitting process. We know that the downside to this is that, in many locations, proper steps were not taken to educate the community and get their opinion. The enormous sum of money paid in the community benefit funds when wind farms were fast-tracked made the gap in communication between companies and communities seem justifiable somehow. While this seems to be a major downfall in the construction of other wind farms, Bull Hill's location means there are few strong opponents and it is therefore mostly seen as a jackpot to the county. Hancock County and the town of Eastbrook will receive a total of \$240,000 in community benefit funds annually for 20 years (Levesque 2012). The more than \$4

million received in 20 years can be used to improve the local infrastructure such as schools, roads, and public services. In addition to the benefit funds, First Wind must also pay taxes to Hancock County and East Brook. Each year, the company will pay approximately \$100,000 in taxes to the community. Finally, Along with the wind farm, First Wind is constructing a communication tower so that 911 communications can happen more effectively within the county (Curtis 2012). It is evident that many corners of Hancock County will be positively touched with the economic boost that the wind turbines bring.

The dynamic between the benefits of the economic boost of wind farms and the disadvantages of the expedited legislations is a fragile balance. It seems that in order to stabilize this balance the two must become completely separate. There needs to be the same requirements for the economic boosts given to communities, but not at the cost of speedy mistakes and lack of community education.

## THE THROBBING HUM OF A TURBINE

A never ending Whoosh, Whoosh, Whoosh of turbine blades slicing through the air is the sound that those who live within three miles of wind mills have been forced to grow accustomed to. However, it seems that perhaps the sound is not something that you cannot adjust to physiologically or mentally. The single largest complaint of individuals living near windmills is that of the noise and how it affects their life. A constant, never-ending noise could rattle or annoy anybody, but new reliable scientific studies in the Bulletin of Science, Technology, and Society show that the engine used to capture the energy created by the spinning turbines creates vibrations that are damaging to human health. The regulations on noise in Maine are based on the audible sound in decibels that the human ear can hear. Each town decides their own decibel limits depending on the location and surroundings, but no regulation has ever addressed this new kind of low frequency vibration. These vibrations not audible to the human ear, but very much felt by the human body, are called infrasounds, which have been recently shown in several studies to limit serotonin levels and produce constant anxiety. These two factors in your body and mind can, and do, lead to depression. I talked to one woman whose friend committed suicide as a result of the windmill induced depression, and talked to a few who had to move away from their homes because it was so awful. There are clearly negative health impacts to people living close to wind farms, even if it is hard to prove until windmills have been in one place for several years. According to the calculation of the scientific studies, the simple solution is to write legislation so that wind farms are not constructed within 2.2 miles of personal homes.

At the Fox Island Wind Farm, those who live close by the windmills feel that "the industrial whoosh-and-whoop of the 123-foot blades is making life in this otherwise tranquil corner of the island unbearable" (Zeller 1). Vinalhaven, an otherwise beautiful serene place for tourists and locals alike, has been ruined for several families. While all evidence seems to show that the Fox Island project was fairly well supported by the community before operation, the start of the turbines spinning brought many negatives to light, and began an era of noise compliance issues. Some island residents, such as Art Lindgren, feel that the noise from the turbines is disruptive, unsafe, and much different than the pre-operational assurances the community was given: Lindgren claims, "People I knew and trusted told me I would not hear the turbines. I believed them. I got hoodwinked" (Lindgren 2015). FIWN is the blog created by a collaboration of these upset, outspoken members of the Vinalhaven community, who's main goal is to voice opinions, stir up support, and take action to try and change aspects of the wind mill to make living there more bearable. Ever since the opening of the wind farm, the blog has been extremely active in informing and provoking the community in the fight against excessive noise. In a document submitted to Maine courts later, Fox Island Wind Neighbors claims that before construction CEO of Fox Island Wind, George Baker, assured them that "the nearby residents would not hear noise from the project during normal operations because of masking ambient background noise" (Fox Island Wind Neighbors 2011). Baker's statement proved to be entirely false, according to records and complaints of those nearby residents. Whether the noise travels farther because the windmills are near water, engineers simply miscalculated the amount of noise, or Baker was lying to get support, neighbors were blindsided by the constant hum that began with the opening of the wind farm.

Art Lindgren is a community member of Vinalhaven who has spent a lot of time analyzing the many details of the Fox Island Wind farm because he and his family were substantially affected by the noise of the three turbines. I spent a morning with Art, listening to his story, and was both inspired and horrified by what he told me. However, Art's experience is representative of many other Maine residents that I encountered who live, or lived, close to wind turbines. Art and his wife saved up money to retire on Vinalhaven, a place they had visited many times before because members of their family owned a camp there. When they finally retired, they used the money they had saved up and built a house with their own hands in an idyllic, peaceful area of Vinalhaven. About five years after they moved into their house, they started to notice test wind weather stations near their house. During this time, according to Art, the company never once approached them until very late in the process. Lindgren says that they find ways to make "inroads on the selectmen committee. They will get a couple key people on the selectman committee and make it good for them-- what they do is not talked about" (Lindgren 2015). The people who lived on the property where the windmills now sit, adjacent to the Lindgren's house, sold the land to the Fox Island Electric Cooperative. However it seems likely that they were somehow convinced to do so because the couple had just finished building a house of their own on the property. Lindgren's wife even helped the neighbors tile their bathroom. The Cooperative talked to Lindgren and his wife only once in the entire process. It was before the vote, however all they said was that the Lindgren's would never hear the windmills. They claimed that when there was wind to spin the turbines, the rustling of the leaves would absolutely cover the sound. Lindgren had no reason not to believe them, so he was a proponent for the windmills and voted yes. He says, "I voted for it. I got duped (tricked), so I voted for it" (Lindgren 2015). He can assure you that you absolutely can hear the wind turbines,

