CLEAN ENERGY OR DANGEROUS SKIES? INTERACTIONS BETWEEN THE WIND ENERGY AND AERIAL APPLICATION INDUSTRIES

*Priyanth Manjooran**

I. INTRODUCTION

Some industries compliment and foster each other's growth, while others are inherently competitive and have conflicting objectives. The success and growth of one industry can lead to severe consequences to, and the diminishment of, another. The aerial application of crop production products to agricultural

* J.D., Drake University Law School, 2013; B.A., Cornell College, 2010.

crops and the wind energy industries represent an example of such a relationship. As wind turbines are erected around the country, pilots in the aerial application industry are faced with new challenges as they try to apply crop protection products while trying to avoid collisions with wind turbines and associated structures. Many issues have yet to be resolved in regards to this interaction. The conflicts between the two industries will need to be addressed, however, in order to ensure that energy and food production will be sustained to meet the growing needs of society. This Note begins by discussing background information about the aerial application industry and the growth and spread of the wind energy industry. Next, this Note explores interactions between the two industries, including current policies and regulations in place that affect this interaction and the benefits and detriments posed by each industry. Finally, this Note presents potential policies and goals that could help resolve the conflicts that occur between the two industries.

II. Background on the Industries

A. *The Aerial Application Industry*

As the world's population and markets expand, there is an ever growing need to increase the use and efficiency of cropland in order to produce the greatest amount of food possible.[1] This has required the development and application of various technologies and management practices in order "to produce more food per unit of land."[2] One of the most popular practices is the widespread use of commercial fertilizers or pesticides. In fact, the average percentage of crop yield attributable to fertilizer use has been generally found to be between thirty and fifty percent in the United States and England.[3] In order to apply fertilizers and pesticides, various delivery systems have been utilized by farmers. One such delivery method is aerial application, more commonly known as crop dusting.

One-fourth of crop production products are delivered through aerial application in U.S. agriculture.[4] This method of application is valued due to the ability of an aircraft to cover vast areas of land in a relatively short time, all while avoiding disturbing the crops and soil being treated.[5] The first aerial application occurred in 1921, when a modified airplane was used to spread lead arsenate dust

---

1. W.M. Stewart et al., *The Contribution of Commercial Fertilizer Nutrients to Food Production*, 97 Agronomy J. 1, 1 (2005).
2. *Id.*
3. *Id.* at 5 (synthesizing data from a number of long-term crop productivity studies).
4. *History of Agricultural Aviation*, Nat'l Agric. Aviation Ass'n, http://www.agaviation.org/content/history-agricultural-aviation (last visited Apr. 9, 2013).
5. *Id.*

on trees to kill moth larvae.[6] The practice spread, and the first commercial crop dusting executed with a specially-built aircraft occurred in 1923 by Huff-Daland Dusters, Inc.[7] Since then, aerial application has expanded. Presently, there are 1350 aerial application businesses and more than 2700 aerial application pilots in the United States.[8] Aerial application is the chosen method of application "for almost 25% of commercially applied crop protection products."[9] Approximately seventy percent (286 million acres) of the 408 million acres of cropland in the United States are commercially treated with crop protection products such as fertilizers and pesticides.[10] Of this area, seventy-one million acres of cropland are treated by aerial applications each year.[11]

Aerial applicators also provide a quick way for crop producers to apply a cover crop to their fields. Cover crops are planted for the many benefits they provide, including reduction of soil erosion, improvement of soil physical properties, conservation of nutrients, increasing nitrogen in the soil, suppression of weeds, and control of insects.[12] Similar to fertilizer and pesticide application, aerial seeding is a quick and economical way to apply cover crops to a field.[13] The cost to apply a cover crop to an acre of land ranges from fifteen to twenty dollars, not including seed costs.[14] Taking into consideration time, equipment, and fuel costs, the affordability of aerial application is comparable to on-the-ground application of cover crops.[15] Aerial application allows for seeding when crops are still present and when wet soil makes on-the-ground application impos-

---

6. *Id.*
7. *Id.*
8. *Facts About the Aerial Application Industry*, NAT'L AGRIC. AVIATION ASS'N, http://www.agaviation.org/content/facts-about-aerial-application-industry (last visited Apr. 9, 2013).
9. *Id.*
10. *Id.*
11. *Id.*
12. J.J. Meisinger et al., *Effects of Cover Crops on Groundwater Quality*, *in* COVER CROPS FOR CLEAN WATER 57, 57 (W.L. Hargrove ed., 1991); *see* Robert L. Bugg, *Cover Crops and Control of Arthropod Pests in Agriculture*, *in* COVER CROPS FOR CLEAN WATER, *supra*, at 157, 157–63; Mark Schonbeck, *Plant and Manage Cover Crops for Maximum Weed Suppression*, IOWA STATE UNIV. EXTENSION & OUTREACH, http://www.extension.org/pages/18525/plant-and-manage-cover-crops-for-maximum-weed-suppression (last updated Aug. 30, 2011).
13. Christina Curell, *Aerial Application: The Next Generation of Cover Crop Seeding*, MICH. STATE UNIV. EXTENSION (Sept. 7, 2012), http://msue.anr.msu.edu/news/aerial_application_the_next_generation_of_cover_crop_seeding.
14. *Id.*
15. *Id.*

sible.[16] Aerial application also permits crop producers to overcome the challenge presented by the narrow window of opportunity to plant cover crops between harvest and the end of the growing season in areas where cover crops can be planted even before the cash crop has been harvested.[17] Even though "there is an increased chance of seed mortality [due to lack of enough topsoil moisture], insect damage, or animal predation,"[18] aerial application has proven to be a viable option for many crop producers.

The aerial application industry has been established for a substantial period of time and is carefully regulated. People interested in a career in aerial application must undergo a great deal of training to become agricultural pilots. Title 14 of the Code of Federal Regulations outlines the federal requirements a pilot has to meet in order to spray crop protection products.[19] Among the many requirements, aerial application pilots are required to "hold a current U.S. private, commercial, or airline transport pilot certificate," have "at least one certificated and airworthy aircraft, equipped for agricultural operation," and demonstrate knowledge on topics such as aerial application pre-flight procedures, safe handling of poisons and chemicals, the general effects of these chemicals on plants, animals, and people, performance capabilities of the aircraft to be used, and other various safe flight and application procedures.[20] In addition, a flight test is required in order to prove a pilot's competence in the handling of an aircraft in various aerial application maneuvers.[21]

The Code of Federal Regulations also places controls on the types of aircraft and safety procedures to be used in aerial application,[22] and requires proper dispensing methods of pesticides and fertilizers.[23] In addition to these regulations, guidelines are placed upon aerial application operations over certain areas that present unique challenges and issues, as will be discussed later.[24] These requirements, combined with continuing education opportunities for aerial applicators such as the National Agricultural Aviation Association's Professional Aerial Applicators' Support System (PAASS), have resulted in an industry consisting of

---

16. *Technical Notes, Agronomy #36: Aerial Seeding of Cover Crops*, NAT. RES. CONSERVATION SERV., USDA, 1 (Sept. 2010), ftp://ftp-fc.sc.egov.usda.gov/IA/technical/TechNote36.docx.
17. *Id.*
18. *Id.* at 2.
19. 14 C.F.R. § 137.19 (2012) (certification requirements).
20. *Id.*
21. *Id.* § 137.19(e)(2).
22. *Id.* §§ 137.31, .42–.53.
23. *Id.* § 137.37.
24. *Id.* §§ 137.49–.53.

highly trained professionals who provide a reliable and valuable service in the production of crops.[25]

Even with the benefits aerial application brings to crop production, the aerial application industry is suffering due to the emergence of another: wind energy. Before exploring the effect the wind energy industry has had on aerial application, it is necessary to look at the emergence and growth of wind energy.

