Gone with the Wind? The Potential Tragedy of the Common Wind

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I.
INTRODUCTION

The gentle cool breeze brushing through the trees on a summer's eve, the howl of a blizzard on a cold winter night, the twirling of leaves on an autumn morning and the scent of fresh cut grass on a spring day - all these are made possible by the wind. It is a powerful force of nature, with an essential role in our natural environment. It affects our daily lives by changing the weather conditions. It serves as a means of recreation whenever we fly a kite. It even carries the aroma of fresh coffee in the morning. In recent years, the wind has also enjoyed a growing role as an essential source of energy. In light of the rising concerns over global warming, and the exhaustion of fossil-fuel resources, wind energy presents a clean, renewable alternative for energy production. Wind is an asset. It is an important environmental and financial asset. And due to the recent winds of change, it is time we examine this valuable asset closely.

Given the importance of wind in the present and its expected significance in the future, this article explores the property interests in the wind, the potential problem of overuse and possible ways to avoid it. The second Part discusses the importance of wind to the environment and as a source of energy. The third Part examines who holds the right to harvest the wind, arguing that wind-rights are allocated to the private landowners, but also to the public as a whole, thus creating a mixed property regime. Given this complex property regime, and the unique nature of wind as an asset, the forth Part discusses the potential tragedy of the commons that might occur. This Part will look at the typical characteristics of the tragedy, and argue that they could possibly occur with wind. Finally, the fifth Part discusses two possible ways to protect this valuable asset, on a private level and as a public interest.

II.
UNDERSTANDING WIND AND ITS IMPORTANCE

Wind is the *movement*, or the *flowing* of air on the surface of the earth. The movement of air is created by differences in air-pressure, caused by alterations in temperature together with the rotation of the planet.[1] Warmer air is less dense than cooler air,

1. C. DONALD AHRENS, METEOROLOGY TODAY: AN INTRODUCTION TO WEATHER, CLIMATE, AND THE ENVIRONMENT 203 (2007). High winds are created

and rises above it. The cooler air then rushes to fill the low pressure areas, thus creating wind.[2] As opposed to the numerous discussions regarding air pollution, this paper is not concerned directly with the chemical components of the air particles, but rather with the movement of these particles and its effect on the environment.

A. *Wind's Role in the Environment*

Although the movement of air is invisible, we see evidence of it nearly everywhere we look. It is a powerful element – it sculpts rocks, and shapes the landscape by moving the terrain from one area to another. Consider, for example, the desert sands, which clearly bear the finger-prints of the blowing wind, or the snowy slopes of the highest ridges formed over time by forceful howling winds.[3]

Described as the workhorse of weather, winds can greatly affect the climate of a region. Wind has the power to move storm or fair-weather systems around the globe, and lift water vapor upward to where it can condense into clouds. Onshore winds in the summer carry moisture, cool air and fog into coastal regions, whereas offshore breezes carry with them warmer and drier air. Winds can pleasantly cool us off on a hot day or cause us to shiver.[4] Wind also influences the water on earth – it makes waves. Just as air blowing over the top of a water-filled pan creates tiny ripples, so waves are created as the blowing wind transfers energy to the water.[5] These waves can change in shape and form as they are affected by the wind's properties. In general, the greater the wind speed, the greater the amount of energy added, and the higher the waves will be.[6]

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by steep pressure differences, whereas light winds are caused by more gentle pressure variations. *Id.* at 204-05. For a more detailed description of the physical forces that influence the wind, see *id.* at 203-14; *What Causes the Wind?*, RENEWABLEUK (formerly named British Wind Energy Association), http://www.bwea.com/edu/wind.html (last visited Mar. 13, 2010).

2. ROLAND. B. STULL, METEOROLOGY FOR SCIENTISTS AND ENGINEERS 205 (2000); SIDNEY BOROWITZ, FAREWELL FOSSIL FUELS: REVIEWING AMERICA'S ENERGY POLICY 145 (1999); *Wind Power Today*, AM. WIND POWER ASS'N, www.awea.org/pubs/factsheets/WindPowerToday_2007.pdf (last visited April 7, 2009). [Hereinafter Wind Power Today].

3. AHRENS, *supra* note 1, at 227-28.

4. *Id.* at 222, 232.

5. VACLAV SMIL, ENERGY IN NATURE AND SOCIETY: GENERATION ENERGETICS OF COMPLEX SYSTEM 39 (2008).

6. AHRENS, *supra* note 1, at 230.

Furthermore, wind has an important effect on vegetation. At times, wind can have a negative impact on plant life – strong winds can twist the branches of trees or damage tender vegetation thus decreasing crop productivity.[7] Yet wind also assists the reproduction of plants - it moves leaves, transports heat, moisture, dust, insects, bacteria, and pollens from one area to another.[8] By moving small particles downwind of their point of origin, the wind aids plants and other immobile organisms in dispersal and reproduction. Although wind is not the primary form of seed spreading in plants, it provides dispersal for a large percentage of the biomass produced by land plants.[9] There is no doubt that without the wind our plant life would be quite different.