and that you feel their negative effects at all times. In court, the electric cooperative still insists that you cannot hear the turbines, and the DEP believes them. Lindgren suspects that partially they choose to believe the company because if they did not, it would be like admitting they were wrong to approve the project in the first place. Lindgren and his wife were so affected by the turbines, that they bought a small property near the Belgrades. They still own the house on Vinalhaven, and he does not know what to do with it. The house is worth practically nothing now because nobody wants to buy a house near a wind turbine. Lindgren explained this frustration and its serious impacts by laying out the situation clearly for me. He said, "Most people, like me, are not wealthy and when they have a house it is 90% of their economic worth. If that gets stolen from you, you are poor. Or you are forced to live in the situation and you get sick" (Lindgren 2015). Lindgren's daughter is an artist on Vinalhaven and is in the category of people who cannot afford to move. They now claim she is sick: she suffers from serious sleep deprivation, anxiety, and depression. Lindgren and his neighbors lost millions of dollars with the construction of the wind turbines because nobody will buy their houses, and never got the chance to educate themselves and protest because they were fully deceived. Lindgren knows that with any new renewable energy source there will be costs. But he argues that if it is a change that costs something to everyone, there can be a discourse, a fight, a mutual understanding because everyone is going through it. With windmills, you are taking millions of dollars away from a select few, and nothing away from others. This creates a divide and makes it so it is easy for society to overlook any negative aspects, and only focus on the benefits. Lindgren summarizes: "Windmills sound like a great idea: wind is free, green, not adding pollution to the atmosphere. It sounds like something is there. Most people are lazy: they like the conventional view because they can get along with their neighbor and don't have to do any homework themselves, don't



have to think it through, don't have to ask questions. A lot of people don't really care" (Lindgren). It seems that perhaps people need to care, and somehow an education system must be in place in the process of approving wind farms so that community members can take a stance on the issue from an educated, rather than ignorant, position. Art's story is sad because the deception is so clear. He is not fighting against the wind turbine noise because he is someone who has always hated wind. Instead, he is fighting against it because he was lied to and voted for the movement that robbed him of his life fortune.

Their determination in the fight against Fox Island Wind in the last five years shows how passionate some community members, like Art, are to try to limit the noise or hours of operation. When Fox Island Wind ignored casual community complaints, the group of advocates making up Fox Island Wind Neighbors, including Lindgren, began a legal battle that has continued for over five years. This battle brought into question the process by which wind farms are implemented in towns. Many uncharted waters have been crossed in the process, such as delegating what level of government has the authority on noise levels. Early on in the noise battle, in spring of 2010, Fox Island Wind Neighbors submitted twenty official noise complaints to the Department of Environmental Protection (DEP) with requests that Fox Island Wind submit their formal compliance assessment data. The company refused to submit their data because they felt they had no legal obligation to (Fox Island Wind Neighbors 2011). This begs the question whether the company was operating above the DEP's noise regulations. If in fact that were the case, the problem would no longer lie in the process by which this wind farm was implemented. It would instead lie in the honesty of the Fox Island Wind Company for not operating at previously determined values. For the purpose of this study, that problem would be a situation-based

complaint and would not validate the need for reformed public policy. However, the fact that there was no legal system in place to force the company to submit regular data seems to be a large problem. The result of the advocates' first twenty official complaints was that the DEP's noise consultant, Warren Brown, formulated complaint protocols. These protocols legally forced First Island Wind to submit monitoring data within a week of a formal complaint (Fox Island Wind Neighbors 2011). This change in protocol seems to be a very logical step, and it is a little crazy that it only happened because Fox Island Wind neighbors hired a lawyer, hired an acoustical engineer to collect and analyze data, and submitted twenty noise complaints.

While the change in protocol was a great step for Maine's regulations in regards to the implementation of wind farms, at Fox Island the regulations were ignored. According to records kept by Fox Island Wind Neighbors, the company disputed the protocols rather than submitting information. Eventually, the company submitted partial data two weeks after they were supposed to submit a full set of data. It seems that either Fox Island Wind had no way of recording accurate data, or they were simply operating on their own volition because there were no strict laws in place to start with. Either way, the company was fairly resistant to the protocols set by the DEP. The lawyer for FIWN eventually submitted a request for Fox Island Wind to turn off their turbines at night until the company fulfilled its duties of submitting proper operating data. He states, "As matters stand, my clients are being asked to suffer complaints, night after night, without any relief and FIW is being allowed to operate outside the law, month after month, with no adverse consequences whatsoever. This is clearly not right or fair to the affected citizens of Vinalhaven" (Fox Island Wind Neighbors 2011). The debate between the DEP and FIW has been

continuous, with the ultimate problem being that FIW has an operating license. This license spells out certain operating conditions. The company argues that as long as it is in compliance with those operating levels, it should not have to pay attention to compliance complaints from aggrieved neighbors (Fox Island Wind Neighbors 2011). It is interesting that such a local company would be resistant to changing their operating levels just a little to appease extremely upset community members. No change will ever make everyone happy. Even if perfect regulations were put into place before the construction, and the neighbors knew exactly what to expect, they might still be angry. The lesson that can be learned in the implementation of this wind farm, though, is that the neighbors and community members had no idea what to expect, and there were very few legal protocols put in place to maximize the wind farms success while accommodating those who call Vinalhaven home. Now that the wind turbines are constructed and an operating license exists, it is extremely hard to back track and change the sound regulations that are problematic.

The debate now becomes whether these complaining neighbors are just annoyed by the noise, or if the noise level is affecting their health in a major way, as many of them claim. The growth of wind energy has rapidly increased in the last ten years, especially in the United States. With the growth of wind energy comes many side effects that society simply did not think of before. For example, many citizens did and still do think it is impossible that the sound of a windmill spinning could have legitimate medical side effects. Those living within two miles of the Fox Island windmills claim that the noise absolutely affects their health.