B. *The Emergence and Rapid Growth of Wind Energy*

With a growing population and continued depletion of nonrenewable energy sources comes the need to develop additional sources of power. Even though coal, oil, and natural gas still dominate the energy industry in terms of energy production and consumption, it has become increasingly important to find a renewable and cleaner source of energy. One such source is wind energy.

Between 2009 and 2010, the United States consumed nearly ninety-eight quadrillion British Thermal Units (Btu) of energy.[26] Petroleum, coal, and natural gas comprised eighty-three percent of national energy usage, while nuclear power comprised nine percent and renewable energies comprised the remaining eight percent.[27] Of the eight percent that came from renewable energy, eleven percent came from wind energy.[28] Though wind might not yet be the most prevalent source of renewable energy, it is still one of the fastest growing across the world.[29] The U.S. wind power capacity has grown annually at a rapid pace. In 2007, the United States installed 5249 megawatts of wind power capacity.[30] This was followed by continued growth with 8361 megawatts, 10,000 megawatts, and 5214 megawatts being installed over the next three years.[31] According to the American Wind Energy Association, "The U.S. wind industry has added over 35% of all new generating capacity over the past five years, second only to natu-

---

25. *See Professional Aerial Applicators' Support System*, NAT'L AGRIC. AVIATION ASS'N, http://www.agaviation.org/content/professional-aerial-applicators-support-system (last visited Apr. 9, 2013).

26. U.S. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, RENEWABLE ENERGY CONSUMPTION AND ELECTRICITY PRELIMINARY STATISTICS 2010, at 1 (2011), *available at* http://www.eia.gov/renewable/annual/preliminary/pdf/preliminary.pdf.

27. *Id.* at 1 fig.1.

28. *Id.*

29. RYAN WISER ET AL., U.S. DEP'T OF ENERGY , 2011 WIND TECHNOLOGIES MARKET REPORT 5–6 (2012), *available at* http://www1.eere.energy.gov/wind/pdfs/2011_wind_technologies_market_report.pdf (describing growth of wind production worldwide).

30. AM. WIND ENERGY ASS'N, U.S. WIND INDUSTRY 1ST QUARTER 2008 MARKET REPORT 11 (2008), *available at* http://www.awea.org/learnabout/publications/upload/1Q08.pdf.

31. *Industry Statistics*, AM. WIND ENERGY ASS'N, http://www.awea.org/learnabout/industry_stats/index.cfm (last updated Jan. 30, 2013).

ral gas, and more than nuclear and coal combined."[32] The cumulative wind energy capacity of the United States totaled 60,007 megawatts through the end of 2012.[33] Even with this great growth, wind energy's potential has yet to be fully realized. According to the National Renewable Energy Laboratory, the United States' onshore wind resource potential is calculated at 10,955 gigawatts.[34]

The growth of wind power has been fostered by various government initiatives. Because of government support, the U.S. wind power capacity now represents "more than 20% of the world's installed wind power."[35] This prominence has been encouraged by policies like the renewable portfolio standard (RPS).[36] A RPS "requires electricity retailers to provide a minimum percentage or quantity of their electricity supplies from renewable energy sources."[37] A RPS usually establishes a base requirement for renewable energy but allows local market conditions to determine "which renewable energy resources will meet that demand."[38] Renewable portfolio standards are typically enacted on a state-by-state basis.[39] Many state legislatures have desired to enact their own RPS for many reasons, including greenhouse gas reduction, coal emission reduction, nuclear waste management, promotion of economic development, and strengthening and diversifying the state's electricity supply.[40] "By the end of 2007, 25 states and the District of Columbia had enacted RPS policies, ranging from 2% of the electricity supply in Iowa to 40% in Maine" by 2017.[41] By the end of 2012, this number increased to twenty-nine states, and an additional eight states have adopted non-binding goals to increase their wind energy production.[42] These

---

32. *Id.*

33. AM. WIND ENERGY ASS'N, U.S. WIND INDUSTRY FOURTH QUARTER 2012 MARKET REPORT 3 (2013), *available at*. http://www.awea.org/learnabout/publications/reports/upload/AWEA-Fourth-Quarter-Wind-Energy-Industry-Market-Report_Executive-Summary-4.pdf.

34. ANTHONY LOPEZ ET AL., NAT'L RENEWABLE ENERGY LAB., NREL/TP-6A20-51946, U.S. RENEWABLE ENERGY TECHNICAL POTENTIALS: A GIS-BASED ANALYSIS 14 tbl.6 (2012), *available at* http://www.nrel.gov/docs/fy12osti/51946.pdf.

35. *Industry Statistics*, *supra* note 31.

36. *See* K.S. CORY & B.G. SWEZEY, NAT'L. RENEWABLE ENERGY LAB., NREL/TP-670-41409, RENEWABLE PORTFOLIO STANDARDS IN THE STATES: BALANCING GOALS AND IMPLEMENTATION STRATEGIES 1 fig.1 (2007), *available at* http://www.nrel.gov/docs/fy08osti/41409.pdf (showing states that have adopted a RPS).

37. *Id.* at 1.

38. *Id.*

39. *See* BARRY G. RABE, PEW CTR. ON GLOBAL CLIMATE CHANGE, RACE TO THE TOP: THE EXPANDING ROLE OF U.S. STATE RENEWABLE PORTFOLIO STANDARDS 5 (2006), *available at* http://www.c2es.org/docUploads/RPSReportFinal.pdf.

40. *Id.* at 6–7.

41. CORY & SWEZEY, *supra* note 36, at 1 fig.1.

42. *Renewable Portfolio Standard Policies*, DSIRE, DEP'T OF ENERGY (Jan. 2013), http://www.dsireusa.org/documents/ summarymaps/RPS_map.pdf.

policies have fostered growth that, in some states, has surpassed the goals the RPS put into place. For instance, Iowa currently produces twenty percent of electricity generated within the state from wind production compared to the state's initial two percent (105 megawatt) goal.[43]

In addition to RPS, projects like "20% by 2030" have also facilitated the growth of the wind energy industry.[44] This research project was created in 2006 with the collaboration of a variety of participants, including the U.S. Department of Energy and the American Wind Energy Association.[45] The report encouraged an "energy scenario in which wind provides 20% of U.S. electricity by 2030."[46] The positive publicity the project provided combined with economic demand to create a fast expanding industry.[47] As the wind industry goes through a boom, however, it has led to conflicts with the aerial application industry.

C. *Interactions Between Wind Energy and Aerial Application*

The explosive growth of the wind energy industry has increased the concerns of aerial applicators around the country. In addition to raising safety concerns for aerial applicators, wind farms can also limit an applicator's ability to treat crops.[48] This section explores the interaction between the wind energy and aerial application industries, as well as the safety and economic issues wind farms pose to aerial applicators.

---

43. *Compare* IOWA CODE §§ 476.41–.44 (2011) (outlining initial 105 megawatt goal), *with Wind Power Facts*, IOWA WIND ENERGY ASS'N, http://iowawindenergy.org/whywind.php (last visited Apr. 9, 2013) (citing 4536 megawatts of installed wind capacity in Iowa as of September of 2012).

44. *See generally* U.S. DEP'T OF ENERGY, DOE/GO-102008-2567, 20% WIND ENERGY BY 2030: INCREASING WIND ENERGY'S CONTRIBUTION TO U.S. ELECTRICITY SUPPLY (Steve Lindenberg et al. eds., 2008), *available at* http://www1.eere.energy.gov/wind/pdfs/41869.pdf (discussing wind energy production generally and outlining the steps necessary to reach a goal of twenty percent of U.S. electricity being supplied by wind power by 2030).

45. *Id.* at 1.

46. *Id.*

47. *See* David R. Baker, *Energy Dept. Says Wind Power Could Be Savior*, S.F. CHRON., May 13, 2008, http://www.sfgate.com/green/article/Energy-Dept-says-wind-power-could-be-savior-3215401.php (discussing the positive nature of the report and its effect nationally and in California specifically).