Wind also plays an important role in the environment by shifting polluted air in the downwind direction, thus scattering the pollution from one area to another.[10] This of course could be an advantage to those living upwind, but a problem to those in the downwind direction. Wind also has an important recreational role in our lives, from kite flying to wind and wave surfing. A breeze can even sharpen our appetite when it blows the aroma from the local bakery in our direction. It is clear that the wind follows us wherever we go, affecting human life in varied and significant ways. Recently, the impact of wind upon society has expanded dramatically, as it has become a growing source of energy.

B. *The Importance of Wind as a Source of Energy*

Energy is a key factor in the economic endurance of modern societies[11] Dependable energy sources encourage the economic growth of a nation, and are necessary to improve the lives and wellbeing of its citizens.[12] In recent years, wind has become an increasingly more valuable and prevalent source of energy. The

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7. *Id.* at 229.

8. B. S. BECKETT, BIOLOGY 173 (1986).

9. JAMES D. MAUSETH, BOTANY: AN INTRODUCTION TO PLANT BIOLOGY 195-96, 208-11 (2008).

10. For an extensive review of the transportation of pollutants by the wind and the various factors at play, see B. J. ALLOWAY & D. C. AYRES, CHEMICAL PRINCIPLES OF ENVIRONMENTAL POLLUTION 27- 35 (1997).

11. Michal C. Moore, *Sustainable Development and Smart Energy: Renewable Technologies to Power and Empower the Developing World*, 16 COLO. J. INT'L ENVTL. L. & POL'Y 377, 378 (2005).

12. *Id.*

increased concerns about climate change have encouraged the development of wind technology.[13] In addition, traditional energy sources are becoming more and more precious, especially in light of the geopolitical tensions in oil-rich areas,[14] inspiring states to pursue measures that will reduce dependence on fossil fuel supplies.[15] In view of these difficulties, wind energy presents a renewable, clean alternative.

Because of its many advantages, wind has been used as a source of energy throughout history. Early civilizations migrated over hundreds of kilometers using elementary sailing craft.[16] Sailing ships were used by Phoenician sailors[17] and by Egyptians as early as 3100 B.C. During the Roman Empire and through the Middle-Ages sailors continued to develop new sailing expertise, and even today the innovation of new sailing technologies carries on.[18] Wind energy was first captured by the Persians with land-based windmills in the seventh century CE in order grind grains for bread,[19] and the technology was later perfected by the Dutch.[20] Aside from milling, people used wind power to draw water from wells, fly hot-air balloons and eventually to create electricity. Yet the number of wind-based machines declined rapidly as rural electrification swept the world. Lately however, there has been a revived interest in wind energy.[21]

Wind power technology, increasingly revisited as human society struggles to cope with the modern energy demands and environmental concerns,[22] has grown significantly more popular in the last decade. Today wind power is considered to be the fastest

13. Christopher W. Fry, Note and Comment, *Harvesting the Sky: An Analysis of National and International Wind Power*, 19 COLO. J. INT'L ENVTL. L. & POL'Y 427, 432 (2008); American Wind Energy Association, Utility Scale Wind Energy and Sound, www.awea.org/pubs/factsheets/Sound_Factsheet.pdf (last visited Mar. 22, 2009).

14. Moore, *supra* note 11, at 378-79.

15. Fry, *supra* note 13, at 429.

16. Joseph O. Wilson, Note, *The Answer, My Friends, Is in the Wind Rights Contract Act: Proposed Legislation Governing Wind Rights Contracts*, 89 IOWA L. REV. 1775, 1778 n.9 (2004) (citing ROBERT W. RIGHTER, WIND ENERGY IN AMERICA: A HISTORY 5-6 (1996)).

17. Fry, *supra* note 13, at 429.

18. Wilson, *supra* note 16, at 1778 n.9 (citing RIGHTER, *supra* note 16, at 6-7).

19. *History*, CENTRE FOR ENERGY, http://www.centreforenergy.com/About Energy/Wind/History.asp (last visited Apr. 7, 2009); *see also History of Wind Turbines*, DANISH WIND INDUSTRY ASS'N, http://www.windpower.org/en/pictures/index.html (last visited Apr. 7, 2009).

20. Fry, *supra* note 13, at 429-30.

21. Wilson, *supra* note 16, at 1778.

22. Fry, *supra* note 13, at 429-30

growing source of energy in the world:[23] wind power capacity over the world has tripled in the last few decades with an annual growth rate of roughly twenty percent.[24] Wind power in the 1990s was mostly dominated by Europe. For example, the Schleswig-Holstein region in north Germany derives ten percent of its electricity from wind power.[25] This rate is expected to grow even further and spread through the EU members as the European Directive[26] aims to ensure that the share of renewable energy in the EU reaches at least twenty percent by 2020. In the US, wind energy still supplies only a small percentage of the electricity capacity, although data show increases: over 8500 megawatts (MW) of new wind generating capacity was installed in 2008, bringing the total installed capacity to 21,017 MWin 35 states.[27] The American Wind Energy Association (AWEA) estimates that wind farms in the US generated approximately 25,000

23. Jeremy Firestone, Willett Kempton, Andrew Krueger & Christen E. Loper, *Regulating Offshore Wind Power and Aquaculture: From Land and Sea*, 14 CORNELL J. L. & PUB. POL'Y 71, 75 (2004); Christopher Flavin & Seth Dunn, *Renewable Energy Technologies and Policies: Status and Prospects*, 5 BUFF. ENVTL. L.J. 1, 3 (1997).