Recent studies published in issues of the *Bulletin of Science, Technology, and Society* show that in fact the Fox Island neighbor's complaints may be extremely valid. In an experiment performed in the North Island of New Zealand, scientists compared two identical groups of people who lived in two distinct locations to determine if wind turbine noise affected a person's health related quality of life. One group lived within two kilometers of the windmills, while the other group lived eight kilometers away. The group used a questionnaire created by the World Health Organization to measure physical, psychological, and social health related quality of life. The survey's purpose was hidden when given to the community members because it was a questionnaire that asked about many areas of the town. The results were that the people living near the turbines had a lower mean physical quality of life score and environmental quality of life score. Similar to other studies on this matter, the scientists found that sleep satisfaction ratings were significantly down in the group living close to the turbines. This could explain the observable difference in health related quality of life. At Fox Island, Lindgren told me that he and some of his neighbors have been giving their children sleeping pills for years now so that they can sleep enough to be able to learn in school and grow properly (Lindgren 2015). The New Zealand study goes on to state that, "A large proportion (23/39) of respondents from the turbine group identified turbine noise as a problem and rated it to be extremely annoying. It should be noted that, in contemporary medicine, annoyance exists as a precise technical term describing a mental state characterized by distress and aversion, which if maintained, can lead to a deterioration of health and well-being" (Shepard et. al 2011). While this study seems to show that the noise from the turbines effects health in some way, it doesn't explain why the sound of

wind turbines precisely, which fall in a very average decibel range, have such a large effect. The nighttime decibels of a city are surely larger than that of a wind turbine spinning.

Further studies show us the answer to this particular question of why the specific noise a turbine makes has such a negative impact. Dr. Alec Salt and Dr. James Kaltenbach of the University of Washington and Cleveland Clinic published an enlightening paper on the elements of sound beyond those that are audible to the human ear. Infrasounds are low frequency waves typically inaudible to the human ear. However, according to expert biologists, sensory cells in the human ear are sensitive to the specific wave of the infrasounds. Scientists demonstrated this using electrical recordings and monitoring the effects. The cells affected by infrasounds produce sensations of fullness, pressure, and ringing in your ears. These subconscious feelings could distinctly alter successful sleep patterns (Salt and Kaltenbach 2011). This trial measured the sound produced by a typical 1.5 MW wind turbine in a home that was 1500 feet away. They used a microphone that was able to record the low frequency sounds that the human ear cannot audibly hear. During the period that the scientists analyzed, the sound level varied from 28 decibels to 43 decibels. These values are on the lower end of the range of the sounds that the Fox Island wind turbines produce. The scientists found that infrasounds made up a much larger component of the sound than audible sounds did (Salt and Kaltenbach 2011). No studies have been published on the effect of these infrasounds over a long time period yet. Therefore, it is difficult to know whether the noise produced by wind turbines cause long term health effects, but in the short term the waves produced by turbines can result in extremely disrupted sleep and agitation all day which, in turn, can lead to stress and anxiety. These findings agree well with the

case study completed in New Zealand where community members who lived within three kilometers of wind turbines reported a lower overall health-related quality of life.

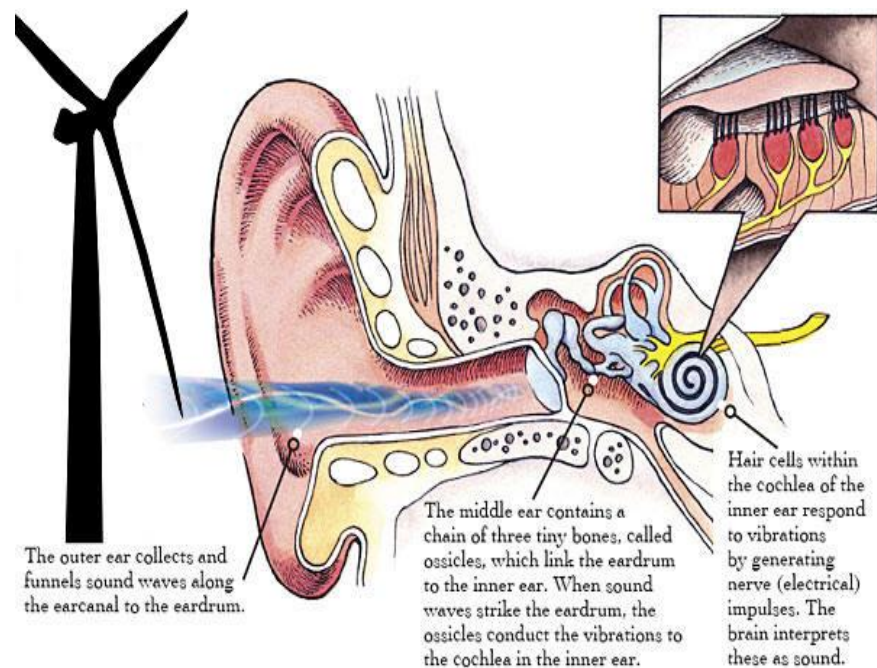


Image 4: The infrasounds from the spinning turbines vibrate the cochlea in the inner ear and send electrical pulses to the brain, which it interprets as noise, and if constant, can cause anxiety and stress to the individual.

The scientific findings of these two, and several other studies, have strong implications for future wind farm installations. Companies that plan to build wind turbines must adjust to account for the negative health effects by designing technologies to install on the turbines that dampens the infrasound, moving windmills to be 3-5 miles from any residential areas, or designing technologies to put in your house that would cancel out the turbine noise, both audible and inaudible. Governments, both national and local, should work to set legislation that makes construction of windmills near residential areas illegal. While none of these solutions have been realized indefinitely, many have begun to infiltrate conversation around wind farm construction. In 2010, the company Acentech Incorporated performed a study to determine whether noise-

cancelling technologies could be used to limit to the noise produced by wind farms. The concept of the project was that turbine sound waves would be measured and then analyzed to determine if speakers installed inside your home that produce sounds to destructively interfere with the wind turbine noise could fix the problem (Working Waterfront 2010). The results were inconclusive, and no such technology has been installed in any homes on Vinalhaven.

One family, however, took the sound matter into their own hands. Sally and David Wylie own a vacation home on Vinalhaven. They moved to their house "for the peace and quiet" (Turkel 2014) traditionally attributed to the beautiful island of Vinalhaven. Last year, they built an addition to their house that has a wall that is 1 foot thick, and filled with sound-deadening insulation (Turkel 2014). The couple wants to be able to escape from the noise and infrasounds of the turbines at least when they are sleeping. While community members try to find ways to deal with the noise, many are extremely upset because both their property values and their quality of life decreased exponentially when the wind turbines began operation.