48. Nat'l Agric. Aviation Ass'n, *Towers: Challenging Obstacles to the Aerial Application Industry*, AGRIC. AVIATION, May/June 2008, at 17, 18 [hereinafter NAAA, *Towers*], *available at* https://www.faasafety.gov/files/notices/2010/May/towerarticle2008.pdf.

1. *Safety*

As discussed earlier, aerial application is highly regulated and requires trained professionals to operate the agricultural aircraft.[49] This is necessary due to the inherent dangers that are involved with spraying chemicals relatively close to the ground. The rapid emergence of wind farms throughout the nation has increased these dangers due to possibility of collisions with wind farm structures. The 1.8 megawatt wind turbines commonly constructed today "have rotor disk diameters of over 260 feet, which is larger than the wingspan of a Boeing 747."[50] When attached to a tower base, the top of a typical wind tower rises more than 400 feet from the ground.[51] In comparison, aerial applicators generally fly between eight and ten feet, the maximum suitable distance, over the canopy of the crops in order to apply their pesticides and fertilizers.[52] The problems posed by the immense size of each individual turbine are multiplied by the fact that most wind farms contain many turbines. The spacing between individual wind turbines is usually between two to three rotor diameters (or a few thousand feet) apart.[53] Additionally, there is no consistent and specific pattern for the layout of a wind farm across the industry.[54] Instead of placing wind turbines in a linear format, wind farm developers place towers according to factors such as the proximity of roads to the turbines in order to allow for efficient servicing, property owner preferences regarding placement, and the efficiency of air movement through a specific area in order to maximize wind flow.[55] Additionally, many wind farms are located near large transmission lines in order to properly distribute the electricity they produce.[56] Adding to the challenge, the obstacles in the path of an aerial applicator created by wind farms are not just restricted to wind turbines and transmission lines; each wind farm will typically have a meteorological tower (MET) that is used "to sense and record wind patterns and possibly control the orientation of the farm's rotating turbine blades" to aid in the most efficient wind production.[57] MET towers can often rise 300 feet in height and are

---

49. *See* discussion *supra* Part.II.A.
50. NAAA, *Towers*, *supra* note 48, at 19.
51. *Id.*
52. PAUL E. SUMNER, UNIV. OF GA COOP. EXTENSION, SPECIAL BULLETIN 18, AERIAL APPLICATION OF PESTICIDES 67 (2004), *available at* http://www.caes.uga.edu/applications/publications/files/pdf/SB%2018_3.pdf.
53. NAAA, *Towers*, *supra* note 48, at 19.
54. *Id.*
55. *Id.*
56. *Id.*
57. *Id.*

usually marked and lit.[58] They can still be very difficult to see, however, especially in the presence of massive wind turbines.[59] Some MET towers even have guy wires that can be inconspicuous and can lead to airplanes sheering off their wings if they collide with these wires.[60]

Over the past ten years, twenty-four percent of all agricultural aviation fatalities involved collisions with wires and towers.[61] During that period, collisions with towers resulted in seven fatalities, while another fourteen were the result of collisions with power lines and supporting structures.[62] It is not difficult to imagine how these collisions occur considering the many dangers present on a wind farm. In some states, a square mile of land can contain up to five or six turbines.[63] Aerial applicators normally maneuver within a radius of half a mile from the target site.[64] This space requirement "creates a total operations area of two square miles and approximately 10–12 turbines inside the operations area."[65] No matter how visible and how well lit the turbines are, their size and proximity still create a substantial problem to aerial applicators. Lighting and visibility issues raise concerns as well, especially in the case of MET towers. The Federal Aviation Administration and Federal Communication Commission require obstructions with a height of 200 feet or more to be registered with the FAA and marked with lights and markers in order to be seen from the air.[66] These regulations are not always applicable to MET towers, however, as the majority of MET towers are shorter than 200 feet and are not required to be painted or lit.[67] This,

---

58. *Id.*
59. *Id.*
60. *Id.*
61. *Let's Be Fair About Sharing the Air*, NAT. AGRIC. AVIATION ASS'N, http://www.agaviation.org/content/lets-be-fair-about-sharing-air (last visited Apr. 9, 2013).
62. *Id.*
63. Alison Hunter, *Wind Turbines and Aerial Application*, 2 FLY LOW, FLY SAFE (NationAir Aviation Ins., Chi., IL) Fall 2010, at 1, *available at* http://www.nationair.com/pdf/FlyLowFlySafe_Fall10.pdf.
64. *Id.*
65. *Id.*
66. 14 C.F.R. § 77.9 (2012) (requiring notification to FAA); *id.* § 77.17(a)(2) (defining obstructions); 47 C.F.R. § 17.7 (2011) (requiring notification to FAA); FED. AVIATION ADMIN., U.S. DEP'T OF TRANSP., AC 70/7460-1K, OBSTRUCTION MARKING AND LIGHTING 3 (2000), *available at* http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/systemops/fs/alaskan/towers/obstruction/media/AC70_7460_1K.pdf (describing FAA lighting and marking requirements); *see also* 47 C.F.R. § 17.21 (specifying *antenna* structures over 200 feet above ground level must be painted and lighted).
67. *See* 14 C.F.R. § 77.17(a)(2); *see also* Hunter, *supra* note 63, at 1.

in addition to MET towers generally being quite slim and inconspicuous,[68] makes them a dangerous risk to many aerial applicators.

Running into wind turbines, MET towers, the associated guy wires, and the electrical lines necessary to utilize the power produced by the wind farm are not the only safety concerns aerial applicators need to have when working near wind turbines. Applicators also need to be aware of conditions caused by the blades of the turbines, such as turbulence and shadow flicker. The jet engines of a commercial airliner can leave a trail of disturbed wind called "jet wash" that can cause major turbulence to airliners that follow the jet or run into its wash.[69] Wind turbines can create a similar effect due to the turbulence the blades can generate as they spin.[70] Aerial applicators have complained of the turbulence caused by these turbines due to its impairment of their ability to safely control their aircraft.[71] In addition to turbulence, aerial applicators also need to worry about shadow flicker, a phenomenon that "occurs when the turbine is in between the sun and the viewer and the blades are perpendicular to the line between the sun and the viewer."[72] This creates a flashing effect and can lead to visual mis-representations and result in pilot disorientation.[73]

2. *Financial Impacts*

In addition to the safety implications for pilots in the aerial application industry, the wind industry may also affect applicators financially. There can be many costs for both the aerial applicator and the farmer whose fields need application. First, the inclusion of a wind turbine in an area that requires aerial application would cause that particular area to be more expensive and inefficient to treat as compared to the same area without any turbines present.[74] This problem

---

68. *See Met Towers: Possible Hazard to Low Altitude Flight Operations*, FED. AVIATION ADMIN., http://www.faasafety.gov/files/notices/2010/may/met_tower_power_point_st._cloud.pdf (last visited Apr. 9, 2013) (providing aerial photographs of MET towers under various conditions).

69. Press Release, Anne M. Stark, Lawrence Livermore Nat'l Lab., In the Wake of Wind (Apr. 26, 2011), *available at* https://www.llnl.gov/news/newsreleases/2011/Apr/NR-11-04-06.html; Caleb Denison, *Turbulent Wind Turbine Wakes Studied*, EARTH TECHLING (May 2, 2011), http://www.earthtechling.com/2011/05/turbulent-wind-turbine-wakes-studied/.

70. Stark, *supra* note 69.

71. Marty Touchette, *Wind Farm Opponents Site Concerns for Crop Dusting*, DAILY REV. ATLAS (Aug. 3, 2010), http://www.reviewatlas.com/news/business/x84682246/Wind-farm-opponents-site-concerns-for-crop-dusting.