24. Flavin & Dunn, *supra* note 23, at 5.

25. *Id.* According to another source, wind energy in all of Germany facilitated in 2007 over 7% of the country's needs. *Wind Energy*, ENVTL. AND ENERGY STUDY INST., http://www.eesi.org/wind (last visited Apr. 12, 2009). In general, Europe is currently considered the world leader in wind power development. According to The European Wind Energy Association, at the end of 2008, there were 65 GW of wind power capacity installed in the EU-27 producing 142 TWh hours of electricity, and meeting 4.2% of EU electricity demand. *WindEnergy Statistics*, THE EUROPEAN WIND ENERGY ASS'N, http://www.ewea.org/fileadmin/ewea_documents/documents/publications/factsheets/EWEA_FS_Statistics_FINAL_lr.pdf (last visited Apr. 13, 2009).

26. The purpose of the 2001 European Renewable Energy Directive is "to promote an increase in the contribution of renewable energy sources to electricity production in the internal market for electricity and to create a basis for a future Community framework thereof." Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, 2009 O.J. (L 140) 16, *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF (last visited Mar. 13, 2010). The 2001 Directive will be replaced by the recently agreed Renewable Energy Directive during 2010 and 2011. For a further review of this subject, see *Legal Framework for Wind Energy*, THE EUROPEAN WIND ENERGY ASS'N, http://www.ewea.org/index.php?id=197 (last visited Apr. 13, 2009).

27. *2008: Another Record Year for New Wind Installations*, AM. WIND ENERGY ASS'N, http://www.awea.org/pubs/factsheets/Market_Update.pdf (last visited Mar. 20, 2009) [hereinafter AWEA, Another Record Year]. During the 1980s the installed wind-generation capacity in the United States grew by nearly 1400%. The vast majority of this growth occurred in California, which had the best sites and the most receptive political climate. Much of the contemporary growth is concentrated

megawatts (MW) of wind energy in 2008, just over 1.25 percent of US electricity supply, powering the equivalent of over 5.7 million homes.[28] Further growth is expected in the near future,[29] and it is estimated that US wind resources are potentially large enough to produce more than the total electricity required in the US.[30]

1. How Wind Turbines Create Electricity

As opposed to a household fan that uses electric energy to generate wind, a wind turbine utilizes wind to create electricity, by converting the kinetic energy locked in the wind – to electric energy.[31] A typical modern large-scale wind turbine includes a set of three feather-shaped blades attached to a metal tower.[32] The wind causes the blades to turn, which then in turn, rotates a connected shaft. The shaft is attached to a generator by a gearbox, which by spinning large magnets transforms the kinetic energy previously locked in the wind into electric energy.[33] The voltage power then flows through underground lines to a collection point where the power may be combined with other turbines, and then sent across many miles to distant cities and

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in the Great Plains states due in large part to the abundance of suitable sites. Wilson, *supra* note 16, at 1779.

28. AWEA, Another Record Year, *supra* note 27.

29. In May 2008, the Department of Energy released a report demonstrating that wind could contribute up to 20% of the U.S. electricity supply by 2030. *See, Wind Energy*, ENVTL. AND ENERGY STUDY INST., http://www.eesi.org/wind (last visited Apr. 12, 2009).

30. Firestone et al., *supra* note 23, at 87.

31. Adam M. Dinnell & Adam J. Russ, *The Legal Hurdles to Developing Wind Power as an Alternative Energy Source in the United States: Creative and Comparative Solutions*, 27 NW. J. INT'L. L. & BUS. 535, 539 (2007).

32. The blades are designed to gradually feather (reduce their angle of attack) as wind speed increases. This way the turbine spins at a constant speed regardless of the wind speed and power generation is relatively constant. Stull, *supra* note 2, at 207.

33. Dinnell & Russ, *supra* note 31, at 539-40; *Wind and Hydropower Technologies Program: How Wind Turbines Work*, U.S. DEP'T OF ENERGY http://www1.eere.energy.gov/windandhydro/wind_how.html (last visited Apr. 5, 2009). The theoretical power available from the wind is proportional to wind speed cubed. Stull, *supra* note 2, at 207. Turbines are typically very large–the tower of one of the most popular models stands 208 feet tall, and each blade measures seventy-nine feet long. The larger the turbine, the more energy it can produce, even though the blades spin more slowly. Christine Real de Azua, *The Future of Wind Energy*, 14 TUL. ENVTL. L.J. 485, 488 (2001).

factories.[34] The U.S. Code follows this technical description in stating[35]

> The term "wind energy system" means a system of components which converts the kinetic energy of the wind into electricity or mechanical power . . . to provide electricity or mechanical power for individual, residential, agricultural, commercial, industrial, utility, or governmental use.