Bull Hill wind farm avoids these noise complaints because it is carefully placed in Township 16, a location that has no yearlong residents, only camp owners (Wood 2012). Dave Fowler, the Northeast development director for First Wind claims that after its first project in Maine at Mars Hill, the company learned that it was necessary to have greater distance from homes (Dilger 2013). This adjustment away from locations with yearlong homes seems to make sense because it eliminates one large drawback of wind farms: the noise.

In addition, The LURC (Land Use Regulation Commission) took the concerns raised by the community near Bull Hill and addressed them by analyzing First Wind's plans and then

forcing them to revise. Unlike at the Fox Island wind farm, First Wind was very responsive to the requests of the LURC. For example, one concern of the public was on the issue of sound produced by the wind turbines. In general, the DEP sets noise limits for the state of Maine, but the local limits set in Hancock county are lower than that required by the DEP. When the LURC requested it, First Wind provided additional sound modeling based on the local sound requirements, rather than the DEP requirements as they had before (Maine Government 2012). The LURC also made sure to not fall into the issue of unreported sound data that Fox Island faced. The permit states that:

The Commission is applying noise limits that are significantly lower than the DEP standards based on the quantifiable provisions of the local ordinance and will require compliance testing to ensure that those noise levels are not exceeded. The record in this case does not demonstrate that there is a need to provide additional protection in order to avoid an undue adverse impact on human health. (Maine Government 2012, page 69)

Another, very related passage mandates:

The local ordinance requires reporting for the first two years of the project's operation, and every three years thereafter. The MDEP noise control rules at section 375.10, H require that the applicant take monitoring sound limit measurements at regulatory locations during post construction study to verify preconstruction modeling and compliance with standards. (Maine Government 2012, page 58)

These passages of the permit state that noise limits that are desired by the community will be met and monitored with regular testing. It takes into account the desires of the community. It also implies that the LURC did research about this specific location and deemed that the turbines would not be loud enough to cause the adverse health effects that exist among community members living on Fox Island.



Quality of life is extremely hard to measure quantitatively, but is an extremely important aspect of life. When you have a poor quality of life, you constantly work to change and improve it. When a wind farm is constructed within three kilometers of your house and you do not have the ability to change it, both your quality of life and your feeling of being able to do something about it dramatically decrease. Perhaps technology will improve to the point that wind mills will become silent and not produce infrasounds, but for now, companies and state governments must be sensitive to human health and quality of life. In conclusion, regulations must be made to ensure that windmills are not built within 2.2 miles of a home.

## **FALSE INFORMATION LEADS TO POOR COMMUNITY RELATIONSHIPS**

A large problem that many new wind farm communities face is that they have been given false information about not only the sound, but also the energy outputs. The Maine Wind Energy Act allowed for shortcuts in implementation. Companies take advantage of these shortcuts and use highly inflated statistics to provide exaggerated information to the public that makes wind farms seem ideal. It is possible that companies are not aware that they are feeding false information because they do not truly know what the wind farms will bring. However, Karen Pease's experience in the Highland Mountains where the company will not meet with the township members suggests conscious deception may be prevalent. Wind farm companies know that if the proposal is passed and the turbines are constructed, they will make a lot of money. When community members do not have the time to educate themselves on wind power in general, and especially the project in their town, they have no chance to learn any information beyond what the commissioning company tells them. This lack of education puts the community at a large disadvantage, and forces them to learn about the drawbacks through experience alone: once they have no ability to change it. The nonexistence of knowledge can also create a divide among the community itself after construction is complete because many view those who complain as cry babies who are not accepting the changes that come with renewable energy. By requiring a commissioning company to share their specific proposal with the community, governments could decrease the deception, increase the community's education in the project, and therefore allow community members to feel that they have a stake in the project, which

would in turn improve relationships within the town and between the town and the wind farm contracting company.

The first example of false promises creating a divide between the community and the wind farm comes in the proposal of the Kibby project by TransCanada. Trans Canada "told everyone they would do the absolute least damage to the ridges and summits as possible" (Sibulkin 2014). Kibby is located in The Boundary Mountains, which are in a beautiful, pristine location. Destroying the beauty of the mountains and ridgelines is a large concern for locals and Mainers alike. Despite Trans Canada's claims that they would keep the destruction to 2 acres per tower and keep the road 35 feet wide, they actually have made some tower areas as large as 6 acres, and many of the roads about 100 feet wide (Sibulkin 2014). Once the damage has been done, there is no turning back to rebuild the natural mountainsides. Tom Reed, whose company was contracted to build the road system and construct the turbines, cites the zero grade policy as his defense for this claim at Kibby. He said that the company they hire to do the blasting of the roads follows a policy that no earth is brought in or out, the existing dirt is just moved around to create the roads. He also explained that the reason the roads were so wide at first is because the cranes required to lift the massive turbine blades are enormous. He told me that after the construction is done, and once the huge cranes are gone, they plant new trees and vegetation on the sides of the roads to narrow them. While this may be the best solution Reed&Reed has, it is easy to understand why community members are so opposed to that. Saying you will only clear 35 ft wide roads is very different than clearing hugely wide roads and then replanting them to make a 35 ft road. The second option is much more disruptive, and has the ability to make community members exponentially more upset with the process. The ecological effects of destroying are essentially the same as the ecological effects of destroying and replanting because

the destroying aspect tears apart an ecosystem and the complicated web of relationships in that ecosystem. When you replenish the dirt, and attempt to rebuild the ecosystem, all of the animals, plants, nutrients, and bacteria must revive themselves, a process that takes time. While these kinds of processes and destructions may not be avoidable, it is essential that they be communicated clearly in proposals and to the community in advance so that they know all aspects of what they are voting for.

Some Maine residents, such as Karen Pease and others in the Friends of the Boundary Mountains, agree that if there were better or stricter policies in place as to where you could build farms and how you had to build them, the construction of a wind farm would be less careless and damaging to a community. Lauri Sibulkin, a Maine resident who wrote an editorial on the Boundary Mountain blog about the lies of TransCanada in the process of constructing Kibby, has nothing against wind energy. However, she speaks out against "the lying and scheming that is going on to get these projects fast tracked and rapidly built" (Sibulkin 2014). Many of the complaints about wind farms are highly intertwined, and seem as though they could be improved with stricter regulations, clearer communication, and longer timelines.