72. Hunter, *supra* note 63, at 1.

73. *Id.*

74. Mikkel Pates, *Aerial Applicator Notes 'Cost' of Turbine Sitings*, AGWEEK, July 20, 2010, http://www.agweek.com/event/article/id/16783/.

is further accentuated on wind farms where wind turbines are cited in an irregular and non-linear fashion.[75] "Flying around at 130 miles per hour among 400-foot wind towers may take longer because of the time to maneuver around the turbines."[76] Additionally, aerial applicators who decide to treat those fields may have to carry lighter loads in order to compensate for the extra fuel they need to carry to make the trip.[77] These inefficiencies can add up and become a substantial detriment to the aerial applicators. Even so, these inefficiencies do not compare to the harm caused to farmers by the growing trend of aerial applicators' preference to avoid fields containing wind turbines in order to ensure their continued safety.[78] Some aerial applicators may impose a surcharge of over fifty percent if engaged to spray a field in the vicinity of a wind turbine.[79] Many aerial applicators, however, completely refuse to treat land occupied by wind turbines.[80] This policy can also have an effect on accessibility of land that has no wind turbines. Because some aerial applicators refuse to work *near* any wind turbines, the erection of wind turbines close to the property line of a neighbor may eliminate that neighbor's ability to have his crops aerially treated by these unwilling pilots.[81] With wind farms being erected on prime farmland, aerial applicators may suffer great financial losses as a result of not being able to treat large areas of land.[82] The wind energy industry can have—and has had—a substantial financial effect on aerial application. Independent industry actions can affect the outcome of these conflicts, but major factors in the interaction between the two industries include federal, state, and local regulations affecting each industry.

D. *Government Regulations and Policies, Organizational Policies, and Individual Actions Affecting Industry Interactions*

1. *Federal and State Regulations and Policies*

Before we can look at how the various parties involved in the conflicts created by wind energy and aerial application resolve and handle these situations,

75. *Id.*
76. *Id.*
77. *See id.*
78. *Id.*
79. Touchette, *supra* note 71.
80. *Id.*
81. Cole Gustafson, *New Energy Economics: Unintended Effects of Wind Energy—Aerial Spraying*, N.D. STATE UNIV. EXTENSION SERV., http://www.ag.ndsu.edu/news/columns/biofuels-economics/new-energy-economics-unintended-effects-of-wind-energy-2013-aerial-spraying/ (last visited Apr. 9, 2013).
82. *See* Pates, *supra* note 74 (discussing emergency treatments to combat drought or pests).

it is necessary to see how the federal and various state governments affect this interaction. While many legislatures have not explicitly addressed the interplay between wind turbines and aerial applications, there are still many statutes that affect both industries that play a significant role in these situations.

The first few federal regulations to look at are those that affect the ability of aerial applicators to spray near wind turbines. Title 14 of the Code of Federal Regulations imposes regulations upon agricultural aircraft operations.[83] This Note already examined the certification requirements for agricultural pilots within this title; however, subpart C of section 137 also contains regulations on flight operations.[84] Sections 91.119 and 137.49 give instructions on general operating permissions in regards to altitude and proximity for normal and agricultural aviation purposes respectively.[85] Under section 91.119, for most flights (except when necessary for takeoff or landing), no person may operate an aircraft below "[a]n altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure."[86] Section 91.119 requires aircraft to maintain an "altitude of 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet" if the aircraft is "[o]ver any congested area of a city, town, or settlement, or over any open air assembly of persons."[87] This restriction, however, is not very practicable for the purposes of aerial application. Thus, Congress created special exemptions or variances for agricultural aircraft under sections 137.49 and 137.51, which control aerial application operations above non-congested and congested areas respectively.[88] Regulations for aerial application over congested areas are not as relevant to this topic since most of the target fields for application and wind farms are located in non-congested areas. Focusing on non-congested areas, section 137.49 states that:

> during the actual dispensing operation, including approaches, departures, and turnarounds reasonably necessary for the operation, an aircraft may be operated over other than congested areas below 500 feet above the surface and closer than 500 feet to persons, vessels, vehicles, and structures, if the operations are conducted without creating a hazard to persons or property on the surface.[89]

This exemption for agricultural aircraft allows aerial applicators a relatively large amount of freedom to spray the fields the way they see fit. Although

83. 14 C.F.R. §§ 137.1–.77 (2012).
84. *Id.* §§ 137.29–.59.
85. *Id.* §§ 91.119, 137.49.
86. *Id.* § 91.119(c).
87. *Id.* § 91.119(b).
88. *Id.* §§ 137.49, .51.
89. *Id.* § 137.49.

it allows aerial applicators flexibility in aircraft operation, the standard to not create a "hazard to persons or property on the surface" is not very clear and leaves a great amount of discretion and control up to aerial applicators. Thus, even though there are a few regulations for agricultural aircraft, these statutes do not do much to resolve the conflicts between the wind energy and aerial application industries.

As established earlier, the Federal Aviation Administration requires all structures that exceed a height of 200 feet to be marked and/or lit in order to be visible to air traffic.[90] The recommendations on marking and lighting these structures vary according to the number and layout of the structures, local weather patterns, and geographic locations.[91] While these regulations are of some help to making certain structures more visible to aerial applicators, these requirements fall short on making the marking and lighting of all MET towers a federal requirement. As discussed earlier, MET towers usually fall below the FAA regulatory cut-off of 200 feet.[92] The FAA recognized this problem, however, and after notice and comment issued recommended guidance for the voluntary lighting and marking of MET towers less than 200 feet tall in response to the dangers they pose and in accordance with advisory circular AC 70/7460-1K.[93] In the comprehensive circular, the FAA details recommendations for making structures safer for aircraft.[94] The FAA proposes painting structures with alternating bands of aviation orange and white.[95] Next, the FAA recommends flags and spherical markers be used in addition to the recommended paint patterns.[96] Finally, the circular recommends various lighting systems that make structures more visible to low flying aviators.[97] The recommendations found in the advisory circular can help regulate and prevent negative outcomes in the interactions between the wind energy and aerial application industries. But because they are not mandatory, these recommendations do not go far enough in ensuring safety for aerial applicators.

90. FED. AVIATION ADMIN., *supra* note 66, at 3.

91. *Id.*

92. Hunter, *supra* note 63, at 1; *see also Met Towers*, *supra* note 68.

93. In early 2011, the FAA sought public comments on proposed guidance for voluntary marking of MET towers less than 200 feet above ground level. 76 Fed. Reg. 490, 491 (proposed January 5, 2011) (to be codified at 14 C.F.R. pt. 77). Days after publication, a fatality was suffered in CA when an aerial applicator collided with a MET tower. 76 Fed. Reg. 36,983, 36,984 (June 24, 2011). After reviewing all comments, the FAA suggested tower owners follow the guidance applicable to structures over 200 feet above ground level outlined in Advisory Circular 70-7460-1K Obstruction Marking and Lighting. *Id.*; *see also* FED. AVIATION ADMIN., *supra* note 66, at 5–7.

94. FED. AVIATION ADMIN., *supra* note 66, at 5–10.

95. *Id.* at 5–6.

96. *Id.* at 6–7.

97. *Id.* at 7–10.

If mandatory and voluntary marking and lighting cannot fully solve the safety issues present when aerial applicators fly near wind turbines and MET towers, the U.S. Code provides a prior warning requirement for structures that could interfere with aviation that may aid the aerial application industry.[98] Section 44718 of title 49 of the United States Code states:

> [I]f the Secretary [of Transportation] decides that constructing or altering a structure may result in an obstruction of the navigable airspace or an interference with air navigation facilities and equipment or the navigable airspace, the Secretary shall conduct an aeronautical study to decide the extent of any adverse impact on the safe and efficient use of the airspace, facilities, or equipment.[99]

Upon the completion of this study, the Secretary of Transportation is required to give public notice of the structure's impact.[100] This requirement enables aerial applicators to have access to notices of structures in the areas they plan on treating, thus increasing the information available to agricultural pilots and potentially enhancing their safety.