2. Benefits of Wind Power

WIND: A SOURCE OF RENEWABLE ENERGY

As mentioned, wind is created by differences in air temperature, caused by the sun: the earth's atmosphere and surface do not absorb the sun's energy evenly, thus creating variance in air temperature, resulting in the movement of air from one area to another. Therefore, wind power is a form of renewable energy – energy that is replenished daily by the sun.[36]

WIND: A SOURCE OF CLEAN ENERGY

Besides being renewable, wind energy is also advantageous compared to traditional sources of energy in regards to environmental side effects.[37] Its primary advantage is the lack of carbon emissions: as opposed to fossil fuel electricity production, wind power does not produce carbon emissions, or any other greenhouse gases.[38] For example, the U.S. Department of Energy recently reported that under a scenario where 20 percent of energy comes from wind by 2030, we could avoid 825 million tons of CO_2 annually, which is 20-25 percent below expected electric sector emissions by that time. This equates to taking 140 million vehicles off the road.[39] In addition, wind energy does not present the same complications in connection with transportation of raw materials or disposal of spent fuels. Therefore, every turbine in-

34. AWEA, Wind Power Today, *supra* note 2. The most commonly used model in large-scale applications is rated at 750 kilowatts at its peak output. *Id.* Some turbines produce even more electricity, up to 1.65 megawatts, enough to power approximately 250 average-sized homes. Real de Azua, *supra* note 33, at 488.

35. 42 U.S.C. § 9202(1) (2006).

36. Robert S. Guzek, Comment, *Addressing the Impacts of Large Wind Turbine Projects to Encourage Utilization of Wind Energy Resources*, 27 TEMP. J. SCI. TECH. & ENVTL. L. 123, 126 (2008); *see also* AWEA, Wind Power Today, *supra* note 2.

37. Wilson, *supra* note 16, at 1782.

38. *Wind Power and Climate Change*, AM. WIND POWER ASS'N, http://www.awea.org/pubs/factsheets/Climate_Change.pdf (last visited Mar. 20, 2009).

39. *Id.*

stalled helps decrease the harmful environmental effects caused by conventional energy production methods.[40]

3. Technological Improvements and Limitations

In the past, one of the most the prevailing disadvantages of wind-energy was costly production. However, the cost of wind energy has steadily declined during the past few years, mainly due to the technological advancements,[41] combined with the economies of scale.[42] In fact, the price of wind energy is decreasing at a much faster rate compared to other energy production technologies:[43] the price for wind power has dropped about 90 percent during the past twenty years from $ 0.40 per kilowatt hour in the early 1980s to approximately $ 0.03 per kilowatt hour at present.[44] Due to these changes, the current price of wind energy is competitive with other forms of energy production.[45]

Wind power's current limitation lies in the nature of wind itself – its tendency for irregular and fluctuating behavior.[46] One of the strongest shortcomings of wind power is that wind facilities are only active roughly 20-30 percent of the time – when wind is blowing.[47] The dependence on the prevailing wind conditions means that wind power has a limited load factor even when technically available. Wind blows mostly during the morning and evening, presenting problems during summer days when air con-

40. Wilson, *supra* note 16, at 1782.

41. *Id.* at 1780; Real de Azua, *supra* note 33, at 488.

42. Flavin & Dunn, *supra* note 23, at 3.

43. Wilson, *supra* note 16, at 1781.

44. Victoria Sutton & Nicole Tomich, *Harnessing Wind is Not (by Nature) Environmentally Friendly*, 22 PACE ENVTL. L. REV. 91, 93 (2005).

45. Fry, *supra* note 13, at 436.

46. *Id.* Although technological improvements today have somewhat reduced this problem as well. Sophisticated technology allows many modern turbines to sense meteorological data from their surroundings, and automatically adjust the rotation angle to compensate for the changing wind conditions. Stull, *supra* note 2, at 207. As a result wind turbines can produce energy in winds as low as 5 knots, and a high as 45 knots AHRENS, *supra* note 1, at 235.

47. For example, the Electric Power Research Institute (EPRI) reported that the ridgeline facility in Searsburg, Vermont, produced no electricity at all almost 40% of the time. *See The Poor Record of the Searsburg, Vermont, Wind Plant*, AM. WIND ENERGY ASS'N, http://www.aweo.org/windsearsburg.html (last visited Apr. 7, 2009). Another study by the Irish grid manager finds that the benefits of wind-generated power are small and that they decrease as more wind power is added to the system. *See Impact of Wind Power Generation in Ireland on the Operation of Conventional Plant and the Economic Implications, February 2004*, ESB NAT'L GRID, http://www.eirgrid.com/EirGridPortal/uploads/Publications/Wind%20Impact%20Study%20-%20main%20report.pdf.

ditioning increases power needs midday. As a result, it is not possible to guarantee its use for continual electricity consumption needs. This intermittent property of wind power makes it necessary to keep traditional power sources running as a security supply, forcing operators to run conventional plants below optimal thermal efficiency, resulting in greater emissions.[48] These emissions arguably weaken the advantage of wind energy production. According to one study, these emissions could amount to one-third of the pollution which was saved by using wind energy in the first place.[49] Nonetheless, even with a certain amount of energy lost, there is no doubt that wind energy is a useful source of energy renewable and clean energy.[50]