In the project on Vinalhaven, the noise was not the only deception. The power production promised and cuts in electric rates that were advertised are completely untrue and have further divided the community. The homeowners on Vinalhaven were promised that electricity costs would be practically cut in half from what they were before the construction of the wind turbines. However, since the farm began operations, members of the Fox Island community complain that prices for power have increased, not decreased. The original goal of building the turbines was so that community members would not have to pay the high electrical rates due to

transporting power from the mainland. However, even with the turbines, the energy still has to be transported to the mainland because the island grid does not have the capability to process the voltages into packets of energy that can be put into it. Therefore, the numbers for transmission are the same as they were before the wind turbines began spinning. Furthermore, wind power is extremely unreliable because it cannot be stored. Often the turbines produce more energy than is needed, but the unused energy goes to waste. Then there are times where the turbines do not even come close to producing the amount of energy needed. The plan that the electric cooperative produced was to produce twice as much power than the island needed. Vinalhaven would use half, and the other half would be sold to the mainland. The problem that became clear early in the first months of operation was that the turbines do not produce much power during that day when the demand is high, but do at night when the demand is low. The result is that the mainland buys energy from Vinalhaven at night for a cost much below that of production. What this means is that the cost of the power during the day must account for this loss, and is therefore much more expensive than the production cost. Finally, the millions of dollars spent in the legal battles amongst Fox Island Wind, Fox Island Wind Neighbors, and the DEP are reflected in the cost of energy. Now, on Vinalhaven electric rates have increased to 12 cents/kWh, in comparison to the price of central Maine's power, which is at 7.5 cents/kWh (Lindgren 2015). Due to the ceaseless battle on the part of the FIWN, and the lack of authority of the DEP concerning FIW regulations, this community wind farm has been a problem for six years costing much more money than the wind farm would ever have been able to save in electricity.

When I asked Art Lindgren what effect the turbine battle has had on the community as a whole, he explained to me how much it tore apart some of the members of the previously friendly community. Lindgren chose to fight against these wind farms because he rightly feels

that it is unfair, not effective, and basically was a way of robbing all of his life savings. Lindgren wants the turbines turned off so he can go live at home. Because he and some of his neighbors spoke up, they started a battle that resulted in many court fees for the wind company. These fees are taken from company revenues, and therefore Art and his neighbors are easily blamed for the cost of power. What community members do not understand is that the battle would have never gone to court, if Fox Island Electric had simply been cooperative and willing to compromise a little earlier in the process.

Community members, who are not paying attention to their bill, have the illusion that the wind turbines are saving them money. Once again, if you do not spend time to think about the background and educate yourself about what your bill exactly says, then you can be deceived into thinking that the turbines have in fact cut electricity costs. In 2008, before the wind turbines began operation, electricity was extremely expensive and was about 14 cents/kWh for Vinalhaven. However, when the wind turbines started to spin in 2009, natural gas also became a huge resource and electricity rates plummeted. Vinalhaven's costs used to shadow the trends of the mainland. While Vinalhaven's power was always more expensive than the mainland, if the price on the mainland dropped, so did the price on Vinalhaven. After the wind turbines started to run, the mainland's prices dropped immensely, while Vinalhaven's energy has slowly increased in cost. When you simply look at the beginning and the end prices, it looks like power went from 14 cents/kWh before the wind turbines, to 12 cents/kWh after the turbines. In reality, while the cost trend of the mainland is decreasing, the trend of the island is remaining at pre-turbine prices. The illusion and deception of a wind farms' promise seems to run deep: from noise to cost production.

At Bull Hill, First Wind claims that they did everything they could to tell the nearby communities what to expect. Bull Hill citizens were given an opportunity to go on a site visit to see the exact proposed layout of the farm. First Wind's Dave Fowler said that he "wanted to give the public a chance to get a behind-the-scenes look at the often-controversial wind industry in Maine." (Curtis 2012). Karen Pease, who is living near a proposed site of a wind farm elsewhere in Maine, shared with me that she asked for the privilege to even just see the map of the plans, and was rejected. By contrast, First Wind did a good job allowing the privilege to concerned community members to see for themselves what the farm would look like. The final permit for the Bull Hill wind farm is 91 pages long, and spells out exactly what rules First Wind must follow in a variety of situations. It is clear that the Maine Land Use Regulation Commission looked at many of the potential problems of the wind farm, and tried to avoid them by adjusting their requirements in the permit given to First Wind. One common complaint with the expedited permitting process of new wind farms is that community members never have a chance to share their concerns, and therefore get taken advantage of and lied to. According to governmental records, two evening public hearing sessions were held for community members to voice concerns, along with the opportunity for people to write to the LURC with their questions, comments or concerns on the Bull Hill project (Maine Government 2012). This step that First Wind took seems to be essential in trying to facilitate open, honest communication between a wind farm and a community. While not everyone living nearby is fully supportive of Bull Hill, I have seen no testimonials saying that someone felt lied to, cheated, or deceived.

While Bull Hill wind was clearly the most successful of the three farms in opening honest communication, the numbers surrounding all wind farms may be extremely deceiving. Ben Luce,

who teaches physics at Lyndon State College, has deep roots in the renewable energy world. He was head of alternative energy at the Los Alamos National Laboratory and was an advocate to get New Mexico to pass significant renewable energy legislations. While he is clearly a man who believes in the importance of renewable energy, especially wind and solar, he adamantly states that wind power in the northeast is not worth it. He has examined the energy rates that wind farms are supposed to produce and compared them to the reality of the numbers we are seeing at wind farms in the last ten years. The results are shocking. Luce states that the wind companies advertize the peak output possible from turbines with the unrealistic assumption that they run at all times. The actual amount of energy is quite different if you think about the fact that the wind does not blow 24/7. In fact, in the northeast wind is very inconsistent. The capacity factor of a wind turbine is the amount of electricity that a power plant actually produces in comparison to if it were running at full capacity all of the time. In New England, this capacity factor is between 20-30%. It is trending, however, around 22%. As technology improves, this number is increasing a little, but not by a drastic percentage. Furthermore, often wind developers will falsify the size of the turbines a little, which inflates the capacity factor. In order to produce enough energy through windmills in New England to meet demand, we would need to construct many thousands of turbines. In 2011, the existing wind power only contributed to 0.6 % of the energy needed in New England (Luce 2012). While this was early in the process of wind farm construction, it may not increase enough to make wind farms worth it.