There are considerably fewer state regulations that affect the wind energy industry. Many states, like Iowa, have minimal regulation of wind turbines.[101] Others, like Minnesota, may require the use of additional permits for structures that could affect air traffic.[102] Wisconsin is a state that has specific and extensive regulations on wind farms.[103] Wisconsin's wind energy statutes call for advanced notice requirements to surrounding neighbors and governmental authorities, outline specific setback and siting requirements for wind farms in regards to their distances from other structures and properties, and also set forth specific requirements in regards to aerial application.[104] The regulations

> [r]equire an owner of a wind energy system to offer an agreement that includes monetary compensation to a farm operator farming on a nonparticipating property located within 0.5 mile of a constructed wind turbine if the farm operator demonstrates all of the following:

---

98. 49 U.S.C. § 44718(a) (2006).
99. *Id.* § 44718(b).
100. *Id.* § 44718(b)(2).
101. *Wind and Wildlife*, IOWA DEP'T OF NATURAL RES., http://www.iowadnr.gov/Environment/WildlifeStewardship/NonGameWildlife/Conservation/WindandWildlife.aspx (last visited Apr. 9, 2013).
102. *See* MINN. STAT. ANN. §§ 360.81–.91 (West 2012); *see also Tall Towers: Minnesota Structure Height Regulations*, MINN. DEP'T OF TRANS., http://www.dot.state.mn.us/aero/avoffice/ talltowers.html (last visited Apr. 9, 2013).
103. WIS. ADMIN. CODE PSC §§ 128.01–.61 (2012).
104. *Id.* §§ 128.105, .13, .33(3m).

> (a) Substantial evidence of a history, before the wind energy system owner gives notice under s. PSC 128.105 (1), of using aerial spraying for pest control or disease prevention for growing potatoes, peas, snap beans or sweet corn on all or part of a farm field located within 0.5 mile of a constructed wind turbine.
>
> (b) A material reduction in potato, pea, snap bean or sweet corn production or a material increase in application costs on all or part of a farm field located within 0.5 mile of a constructed wind turbine as a result of the wind energy system's effect on aerial spraying practices.[105]

This provision allows landowners adversely affected by the erection of wind turbines on neighboring property to recover for losses (limited to the four crops explicitly mentioned) due to aerial application limits that result from the nearby turbines. Many local governments have gone further than the existing state and federal regulations pertaining to wind energy by enacting local ordinances on wind turbines in order to reflect local needs and preferences.[106]

2. *Organizational Policies Affecting the Interaction*

While federal regulations and recommendations can have a distinct effect on aerial applicators and wind turbines, how aerial applicators deal with these obstacles can be determined to a greater extent by the policies of the aerial application organizations that represent and promote agricultural aviation interests.[107] Some of these organizations have enacted policies that try to enable agricultural aircraft and wind farms to coexist the same area in a safer manner. Others have adopted policies of completely avoiding land with a wind turbine on the premises.

The National Agricultural Aviation Association (NAAA) is a large trade association that represents more than 1800 agricultural aviators and small business owners.[108] The NAAA established the following safety guidelines for the construction of wind farms that it has tried to promote to increase the safety for aerial applicators:

> [1] Towers should not be erected on prime agricultural land in a manner that may inhibit aerial applicators' access and ability to treat the land.

---

105. *Id.* § 128.33(3m).

106. *Wind Powering America*, U.S. DEP'T OF ENERGY, http://www.windpoweringamerica.gov/policy/ordinances.asp (last updated Sept. 22, 2011) (listing and providing links to 140 state and local ordinances regulating wind turbines).

107. *See generally Professional Aerial Applicators' Support System*, *supra* note 25 (last visited Apr. 9, 2013) (describing PAASS, an effort by an aerial application trade association to "educate rather than regulate").

108. *About NAAA,* NAT'L AGRIC. AVIATION ASS'N, http://www.agaviation.org/content/about-naaa (last visited Apr. 9, 2013).

> [2] Petitions for constructing towers should be provided to the local government zoning authority, landowners and/or farmers and aerial applicators within at least a one-half mile radius of a proposed tower, as well as the state or regional agricultural aviation association, no later than 30 days before tower constructions permits are considered for approval. . . .
>
> [3] If a proposed tower is to be constructed on prime agricultural land or in the vicinity of such land in a way that may inhibit an aerial applicator's access, person(s) that own and/or farm such land should be made aware by the entity responsible for that tower that it may result in the land no longer being accessible to aerial applicators, and in the event of a pest outbreak or plant disease a crop on such land may be put in jeopardy of not being treated.
>
> [4] In the event that a proposed tower is constructed on prime agricultural land or in the vicinity of such land, towers should be freestanding and without guy wires. Furthermore towers should be well lit and properly marked so they are clearly visible to aerial applicators.
>
> [5] Towers erected with guy wires . . . should be marked with aviation orange . . . . [T]hese towers should be equipped with 16 foot high-visibility sleeves . . . .
>
> [6] In the event that a number of proposed towers are to be constructed on prime agricultural land . . . the towers should be constructed in a linear pattern, rather than a random, clustered pattern that would make an area completely inaccessible by air.
>
> [7] During construction and upon completion, the operator of the wind farm should provide detailed field layout information to the local government zoning authority and make this information available to those working in close proximity to that area.[109]

These recommendations try to prevent the most common problems aerial applicators encounter by ensuring that pilots are aware of structures that could pose a threat to their activities. While the NAAA's policy recommendations stress that wind turbines and MET towers should not be erected on prime agricultural land, they seem to accept the spread of wind energy and try to put more reporting requirements on wind developers to make the interactions between the two industries safer.[110] Other organizations have taken a different stance on aerial application activities. The Illinois Agricultural Association, for example, has enacted a policy in which they will "refuse to make an aerial application of any product inside a grouping of wind generators, or to farm land immediately adjacent to a grouping of wind generators, should that proximity be considered haz-

---

109. *Fact Sheet on the Dangerous Effects Towers Pose to the Aerial Application Industry*, NAT'L AGRIC. AVIATION ASS'N, http://www.agaviation.org/sites/default/files/Tower-Issue-Paper-05-11_0.pdf (last updated May 2011).

110. *See id.*

ardous by the pilot of the agricultural aircraft."[111] Similar policies have been enacted internationally by organizations like the Aerial Agricultural Association of Australia, which opposes all wind developments unless comprehensive consultations have been made with aerial applicators, agreements for compensation are provided to parties adversely affected by wind turbine placement, and expert consultation has been made regarding safety and economic impacts on parties that might be affected by a wind development.[112] Policies such as the ones adopted by these various organizations will shape how aerial applicators and wind project developers continue to interact in the future.

3. *Individual Actions That Affect the Interaction*

National and state organizations are not the only entities that can influence and shape the form of interactions between wind developers and aerial applicators. The general public can be significantly affected by conflicts between the two industries and thus have a strong interest in voicing their opinions on future wind farm development to further their own interests. This can take the form of protests, grassroots efforts to sway public opinion, and lawsuits. The development of a wind farm may require a public hearing before actual permits for construction can be given.[113] Public hearings and outreach can be a valuable method of raising awareness and addressing public concerns such as a drop in property values, damage to the land, and, of course, loss in agricultural productivity due to restrictions on fertilizer and pesticide dispersion.[114]

While trying to address concerns directly with the wind developer can be one of the most efficient methods to influence change, an alternative can be the use of direct community or legislative contact. An aerial applicator from Waupun, Wisconsin, Damon Reabe, began using these tactics in 2009 to help stem the

---

111. *Wind Power Farms*, ILL. AGRIC. AVIATION ASS'N, http://www.agaviation.com/wind_farms.htm (last visited Apr. 9, 2013).

112. *Windfarm Policy*, AERIAL AGRIC. ASS'N OF AUSTL., 1 (Mar. 2011), http://www.aerialag.com.au/Portals/0/Users/005/05/5/AAAA%20Windfarm%20Policy.pdf.