4. Future Development

In addition to land-based wind energy production, there have recently been technological developments which allow for offshore wind production,[51] marking an opportunity for harnessing wind power without addressing land-use issues. Offshore projects suffer from high construction costs. Despite the elevated developments costs, the ability to enjoy the force of offshore winds makes these projects cost-effective.[52] Offshore projects have been completed in Europe,[53] and the first project in the U.S. is currently in progress.[54] One proposed project lo-

48. *See, e.g.*, Richard S. Courtney, *Wind Farms Provide No Useful Electricity*, AWEO.COM, http://www.aweo.org/windCourtney1.html (last visited May 19, 2011), claiming that "[T]hey provide no useful electricity and make no reduction to emissions from power generation. Indeed, the wind farm is the source of emissions from a power station operating spinning standby in support of the windfarm."

49. Rustin P. Diehl, Note, *Transitioning to a Clean Renewable Energy Network in the West*, 27 J. LAND RESOURCES & ENVTL. L. 345, 351 (2007).

50. Moore, *supra* note 11, at 379.

51. Fry, *supra* note 13, at 437-38.

52. *Id.* at 439.

53. At the end of 2008, a total of almost 1,471 MW of offshore wind farms were in operation around Europe, in the coastal waters of Denmark, Ireland, Netherlands, Sweden, the United Kingdom, Germany, Belgium and Finland, representing around 2% of the cumulative installed capacity of wind power in the European Union. *See Current Role and Future Prospects for Offshore Wind in Europe*, THE EUROPEAN WIND ENERGY ASS'N, http://www.ewea.org/index.php?id=203 (last visited Apr. 13, 2009); *see also Further Offshore and Larger Wind Farm Developments*, BRITISH WIND ENERGY ASS'N, http://www.bwea.com/offshore/further.html (last visited Feb. 10, 2009). For a review of the many advantaged of offshore wind installations, see *Interior Department Highlights Offshore Renewable Energy Potential*, ENVTL. AND ENERGY STUDY INST., http://www.eesi.org/040509_offshore (last visited Apr. 12, 2009).

54. *Time Line*, CAPE WIND, http://www.capewind.org/article26.htm (last visited Apr. 7, 2009). The Cape Wind project sparked a rather strong public opposition, led

cated off the coast of Cape Cod, Massachusetts, for example, is predicted to supply ten percent of the entire electricity demand of the State of Massachusetts.[55]

A further potential area of development lies in the small wind industry. Small wind typically refers to an individual windmill, which generates no more than 100 KW.[56] The potential market among homeowners for small wind turbines is immense. With multiple small wind support programs that exist today, the system costs are low enough to return an initial capital investment in less than ten years.[57] It is only natural that homeowners are

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by the Alliance to Protect Nantucket Sound. *See Alliance to Protect Nantucket*, SAVE OUR SOUND, http://www.saveoursound.org/site/PageServer (last visited Mar. 31, 2010). Most opposition seems to be centered on aesthetic concerns. For further discussion regarding the legal complexities of the Cape Wind project, see Guy R. Martin & Odin A. Smith, *The World's Largest Wind Energy Facility in Nantucket Sound? Deficiencies in the Current Regulatory Process for Offshore Wind Energy Development*, 31 B.C. ENVTL. AFF. L. REV. 285 (2004); Carolyn S. Kaplan, *Congress, the Courts, and the Army Corps: Siting the First Offshore Wind Farm in the United States*, 31 B.C. ENVTL. AFF. L. REV. 177 (2004); Timothy A. Hayden, Comment, *Reception on Nantucket Sound? A Summary of Current Offshore Wind Farm Litigation and a Federal Legislative Proposal Taking Cues From Cellular Tower Legislation*, 13 PENN ST. ENVTL. L. REV. 217 (2005); Jacquelyn Hadam, Case Note, *The Latest Development in the Debate over Nantucket Sound:* Alliance to Protect Nantucket Sound, Inc. v. Energy Facilities Siting Board, 13 OCEAN & COASTAL L.J. 121 (2007).

In addition, the State of Texas recently approved its second agreement for the development of an offshore wind farm, which will boast more than 100 wind turbines. *See Texas Bid Could be First U.S. Offshore Wind Farm*, RENEWABLEENERGYWORLD.COM, http://www.renewableenergyaccess.com/rea/news/story?id=38618 (last visited Apr. 1, 2009); *Texas Awards Rights for Offshore Wind Farm: 'Wind Rush is On', Official Says*, MSNBC, http://www.msnbc.msn.com/id/21113169/ (last visited Apr. 12, 2009).