Luce uses the simple physics of wind turbines to show why windmills cannot produce immense amounts of power. In a turbine, power generation is proportional to the cube of wind velocity. When there are low speeds of wind, a cube is not a very high exponent and therefore the power output increases very slowly (Luce 2012). In New England, the speeds of the wind



even on our tallest ridgelines are not that high, and are most definitely not constant enough nor fast enough to reliably produce a substantial amount of wind power. With wind power being the cube of velocity, the average energy consumption over time is an integral of the power equation. Therefore, a location needs to have both decent wind velocity and wind consistency to provide any sort of reliable levels of power. The average American consumption of energy each year is 470 GW. One industrial turbine now generally produces 1.5-3 MW. This means that even if we developed 3,000 miles of ridgelines in New England (most of the total ridgeline we have), we would only contribute about 3.3% of the electricity needed for America, using the 2012 population count and data for electricity usage. While these numbers do not stay constant since technologies are always developing to make machines more efficient, they are a shocking demonstration of the reality of wind power today. Luce makes a point when he adamantly claims that on-shore wind power in New England is not the most effective use of our money, especially if it affects society negatively as well.

In conclusion, the numbers, facts, and information that society receives from wind developers and even governments must be taken with a grain of salt. Legislation most certainly needs to be changed to force companies to allow communities get involved and learn the facts, such as the realistic power output of the wind farm location based on wind speed and consistency. It is critical that the timelines of wind farm proposals and construction be lengthened. The legislation expediting wind farm proposals may be the single worst thing. The information, misinformation, and facts are both extensive and confusing. Communities deserve to be able to stand up for what they do not like about a change in their town. Construction of a wind farm is not like construction of a library. It is a massive endeavor that changes the landscape of the community and the inner relations of the community in positive and negative

ways. As seen again and again in Maine, the construction of a wind farm has the ability to tear apart a once cooperating community or create massive amounts of hostility toward the renewable energy movement. It may not even be worth continuing with wind farms in New England if the companies involved continue the deception so commonplace in wind projects.

## **WILDLIFE AND BEAUTIFUL LANDSCAPES**

A typical windmill is taller than the Statue of Liberty and the blade span is wider than the wingspan of a Boeing 747. Understandably, a large concern that many have with wind farms is the effect that the spinning blades and the extensive pathways needed for transmission lines or roads have on wildlife. A new wind farm leaves a very large physical footprint which creates a disruption of the habitat and also damage to migratory species who do not know how to navigate spinning turbine blades. Fortunately, in proposing a wind farm, companies must submit a proposal to the DEP along with the Land Use Regulation Commission (LURC). This submission to the DEP ensures that a wildlife impact assessment is completed for the specific Maine area. Additionally, Maine's woods, mountain ridges, and lakes are known for their picturesque beauty. The construction of wind farms disrupts the beauty of these landscapes. While there is nothing you can do to eliminate these factors completely, awareness and willingness of companies to compromise is essential to limiting both the ecological damage and the anger and disappointment of the members of a community.

Many in opposition to the Kibby Wind Farm expressed their concern for specific wildlife species. The golden eagle species is the first wildlife concern The Friends of Boundary Mountains have. They filed a lawsuit against the U.S Army Corps of Engineers because, by allowing TransCanada to expand to Sisk Mountain, they violated both the Migratory Bird Treaty Act and the Golden Eagle Act (Richardson 2012). In order for the company to do the expansion, they were required to write a permit for filling in wetlands temporarily for construction. The Army Corps of Engineers approved the permit without judging the effect it would have on

wildlife; a step they are required to take with such a permit. The Golden Eagle is considered to be an endangered species and is protected under the federal Bald and Golden Eagle Act (Richardson 2012). Furthermore, according to the *Bangor Daily News* article, new information on golden eagle migration patterns "suggest this species may be the raptor most vulnerable to wind power in the eastern U.S." (Richardson 2012). The golden eagle finds a home in the Boundary Mountains, and therefore the expansion of the already massive wind farm must be evaluated thoroughly before it is passed. Next, the Bicknell Thrush is another bird that spends its summers in the habitat on Sisk Mountain. While the Thrush is not an endangered species, it is listed on the Audubon watch list. The Bicknell Thrush is known for its restricted breeding ranges (Bicknell's Thrush). The Friends of the Boundary Mountains take issue with the wind farm ruining the breeding ground of a rare bird that is already known for its extremely restrictive habitats.



Image 5: The Golden Eagle lives in the Boundary Mountains and is an endangered species

Furthermore, a large complaint of activists against the Kibby Wind Farm is that construction of the wind farm destroyed one of Maine's great wilderness areas, and with it killed

the lure for tourists to hike in the Boundary Mountains. The Kibby mountain range was a beautiful recreation wilderness area with extensive hiking trails before the construction of the massive wind farm began. Robert Kimber, chairman of the Friends of the Boundary Mountains group, claims that not only do the mountains bring ecotourism and backcountry recreation opportunities; they also "are a major reason why people born and raised here stay here and why people who move here choose to settle here" (Kimber 2015). While Maine has an opportunity to enter the energy market, it risks losing the unique attitude of Maine. The renewable energy industry has the ability to be a large asset to the economy of Maine, but unfortunately it directly contradicts one of Maine's largest current markets: tourism. A reoccurring theme in the complaints of Kibby is that Maine rushed into this. If the Maine government took the time to evaluate the entire state, they would be able to find many locations that would both have enough wind and not destroy pristine Maine wilderness. With more careful planning, Maine could capitalize on the economy of both tourism and renewable energy, rather than one or the other.