113. *See, e.g.*, W. VA. CODE ANN. § 24-2-11c(a) (LexisNexis 2008) (requiring a public hearing if protests against a proposed project are submitted); Mountain Cmtys. for Responsible Energy v. Pub. Serv. Comm'n of W. Va., 665 S.E.2d 315, 320 (2008) (state commission conducted multiple public and evidentiary hearings before granting permit for wind development in order to weigh public interest in approval); *see also, e.g.*, W. VA. CODE ANN. § 24-2-11c(c) (requiring a balancing of public interest in the siting of electricity generating facilities).

114. *See* Damon Reabe, *Grassroots Efforts: One Aerial Applicator's Action Plan*, NAT'L AGRIC. AVIATION ASS'N (NOV./DEC. 2009), http://www.agaviation.org/content/grassroots-efforts-one-aerial-applicator%E2%80%99s-action-plan (describing lobbying and public awareness efforts of one individual aerial applicator in Wisconsin).

growth of wind development in his operating region.[115] The first course of action, directed at customers, consisted of an effort to raise awareness of the hazards wind turbines present to aerial applicators.[116] The next step involved presentations to township and county officials at public meetings in areas that contained meteorological towers.[117] In addition to appeals to national organizations that represent the aerial application industry, Reabe sought to engage government officials by holding one-on-one meetings with a state senator and representative, as well as offering testimony at a public hearing at the state capitol.[118] These actions helped convince a few landowners to avoid signing wind lease agreements and even resulted in several moratoriums on the construction of wind farms.[119]

After examining the various policies and players involved in the often confrontational interactions between the wind energy and aerial application industries, the evidence suggests that the advancement of one industry will lead to the diminishment of the other. As a result, a preference for one is necessary in order to ensure that the industry that prevails when conflicts arise is the one that is most beneficial for society. Accordingly, we need to take a closer look at the advantages and disadvantages of wind energy and aerial application including the harms and benefits each provides to the local community and the world in general.

III. Advantages and Disadvantages of Each Industry

A. *Disadvantages of Wind Energy*

With the many benefits of wind energy come some disadvantages. As discussed earlier, wind farms can harm the ability of aerial applicators to spray large amounts of agricultural land. While this affects aerial applicators directly, it also affects the farmers who desire aerial application over their land. In times when it is necessary that fast applications be applied to fields to prevent outbreaks and agricultural diseases, wind farms can make this task substantially harder to accomplish.[120] Because some aerial applicators refuse altogether to operate in areas containing wind turbines, "it could eliminate the possibility of 'emergency' applications, when ground application is impossible."[121] Farmers

---

115. *Id.*
116. *Id.*
117. *Id.*
118. *Id.*
119. *Id.*
120. Pates, *supra* note 74.
121. *Id.*

need to have access to spray applications in order to ensure their crop security.[122] Lack of access may aggravate the effects of pest outbreaks.[123] In a crop pest emergency, almost all farmers will want aerial application as soon as possible.[124] One aerial applicator concludes that "landowners need to expect that farmland without the towers may need to get first priority during times of pest outbreaks."[125] Operating among 400-foot wind turbines may be more time-consuming due to the care required in flying among the towers.[126] Aerial applicators treating fields with wind turbines may have to carry lighter loads hindering their application efficiency.[127] Aerial applicators in these crop emergency situations need to cover as many acres as they can.[128] Naturally, more time consuming, turbine-laden fields would not be a priority.[129] The emergence of wind farms may "create significant gaps in large scale treatment plans—leading to a breakdown of an overall campaign against locusts, cereal rust, noxious weeds, or other pests with massive economic implications for farmers and the economy."[130]

In addition to the economic and production consequences to farmers and aerial applicators, wind turbines can cause health and safety concerns. Among the most common concerns are mechanical failure,[131] sensory effects,[132] impact on wildlife, [133] and some environmental impacts. A notable danger of wind turbines is the potential for malfunctions and total failure. A modern turbine normally spins at twenty-five rotations per minute, or a few million times a year.[134] The forces on a wind turbine blade "'are equivalent to the lift forces faced by aircraft in takeoff, and some blades are of comparable size now to the wing of a Boeing

---

122. *See Windfarm Policy*, *supra* note 111, at 3.
123. *See id.*
124. Pates, *supra* note 74.
125. *Id.*
126. *Id.*
127. *Id.*
128. *See id.*
129. *Id.*
130. *Windfarm Policy*, *supra* note 111, at 3.
131. *See* Simone Kaiser & Michael Fröhlingsdorf, *Wuthering Heights: The Dangers of Wind Power*, N.Y. TIMES, Sept. 10, 2007, http://www.nytimes.com/2007/09/10/world/europe/03spiegel.html?pagewanted=print&_r=0 (discussing mechanical problems).
132. *See generally* JEFFREY M. ELLENBOGEN, ET AL., MASS. DEP'T OF ENVTL. PROT. & MASS. DEP'T OF PUB. HEALTH, WIND TURBINE HEALTH IMPACT STUDY: REPORT OF INDEPENDENT EXPERT PANEL (2012), *available at* http://www.mass.gov/dep/energy/wind/turbine_impact_study.pdf (discussing health and sensory effects).
133. *See Wind and Wildlife*, *supra* note 101 (discussing effects on wildlife and environment).
134. Michael Connellan, *Spinning to Destruction*, GUARDIAN, Sept. 3, 2008, http://www.guardian.co.uk/technology/2008/sep/04/energy.engineering.

747.'"[135] Wind turbines operate in "'the lower part of the Earth's atmosphere, where it is very turbulent and wind is more interrupted.'"[136] The constant forces on turbine blades can cause cracks.[137] Many wind turbine manufacturers assert that their products can last twenty years.[138] Gearboxes inside the wind turbine casings have short shelf lives, however, often breaking down in less than five years.[139] "In some cases, fractures form along the rotors, or even in the foundation, after only limited operation."[140] Blade failures can send large pieces of metal, plastic, and glass flying at high speeds, which could be fatal to anyone in their path.[141] Additionally, "short circuits or overheated propellers have been known to cause fires."[142]

Wind turbines can also present a danger to airborne wildlife populations. Birds and other flying animals can potentially be struck by the blades of wind turbines as they fly through airspace occupied by turbines.[143] This problem is accentuated in large wind farms, where these potentially dangerous blades are grouped together in a relatively concentrated area. According to the United States Fish and Wildlife Service, wind turbines kill an estimated 440,000 birds annually.[144] It is important to note, however, that this number is not substantial when compared to the estimated number of deaths caused by building window strikes (ninety-seven million annually), communication towers (four to five million annually), and car strikes (sixty million annually).[145]

Wind turbines also raise aesthetic and sensory concerns. Wind farms could be considered to be aesthetically displeasing and can detract from the natural beauty of the agricultural areas the turbines are located in. Concerns about health problems caused by wind turbines have been raised, including sleep dis-

---

135. *Id.*
136. *Id.*
137. *Id.*
138. *Id.*
139. Kaiser & Fröhlingsdorf, *supra* note 130.
140. *Id.*
141. *See* Connellan, *supra* note 134 (describing witness accounts of turbine breakdowns and resulting damages).
142. Kaiser & Fröhlingsdorf, *supra* note 131.
143. *See* U.S. FISH & WILDLIFE SERV., BUDGET JUSTIFICATIONS AND PERFORMANCE INFORMATION FISCAL YEAR 2013, at LE-2, http://www.fws.gov/budget/2013/FY%202013%20FWS%20Greenbook%20Final.pdf.
144. *Id.* (expecting bird mortality rates from the more than 100,000 turbines predicted by the year 2030 to exceed one million).
145. U.S. FISH & WILDLIFE SERV., MIGRATORY BIRD MORTALITY 2 (2002), *available at* http://www.fws.gov/birds/mortality-fact-sheet.pdf.

ruption, headaches, nausea, stress, and irritability.[146] The majority of studies have concluded, however, that there is little evidence that wind turbines have any direct adverse physiological effects on people living near wind farms.[147]

Finally, the environmental impacts of wind development characterize another drawback associated with the wind industry. While wind turbines are considered a form of "green energy," the manufacturing and installation of turbines requires significant use of fossil fuels, and though minimal, the erection of wind turbines and the creation of the necessary access roads have an impact on the land. These impacts are not a significant black eye for the wind industry, however, considering the long term benefits accrued from wind energy.