55. Firestone et al., *supra* note 23, at 76. As Firestone notes, in the US, "very large offshore wind resources exist in close proximity to populated areas on the eastern seaboard. In addition, turbines can now be manufactured on a larger scale with a lower cost. This combination has led to a number of proposals for large offshore wind projects along the Atlantic coast." *Id.*

56. Fry, *supra* note 13, at 436. This definition is also adopted by the US Code, which defines small wind as follows: "[T]he term 'small wind energy system' means a wind energy system having a maximum rated capacity of one hundred kilowatts or less." *See* 42 U.S.C. § 9202(2) (2006). *See also SWIIS Project Description*, SMALL WIND INDUSTRY, http://www.smallwindindustry.org/index.php?id=112 (last visited Apr. 11, 2009).

57. *See Small Wind for Homeowners, Ranchers, and Small Businesses*, U.S DEP'T OF ENERGY, http://www.windpoweringamerica.gov/small_wind.asp (last visited Apr. 11, 2009); *Small Wind Tool Box*, AM. WIND ENERGY ASS'N, http://www.awea.org/smallwind/toolbox2/financing.html (last visited Apr. 11, 2009); *Incentives for Wind*, DSIRE, http://www.dsireusa.org/library/includes/techno.cfm?EE=1&RE=1 (last visited Apr. 11, 2009). On the other hand, for a criticizing review of the governmental incentives provided for the Small Wind Industry, see *AWEA Small Wind Turbine Global Market Study 2008*, AM. WIND ENERGY ASS'N, http://www.awea.org/small

likely to take advantage of these economic incentives, and therefore a major increase in small wind could be expected in the near future.[58]

In short, since the wind has so many advantages, and multiple growth opportunities, it is predicted that harvesting the wind will continue to increase significantly in the future. Energy production is generally one of the most dominant and influential industries in the world, effecting employment and the environment like no other industry,[59] and wind energy production in particular is growing at a rapid pace.[60] More countries enjoy wind power potential than other energy resources such and hydropower or coal,[61] thus making wind a rather popular resource. Given the importance of energy resources and the abundance of wind potential, the dramatic growth in wind energy production is likely to persist. Wind holds an enormous economic and environmental importance in human society and will be even further utilized and developed in years to come. In light of this development, it is necessary to examine the property interests in wind.

III.
PROPERTY INTERESTS IN WIND

After reviewing the ecological and economic importance of the wind, we must explore who owns the wind. Is it solely a private interest, or does is combine public and private property rights? Such questions have been briefly presented in the past, yet answers were not provided.[62] In light of the growing wind-energy industry, it is time to examine these questions closely.

A. *Wind as a Private Property Interest*

Wind could be regarded as an asset, which exists only in some areas, and varies in speed and frequency from one area to an-

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wind/pdf/2008_AWEA_Small_Wind_Turbine_Global_Market_Study.pdf (last visited Apr. 11, 2009); Fry, *supra* note 13, at 449.

58. *Small Wind*, AM. WIND ENERGY ASS'N, http://www.awea.org/smallwind (last visited May 2, 2009).

59. Daniel M. Kammen, *Symposium on Renewed Interest: California's Renewable Energy Sector: Renewable Energy in United States Foreign Policy*, 36 GOLDEN GATE U.L. REV. 327, 328 (2006).

60. Sutton & Tomich, *supra* note 44, at 92; *Wind Energy*, RENEWABLE ENERGY POL'Y PROJECT, http://www.repp.org/wind/index.html (last visited Apr. 12, 2009).

61. Flavin & Dunn, *supra* note 23, at 5.

62. John A. Duff, *Offshore Management Considerations: Law and Policy Questions Related to Fish, Oil, and Wind*, 31 B.C. ENVTL. AFF. L. REV. 385, 400 (2004).

other. Therefore, it seems only natural to view this asset as a private property interest of the landowners over which the wind howls. In other words, if wind blows across a farmer's land, the farmer owns the wind just like she owns the crops growing on her soil.

The landowners' rights could be referred to in short as wind-rights, meaning the right to sell an easement or conduct a lease agreement[63] that will allow the holder to conduct site surveys, erect wind turbines on the land, construct transmission lines, and so forth.[64] Wind rights may be recognized under the common law doctrine which determines that the landowner's property rights extend to everything from the center of the earth to the sky.[65] The natural extension of this principle produces a legal right to harvest the wind that blows across one's land, just like one can use the soil of the land.

However, although there is a reasonable doctrinal base for recognizing wind rights, rarely has the court recognized a distinct property right in the wind that can be severed from other interests in land.[66] In 1997, the California Court of Appeals for the First District in the case of Contra Costa Water District v. Va-

63. On the difference of between lease agreements and easements regarding wind sites, see Howard E. Susman & Kathleen J. Doll, *Finding a Suitable Site for a Wind Farm Requires more than Locating a Blustery Location*, 30 L.A. LAW. 35, 35-36 (2008).

64. Wilson, *supra* note 16, at 1776-77. These contracts are typically characterized by information imbalance: The wind power developers typically have considerable knowledge and background, while the landowner has no comprehensive source of guidance in this field. This information imbalance holds the potential to lead to improvident and unfair contracts between landowners and developers. For further discussion on this matter, see Fry, *supra* note 45.