The destruction of habitat and scenic beauty are common complaints about every Maine wind farm. As Karen Pease told me when I interviewed her, we have some of the last places with a true, undisturbed night sky (Pease 2015). Maine is a state renowned for its beauty. Tourists visit Maine's mountains all year, and Maine residents cherish the recreational opportunities and character the mountains provide. When First Wind initially proposed the plans for the Bull Hill wind farm, the largest argument against the idea was the effect the turbines would have on the beautiful landscape. Bull Hill and Heifer Hill Ridgelines are located in Aroostook County, just east of the town of Eastbrook. The ridgelines overlook Spectacle Pond, Narraguagus Lake,

Molasses Pond, and Acadia National Park. Those against the project were very concerned that the turbines could be seen from Acadia National Park, one of the most popular tourist destinations in Maine (Huber). However, First Wind compromised and constructed the turbines with this in mind, and the wind farm operates hundreds of feet lower than other large-scale wind farms (Wood 2012). While constructing the turbines at a lower elevation can limit the wind they get, First Wind claims that the winds at Bull Hill are extremely viable because they are steady. Bull Hill was designed to try to maximize both electricity generated and community satisfaction by compromising and constructing the wind farm in a way that the turbines are not extremely obvious.

The approach that First Wind took when implementing the Bull Hill wind farm seems both unique and highly successful. The Chief executive of First Wind, Paul Gaynor, shared with the *Boston Globe* that they prioritize several variables in the research done before proposing a wind farm. Gaynor claims they find a place that makes economic sense, they work with environmentalists to minimize effects on wildlife, and they try to find places that have infrastructure in place already to limit the impact on the area. This approach is rational, cooperative, and is essential if we aim not to anger communities.

In many of the locations of their wind farms, First Wind has shown they truly care about the environment in which they are building. Gaynor states: "you have to find a way to coexist. You can't look at wind turbines and say they have no environmental impacts" (Gaynor quoted by Ailworth 2013). He and the company are aware that their work makes a footprint, so they try to tread as lightly as possible. The executive director of Maine Audubon, Ted Koffman, confirms

that First Wind does in fact care about these values. He asserts that First Wind always works with both environmental organizations and sensitive communities to try to protect rare or fragile habitats. They do this by sending out analysts to study animal populations and talk with frequent visitors to the wilderness areas. Additionally, at their Hawaii wind farm, First wind built a wildlife sanctuary while building the wind farm (Ailworth 2013). Prioritizing wildlife is a positive step for a wind farm company to take because it is one of the main concerns any population has about the increasing number of wind farms. First Wind also tries hard to design wind farms in ways that they can use already existing transmission lines and roads to run the wind farm and to transport energy (Mahoney as referenced by Ailworth 2013). This step reduces the impact that a wind farm has on its surrounding area. At Bull Hill, there are 19 turbines, which covers nearly 160 acres of land. But because First Wind was able to use existing roads and transmission lines, there were able to minimize their impact on Township 16.

"Wind Power and Wildlife in Maine", an article published by the Maine Audubon about the ecological impacts of wind power, analyzes the amount of viable land for wind power and analyzes the effect wind farms are having on the rich wildlife of Maine. The research began due to a concern of the safety of bats in Maine, but spanned many different ecological concerns. The study concluded that all of the wildlife looked at was threatened by new wind developments, but that the damage was easily minimized or entirely avoided "with proactive planning and thoughtful layout and design of wind project developments" (Gallo 2013). Utilizing Maine resources for wind could be beneficial if it is done right and with proper planning. In this article, Maine Audubon recommends several ways to plan more effectively to have as little effect on the

wildlife as possible. First, they recommend that wind projects avoid areas where there are known valuable wildlife resources. Secondly, they recommend avoiding high elevation sites that have rare natural communities (like the Bicknell Thrush) or are identified as critical summits. Finally, they suggest extensive analysis be done in wind projects within two miles of the coast because often these places often have extensive resources for wildlife (Gallo 2013). Limitations such as the few that the Audubon mentioned need to be considered heavily to ensure that wind farms do no kill off species or special wildlife resources. Along with the recommendations by the Audubon, research and limitations in regards to seasonal, migratory species must be considered.

Companies and towns must be aware of the proximity to natural resources, animal habitats, and beautiful landscaped. Compromises can be made, like they were at Bull Hill, to build the turbines lower than intended so that our demands for energy can be met while also caring for our ecosystems and landscapes. The Maine government also needs to make sure they maintain a balance of economically benefitting from wind power and protecting their beautiful landscapes, thriving animal species, and an extensive tourism industry.



## CONCLUSION

Maine is a beautiful state with abundant amounts of land and water resources. Renewable energy, in particular wind, is becoming an asset for economic prosperity in Maine. This topic is extremely important because the time for renewable energy is now. There are many scientific studies that show how fossil fuels are affecting our global climate. Many countries have realized that not only are resources becoming depleted, but also that we are increasing the amount of carbon dioxide in our atmosphere at a rapid rate with our extensive use of fossil fuels. Reduction, efficiency, and conservation continue to be the best options, however, if renewable power is going to play a large role in the coming years, it is imperative that we act now (Lauber 2005). Many communities and countries, such as Denmark and Germany, are accepting this fact and acting on it by implementing wind farms. The widespread, rapid development of renewable power plants can be a very good thing, but comprehensive action plans are needed "to support rapid renewable power development and expansion at a reasonable cost to society" (Lauber 2005). In order to uncover these societal costs, we must study the good and the bad of what has already been done.

My thesis focused on a small area, Maine, but one that is unique in the transition from fossil fuels to renewable power. Maine is a very large state with many rivers, extensive coastline, lots of uninhabited land, and ridgelines with steady winds. Wind energy has the ability to be an enormous boom in creating Maine jobs and a thriving energy economy. Where hydroelectric dams allowed Maine to prosper in the great depression, windmills could benefit Maine in a huge way in the next century. Wind farms already in place in Maine have boosted small community

economies tremendously in taxes (First Wind 2015). However, Maine prides itself on its unique communities and beautiful landscapes. The sign on the way into Maine reads: "Maine: the way life should be." Furthermore, wind power in Maine is not as successful at energy production as it seemed it would be when Governor Baldacci advocated for the construction of turbines. If we are to continue constructing wind farms in Maine, engineers and developers must be extremely diligent with strategies of wind farm implementation so that Maine can prosper without losing its unique character.