B. *Advantages of Wind Energy*

The most substantial and popular reason for the spread of wind energy is the pursuit and desire of clean energy. In addition to reducing the short-term output of pollution, using cleaner energy can lead to a reduction in the harmful effects of climate change. The United States emits approximately six billion metric tons of carbon dioxide annually.[148] By 2030, the Department of Energy estimates this number could reach between 6.4 and 6.75 billion metric tons per year.[149] The largest source of carbon dioxide emissions in the United States is electricity generation—comprising an estimated thirty-four percent of total carbon dioxide emissions in 2010.[150] The wind industry estimates "[o]ne megawatt-hour (MWh) of wind energy produced reduces CO_2 emissions by roughly 1,200 pounds."[151] Since the average turbine is 1.67 megawatts in size, a "single 1.67-MW turbine would produce over 5,000 MWh of electricity per year and reduce CO_2 emissions by over 3,000 tons."[152] In 2012, installed wind capacity in the United States surpassed 60,000 megawatts.[153] This level of installed capacity will avoid 95.9 million tons of carbon dioxide emissions each year, reducing the con-

146. *See* Michael A. Nissenbaum et al., *Effects of Industrial Wind Turbine Noise on Sleep and Health*, 14 NOISE & HEALTH 237 (2012).

147. *See* ELLENBOGEN ET AL., *supra* note 132, at 54–56.

148. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, DOE/EIA-0383, ANNUAL ENERGY OUTLOOK 2009, 52 tbl.14 (2009), *available at* http://www.eia.gov/oiaf/aeo/pdf/0383(2009).pdf.

149. *Id.*

150. *Sources of Greenhouse Gas Emissions*, U.S. ENVTL. PROT. AGENCY (June 14, 2012), http://www.epa.gov/climatechange/ghgemissions/sources.html.

151. *Wind Power and Climate Change*, AM. WIND ENERGY ASS'N, 1, http://www.awea.org/learnabout/publications/upload/Climate_Change.pdf (last visited Apr. 9, 2013).

152. *Id.*

153. AM. WIND ENERGY ASS'N, U.S. WIND INDUSTRY FOURTH QUARTER 2012 MARKET REPORT 3 (2013), *available at* http://www.awea.org/learnabout/publications/reports/upload/AWEA-Fourth-Quarter-Wind-Energy-Industry-Market-Report_Executive-Summary-4.pdf.

sequences of climate change.[154] Wind energy that displaces fossil fuel generation can also help meet existing regulations for emissions of conventional pollutants, including sulfur dioxide, nitrogen oxides, and mercury. The cumulative wind turbine capacity in 2010 prevents the emission of 75,000 metric tons of sulfur dioxide and 50,000 metric tons of nitrogen oxides annually.[155] Furthermore, "emissions from wind manufacturing and operation are less than 2% those of coal combustion per MWh"—giving wind energy the edge when compared to greenhouse gas lifecycle emissions from other energy sources.[156]

Besides the many benefits wind energy provides to the environment, it also provides health benefits to humans.

> Air quality has a direct impact on human health. Particulate matter in the air, often as a result of power plant emissions, has been shown to affect cardiovascular and respiratory health. . . . The generation of electricity from the wind does not result in any air emissions. By offsetting more polluting forms of energy generation, wind energy can actually improve air quality and our health.[157]

Another set of important benefits of the wind energy industry are economic in nature. Wind energy has now become "one of the most cost-effective sources of new electricity generation."[158] This is the result of lower turbine prices and capital costs, increased domestic manufacturing decreasing transportation costs, and technological improvements making turbines more efficient.[159] Additionally, the wind that turns the blades of a wind turbine is free, thus "locking in a predictable long-term cost of electricity for 20–30 years and protecting families and businesses from unexpected price spikes."[160] Another strong incentive for continued wind energy growth is the relatively local and homegrown economic benefits caused by manufacturing. Today, "over 400 American manufacturing plants build wind components, including all the major turbine components, towers, and blades."[161] Over 100 facilities manufacturing wind energy related parts

---

154. *Id.* at 4.
155. *Wind Turbines and Health*, AM. WIND ENERGY ASS'N, 1 (2010), http://awea.org/learnabout/publications/upload/Wind-Turbines-and-Health-Factsheet_WP11.pdf (citing AM. WIND. ENERGY ASS'N, ANNUAL MARKET REPORT, YEAR ENDING 2010 (2011)).
156. Letter from Willet Kempton and Jonathan Levey, Harvard Sch. of Pub. Health, to the Del. Pub. Serv. Comm'n (May 3, 2007), http://www.ceoe.udel.edu/windpower/DE-Qs/IRP-KempLevy-Health.pdf.
157. *Wind Turbines and Health*, *supra* note 155, at 1.
158. *American Wind Power*, AM. WIND ENERGY ASS'N, http://www.awea.org/learnabout/publications/upload/AmericanWindpowerBrochure.pdf (last visited Apr. 9, 2013).
159. *Id.*
160. *Id.*
161. *Id.*

have come online, expanded, or been announced since 2007.[162] As a result, at least "60% of the U.S.-installed turbine's value is produced" in the United States.[163]

Finally, wind energy provides direct financial benefits to the host landowner for agreeing to have a wind turbine placed on his farm by a wind developer. Landowners who agree to host a wind project typically sign twenty or thirty year contracts, or sometimes even longer commitments.[164] While some of their land will be taken out of agricultural use, often the economic incentives given in exchange are very appealing. Landowners are generally paid on a per turbine per year basis.[165] The rate can vary anywhere from $2000 to $10,000.[166] Due to the number of turbines on a typical wind farm, a landowner would be unwise to pass on an opportunity to gain a steady source of income from an investment that is managed and maintained by a third party.[167]

C. *Advantages of Aerial Application*

As previously discussed, aerial application can be a valuable tool for farmers. Aerial application as compared to ground application of pesticides and fertilizers can be a faster and more efficient option.[168] Aerial application allows for quick responses to agricultural emergencies and can even access and "treat wet fields . . . when crop canopies are too thick for ground rigs."[169] Additionally, yield loss resulting from soil compaction and damage to foliage caused by the ground sprayer wheels is not a factor when aerial application is used.[170]

D. *Disadvantages of Aerial Application*

Even with the advantages aerial application provides to farmers, there are some factors and natural disadvantages that do not make aerial application more

---

162. *Id.*
163. *Id.*
164. *Wind Energy Easements and Leases: Compensation Packages*, WINDUSTRY, 1 (2009), http://www.windustry.org/sites/windustry.org/files/Compensation-2009-07-06.pdf.
165. *Id.*
166. *Id.*
167. *See id.*
168. *About Agricultural Aviation,* NAT'L AGRIC. AVIATION ASS'N, http://www.agaviation.org/content/about-agricultural-aviation (last visited Apr. 9, 2013).
169. *Id.*
170. *See Soil Compaction: Causes, Effects, and Control*, UNIV. OF MINN. EXTENSION (2001), http://www.extension.umn.edu/distribution/cropsystems/components/3115s01.html#section1 (discussing wheel traffic as a cause of soil compaction and plant response to surface compaction).

appealing than other alternatives such as ground application. Although evidence indicates that yield losses occurred in the wheel tracks following repeated sprayer passes used in ground application, research has shown that the losses were less costly than suspected.[171] Aerial application does not cause the increased soil compaction and damage to foliage caused by the wheel tracks of ground application, however, "'aerial doesn't offer the exactness of ground application.'"[172] Aerial application does not treat field corners very effectively and, as a result, some farmers do not plant any crops in these corners.[173] This tends to balance the loss of yield caused by mechanical ground application. Therefore, yield loss alone may not be enough of a reason to choose aerial application over ground application.[174] Aerial application can be "more time effective, but the newer, larger ground sprayers can cover larger areas with their wider booms, which also means the impact of compaction is reduced because fewer passes across the field are required."[175]