65. *Id.* at 1784, explaining that if the landowner is entitled to full enjoyment of the land, he must have exclusive and comprehensive control over it. Otherwise buildings could not be erected and trees could not be planted. This notion is also typically recognized by the judiciary, holding that that defendants' entry onto land gave them rights to the mineral rights below the surface as well as rights to the surface itself. See Broughton v. Humble Oil & Ref. Co., 105 S.W.2d 480, 482 (Tex. Civ. App. – El Paso 1937, writ ref'd).

66. In fact, it seems as though no other cases have been found to support the notion of a right to blowing air (i.e., wind) as a separate interest. *See* Wilson, *supra* note 16, at 1783; Sutton & Tomich, *supra* note 44, at 116). *See also infra* Part V.A. (discussing the nuisance claims brought before the court which do not treat wind as a separate interest). Nevertheless, according to Sutton & Tomich, *supra* note 44, at 116, there has been some legal evolution with respect to solar access protection, and an abundance of cases concerning a right to "light, air, and view" that may serve as a guide for the development of wind access protection in the future.

quero Farms, Inc.,[67] recognized wind-rights as a separate property interest, which must be compensated for in the event a state condemnation denies the property owner his wind.[68] The court held that the rights for "wind energy power conversion and the transmission of power generated by wind, including . . . the exclusive and perpetual right . . . to develop, construct, install, maintain and operate wind power facilities" could be reserved as a property right distinct from the fee ownership of the underlying land.[69]

Several states have recently passed legislation intended to address certain wind energy issues. For example, a Minnesota statute defines "wind easement" as "a right, whether or not stated in the form of a restriction, easement, covenant, or condition . . . executed by or on behalf of any owner of land or air space for the purpose of ensuring adequate exposure of a wind power system to the winds."[70] The Montana Code similarly states: "An easement obtained for the purpose of insuring the undisturbed flow of wind across the real property of another."[71] The language of these provisions shows a clear recognition of wind-rights, and a specific reference to the owner of such rights – the owner of the property over which the wind blows, or even just the air space above the land.

In addition to this statutory suggestion, the current practice of wind farm installation suggests that wind rights effectively exist. Over the course of the last ten years, an increasing number of landowners whose lands are graced with consistent winds have negotiated contracts selling the electricity-producing potential to wind energy developers.[72] Typically, the landowner leases the right to harvest the wind above her property and to install turbines on her land, to a willing developer.[73] Occasionally land-

67. Contra Costa Water Dist. v. Vaguero Farms, Inc., 58 Cal. App. 4th 883 (Cal. Ct. App. 1997) [hereinafter Contra Costa].

68. *Id.* at 893-94.

69. *Id.* at 891. *See also* Duff, *supra* note 62, at 400.

70. MINN. STAT. § 500.30 (2002 & Supp. 2008).

71. MONT. CODE ANN. § 70-17-303 (2007). Similar definitions can be found in a few additional states. *See* OR. REV. STAT. § 105.900-105.915 (2007); S.D. CODIFIED LAWS § 43-13-17 to -19 (Supp. 2003); WIS. STAT. § 700.35 (2001 & Supp. 2007).

72. Wilson, *supra* note 16, at 1776-77.

73. Brian Dietz, Comment, *Turbines vs. Tallgrass: Law, Policy, and a New Solution to Conflict over Wind Farms in the Kansas Flint Hills*, 54 KAN. L. REV. 1131, 1135 (2006).

owners even retain part of the ownership in the projects erected on their land.[74] The wind, it seems, is theirs to sell.

This proves to be a rather clever move from the landowner's point of view, since the annual net income a farmer gains from these wind projects could double the income received from traditional land uses such as cultivation or grazing.[75] Naturally, this additional income provides ranchers with strong incentives to engage in such schemes[76] This tendency is enhanced by legislation designed to encourage landowners to engage in wind extraction projects. The Public Utilities Regulatory Policy Act (PURPA)[77] subsidizes renewable energy projects and requires utilities to buy a certain amount of electricity generated by alternative sources.[78] In addition, tax incentives exist both at the federal[79] and state level:[80] property tax benefits, such as exemptions, exclusions or credits for renewable energy, currently exist in twenty-nine states,[81] and some states even offer some form of personal tax

74. AWEA, Wind Power Today, *supra* note 2.

75. AWEA, Wind Power Today, *id.* A common rate for renting wind rights in Texas for example, could be $2500 to 4000 per megawatt (per turbine per year), or royalties on production of up to 8%. The contracts are typically for a period of 20-30 year with an extension option. *See Land Owner Information: Land Owner Presentation*, ALTERNATIVE ENERGY INST., http:/;www.windenergy.org/landown er/ (last visited Apr. 12, 2009). *See also* Dietz, *supra* note 73, at 1135; *Land Owner Cost Guide*, ALTERNATIVE ENERGY INST., http://www.windenergy.org/landowner/cost guide.html (last visited Apr. 12, 2009).

76. Dietz, *supra* note 73, at 1135.

77. 16 U.S.C. §§ 2601-2603 (2000).