The largest concerns about wind farms are almost all complaints that can be dramatically reduced. In Denmark, an international leader in wind power, legislation is strict and extensive, while also encouraging, allowing for extensive construction but also successful integration into both the energy grid and the communities. In Maine, noise issues and problems with company deception both relate to the fact that the Maine Wind Energy Act encourages speedy, and therefore careless, proposal and construction. It is evident that speed has made for unhappy communities and windmills that have generated many issues.

I am a true liberal art student interested in going into mechanical engineering. I love the technical side of design, yet I also care tremendously about how technology currently affects our society. I began the process of researching this thesis with a very pro-wind energy stance. My hypothesis was that if Maine legislation was more careful and more detailed in regards to the process of approval for wind farms, citizens would be happier about community wind farms, and they would therefore be much more successful energy sources. I wanted to learn how this particular technology affects society and communities. Some of what I learned in this process reflects what I hypothesized, however my attitude and perspective toward wind energy has

changed from me being supportive of wind farms in Maine to me thinking that in Maine, the costs are larger than the rewards, and wind farms may be a bad idea here.

The pure numbers associated with wind production in Maine were one of the biggest shocks to me. I had the attitude that Art Lindgren claimed most people do: that wind energy sounds like a good thing and it is easy to agree to without doing much research. The idea behind wind power sounds incredible: harvesting the natural, everyday process of the wind blowing creates power that we can use. However, now that I have dug deeper and digested many different perspectives on the effectiveness of wind power, I realize the issue is much more complex. I came in with the assumption that, of course this resource is worth it, but how much of a sacrifice can society willing make for it? I am unsure now that this resource is worth it in Maine. On-shore wind farms in Maine do not produce nearly enough energy to meet our societal demands. Ben Luce's projections that assumed maximum possible efficiency of the turbines show that even if we develop every ridgeline that exists, New England will only produce 3.3 % of the current power needs of the entire United States. This shows that the maximum ideal of energy that Maine could produce is very small compared to what other states, such as the Midwest and Texas, can. While some could argue that some percent is better than none, and that we need lots of small sources to cover our extensive and growing electricity needs, the maximum efficiency assumption of Luce's calculation is an enormous one in New England. The problem with Maine is that while the wind does often blow on ridgelines, it is not predictable, and for a lot of the year there just is not enough wind to produce the full capacity of power. There is no way to store the wind energy, so strong wind gusts are actually worse than constant medium wind. On the contrary, in the Midwest there are often fields that go on for miles and are associated with extremely constant wind. Locations like this are ideal for wind farms because the wind is

predictable, reliable, and therefore helpful in providing power to the grid. This thesis made me realize that with any new technology, and definitely with wind farms, you must look not only at effectiveness of the technology, but the way it can affect society as a whole. It is imperative that you also look at specific locations, communities, culture, and feasibility of your technology in a variety of environments before you publish results, share predictions, and implement the technology.

With wind farms in Maine, the numbers may show that wind farm construction is perhaps a waste of money, but as you have seen in this paper it also shows that the farms have tremendous negative and positive effects on society. Health is generally the largest concern for individuals in society, and recent studies on infrasounds show that turbines have extremely negative consequences for health and quality of life. If wind farm construction in Maine continues, it is absolutely imperative that some kind of regulation is passed that requires the turbines be more than two miles as the crow flies away from any house if we want to keep Mainers happy and healthy. Another very large cost of the turbine developments is the environment. Both habitats and species are directly affected by the construction and operation of wind farms. As seen in the DEP's environmental survey, if strict regulation is put in place there are ways to either avoid, minimize, or mitigate environmental impact. The enormous positive impact that wind farms have is economic. Through newspaper articles and talking with Tom Reed, it became clear that the economic stimulation that wind farms provide is not negligible. Thousands of Maine residents have been employed at some point in the wind farm process in the last ten years. Furthermore, wind farm companies are providing taxes, and revenues to their communities- many that are extremely financially troubled. The human cost of the change to

wind power is extremely evident in Maine, and must be addressed if we are to continue constructing wind farms.

In order to limit the clear problems that arise with wind farms, it seems there are two large categories of things that must be done. The first relates to a theme you have seen again and again in this paper: time. Almost all of the problems that wind farm community members complained about can be fixed, at least hypothetically, with more time and more care. An expedited wind law may encourage wind power companies to invest their time and energy into using Maine for wind power, but it also limits community interaction with the project, which in turn creates problems. A wind farm must engage the community it is being constructed in because those are the people to whom it will make the most difference, both good and bad. Communities must be able to educate themselves or bring in technical experts so that community members can have a say on whether or not the proposal is passed. The process needs to be much more structured and available to the public than it is now. It is problematic that many wind farm communities in Maine felt blindsided by the turbine construction. Furthermore, money plays a huge role in the issues behind wind farms because the reason companies started building wind farms in the first place is that those companies made a lot of money off of the Federal and Maine state government tax incentives. Again and again in my interviews and research I got the feeling that the large wind farm companies were using their money and influence to convince important people or pass the proposal through. Even if this is untrue, struggling towns absolutely see the influx of money into their town as a lifesaver, and may have an easy time overlooking other potential problems in order to pass a proposal. In conclusion, it is extremely important that there is a clear, transparent process in order to approve a wind project that evaluates the potential energy production in a particular area, the distance from homes, the impact on the wildlife, and

the opinion of the community. With a designated process, it will be easier to weigh the negative and the positive effects of the wind farm in that particular location to see if the benefits outweigh the costs. If a region can produce enough energy to make a difference, the community as a whole supports it AFTER having time to educate themselves on it and its effects on landscape and wildlife, and it does not affect the health of anyone living in the community, then it is a wonderful place for a wind farm.

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