Another serious concern about aerial application is the threat of spray drift. "Spray drift occurs when wind gusts unexpectedly blow small droplets of chemical crop protection products into the air and take them away from their anticipated settling points."[176] This can "result in pesticide exposures to farm workers, children playing outside, and wildlife and its habitat."[177] Spray drift "can also contaminate a home garden or another farmer's crops, causing illegal pesticide residues and/or plant damage."[178] The contamination is especially problematic when the spray drift affects crops that are supposed to be chemical free, or organic. Because organic crops are required to not come into contact with chemical protection products and may lose their added value if they do, spray drift is very damaging to organic farmers.[179] As such, nuisance and trespass

---

171. SHANE HANNA ET AL., PURDUE UNIV. EXTENSION, SPS-103-W, MANAGING FUNGICIDE APPLICATIONS IN SOYBEAN 2 (2007), http://www.extension.purdue.edu/extmedia/SPS/SPS-103-W.pdf; *Ground Versus Aerial Application*, TOP CROP MANAGER (NOV. 2007), http://www.agannex.com/pests/ground-versus-aerial-application.

172. *Ground Versus Aerial Application*, *supra* note 171.

173. *Id.*

174. *Id.*

175. *Id.*

176. *Pesticide Spray Drift*, CROPLIFE AM., http://www.croplifeamerica.org/pesticide-issues/spray-drift (last visited Apr. 9, 2013).

177. *Spray Drift of Pesticides*, CAL. DEP'T OF PESTICIDE REG. (Dec. 1999), http://www.cdpr.ca.gov/docs/dept/factshts/epadoc.htm.

178. *Id.*

179. DEAN HERZFELD & KAY SARGENT, UNIV. OF MINN. EXTENSION, PRIVATE PESTICIDE APPLICATOR SAFETY EDUCATION MANUAL 118 (Nancy Goodman ed., 19th ed. 2011), *available at* http://www.extension.umn.edu/pesticides/ppat_manual/Chapter%205.pdf.

claims have been filed against aerial applicators for spray drift.[180] The Minnesota Court of Appeals held that "a trespass action can arise from a chemical pesticide being deposited in discernible and consequential amounts onto one agricultural property as the result of errant overspray during application directed at another."[181] The Washington Supreme Court determined aerial application to be an abnormally dangerous activity and thus subject to strict liability.[182] With the growing popularity of organic farming, more lawsuits regarding spray drift are bound to occur, and the imprecise nature of aerial application may increase spray drift conflicts. The Environmental Protection Agency has tried to mitigate the harmful effects of spray drift by enacting new pesticide labeling and registration requirements and by enacting voluntary programs like the Drift Reduction Technology (DRT) Program, "which encourages the development, marketing, and use of application technologies verified to significantly reduce spray drift."[183]

IV. Goals for Future Interactions Between Aerial Application and Wind Energy

As each industry fights for its place and role in the agricultural world, conflicts are bound to arise. In order to prevent strict partisanship and ensure a smooth transition to a new economy and society with changing energy and farming needs, having goals to lessen the severity of those conflicts is necessary. Participation is required by both the aerial application and wind industries in order to allow for the continued growth and survival of each. As discussed in the previous sections, however, each industry has its advantages and disadvantages to society. It is only reasonable that one industry will need to be given preference over the other when conflicts arise. In this situation, the wind energy industry stands poised to provide the greatest long-term societal benefit given the available alternatives to aerial application.

Nevertheless, conflicts between the two industries can be solved in a few ways. The first is increasing the linearity of wind turbines on wind farms. Currently, wind turbines are frequently placed in non-linear formations if wind data and computer modeling has determined that the specific formation is the one that

---

180. *See, e.g.*, Johnson v. Paynesville Farmers Union Coop. Oil Co., 802 N.W.2d 383 (Minn. Ct. App. 2011).

181. *Id.* at 389.

182. Langan v. Valicopters, Inc., 567 P.2d 218, 220–21, 223 (Wash. 1977) (finding strict liability for spray drift damage to neighbor's organic crops). See also Young v. Darter, 363 P.2d 829 (Okla. 1961); Loe v. Lenhard, 362 P.2d 312, 318 (Or. 1961) and Gotreaux v. Gary, 94 So.2d 293 (La. 1957), for other examples of jurisdictions applying strict liability for drift.

183. *Pesticide Spray and Dust Drift*, U.S. ENVT'L PROT. AGENCY (Dec. 2009), http://www.epa.gov/pesticides/factsheets/spraydrift.htm.

is necessary for optimal performance.[184] Although it may not be economical that wind developers sacrifice performance for the sake of appeasement, encouraging a balance might be beneficial as long as some efforts are taken on the part of the wind developer to strive for some linearity when little wind efficiency will be sacrificed. In addition to creating goodwill with aerial applicators, these accommodations can also serve the same purpose for landowners with wind turbines on their properties. It may even encourage more landowners to agree to wind contracts due to the allowance of more crop protection product application options at a cheaper cost.

Other goals that both industries can pursue include increased pre-construction notification, education, registration, and structure marking. As discussed earlier, encouraging wind developers to give prior notice to surrounding businesses and landowners, and registering structures with a central organization, can give aerial applicators the information they need to safely navigate through land containing wind turbines. Additionally, wind developers increasing their marking requirements for turbines and MET towers beyond the minimum required by law can reduce the dangers wind farms pose to low flying aerial applicators. Aerial applicators can also take steps to reduce the risks the farms pose to aerial applicators by providing extra educational opportunities to pilots in order to foster the proper operation of agricultural aircraft among wind turbines.

One great example of a wind developer working with an aerial applicator and landowner to foster a good relationship with each party is a policy by FPL Energy Illinois Wind (a subsidiary of NextEra Energy Resources). The company has instituted a hotline for aerial applicators to notify the company of their application schedule so that the company can temporarily shut down the turbines during application to ensure for a safer experience for the aerial applicator.[185] FPLE takes this a step further and has even proposed that non-participating landowners with land within one-half mile of a wind turbine receive some compensation because they might lose some access to aerial application due to their proximity to the towers.[186] Policies and best practices such as these can help prevent conflicts between wind energy and aerial application from turning into a winner-take-all battle.

---

184. Pates, *supra* note 74.

185. Petition MI-09-01 Wind Farm Special Use Permit Exhibit V from FPL ENERGY ILLINOIS WIND TO DEKALB COUNTY BOARD (Apr. 4, 2009), *available at* http://www.dekalbcounty.org/PlanningZoningBuilding/FPL/Exhibit_V.pdf.

186. *Id.*

V. CONCLUSION

The wind energy industry and aerial application industry are important parts of our energy and food production future. The rapid growth of wind energy, however, brings into question the ongoing role of aerial application. Even though it seems like wind energy is more important and popular at present, it is important for farmers to have access to aerial application for the efficient production of food to accommodate for the growing world population. Despite this, society seems to benefit more from wind energy as we try to develop alternative forms of energy. Compromises may be made in terms of increasingly linear turbine construction, more reporting requirements, and more policies like the one instituted by FPLE. Yet the presence of feasible alternatives to aerial application of farm products seems to make aerial application more expendable than wind energy. Thus, the trend of wind energy infringing upon the aerial application industry will continue, with little resistance.

There are many moving parts in the conflicts between the two industries, including federal and state statutes, regulations, guidance documents, trade groups with their associated interests, and private individuals. With all of these players and factors at work, it is important to maintain open lines of communication to ensure that the best resolutions are made in order to reach mutually beneficial outcomes for the sake of our growing food production and energy needs.