78. Wilson, *supra* note 16, at 1778-1779 (citing MARTIN J. PASQUALETTI ET AL., WIND POWER IN VIEW: ENERGY LANDSCAPES IN A CROWDED WORLD 160 (2002)).

79. 26 U.S.C. § 45(a) (2000).

80. Ronald H. Rosenberg, *Diversifying America's Energy Future: The Future of Renewable Wind Power*, 26 VA. ENVTL. L.J. 505, 532 (2008) (noting that the true initiative in this respect exists at the state level rather than the federal legislation); Corey Stephen Shoock, Note, *Blowing in the Wind: How a Two-Tiered National Renewable Portfolio Standard, a System Benefits Fund, and Other Programs Will Reshape American Energy Investment and Reduce Fossil Fuel Externalities*, 12 FORDHAM J. CORP. & FIN. L. 1011, 1047 (2007). *See also* 16 U.S.C. § 3832(a)(7)(B) (2000) (encouraging installation of wind turbines under the Erodible Land and Wetland Conservation and Reserve Program); 26 U.S.C. § 45 (2000) (providing tax credits for infrastructure associated with alternative sources of electricity production).

81. Rosenberg, *supra* note 80, at 540. For a full review of these incentives, see *Property Tax Incentives*, DATABASE OF STATE INCENTIVES FOR RENEWABLE ENERGY, http://www.dsireusa.org/library/includes/type.cfm?EE=1&RE=1 (last visited Apr. 26, 2009); *Incentives for Wind*, DATABASE OF STATE INCENTIVES FOR RENEWABLE ENERGY, http://www.dsireusa.org/library/includes/techno.cfm?EE=1&RE=1 (last visited Apr. 12, 2009).

deduction for renewable energy use.[82] Many states have also adopted energy source disclosure regulations[83] and Renewable Portfolio Standards (RPS).[84] The RPSs require that utilities purchase a given percentage of their electricity from alternative sources, thus increasing the use of renewable energies, such as wind.[85] Similar support programs have also been adopted in the EU and some of Asian nations.[86] In addition to providing conditions ripe for the growth of privately owned wind production installations,[87] these multiple legislative support programs aimed at the private sector show that wind rights are regarded, at least to some degree, as a private interest.

The combination of the common law doctrinal reasoning, the *de facto* practice of the landowners and the legislative incentives all suggest that the wind is considered landowners' property, a *private* property interest.

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82. Shoock, *supra* note 80, at 1047 ("By building supply from the ground up, the end-use consumers are not only educated about the science and benefits of renewable energy in general, they become active participants with a commercial stake in renewable energy policy.").

83. Fry, *supra* note 13, at 452.

84. *Policy, Transmission & Regulation: Renewable Electricity Standard*, AM. WIND ENERGY ASS'N, http://www.awea.org/policy/renewables_portfolio_standard.html (last visited Apr. 12, 2009) (noting that RES policies currently exist in twenty-eight U.S. states, but not at the national level). *See also* Wilson, *supra* note 16, at 1780. Wilson notes that in addition to RES programs, concessions have been made by traditional energy producers in exchange for relaxation of environmental regulations. This process, taking place mainly in the Great Plains and particularly in Minnesota, has also contributed to the growth of wind energy. *Id.*

85. On the other hand, it is interesting to note the Clean Air Act, which is an environmental oriented act, includes provisions regarding that chemical contents of the air, prevention, control, emission standards and so forth, but is not specifically concerned with the *movement* of the air. 42 U.S.C. §§ 7401-7515 (1990).

86. In Europe a binding target of 20% renewable energy has been set for the EU to achieve by 2020. *See Wind Energy Statistics*, THE EUROPEAN WIND ENERGY ASS'N, http://www.ewea.org/fileadmin/ewea_documents/documents/publications/factsheets/EWEA_FS_Statistics_FINAL_lr.pdf (last visited Apr. 13, 2009). One of the legal frameworks meant to ensure this goal is the Renewable Energy Directive. *See* ENVTL. AND ENERGY STUDY INST., *supra* note 25 & accompanying text. In addition to the European nations, South Asian and Asian countries have demonstrated support for the development of wind energy. See Fry, *supra* note 13, at 445.

87. Wilson, *supra* note 16, at 1779. In addition to the direct financial incentives, these support programs could also contribute to the expanding of wind energy production by creating social norms, which effectively influence the private sector. *See* Victor B. Flatt, *Act Locally, Affect Globally: How Changing Social Norms to Influence the Private Sector Shows a Path to Using Local Government to Control Environmental Harms*, 35 B.C. ENVTL. AFF. L. REV. 455, 457 (2008).

B. *Wind as a Common Property Interest*

There are strong indications that the wind solely belongs to the land-owners. However, taking a closer look could reveal a more complex picture. When wind farms are built on public lands, it is clear that the public has a direct property interest in the wind howling across those lands, just like the farmer has an interest in the winds blowing across her farm lands. Yet in addition to the direct interest, there is possibly a combination of public interests within each individual's private interest.

Arguably, wind is essentially *somewhat* public, even when howling across privately owned lands, since it is created by public elements. As mentioned, wind is created by the variations in air temperature caused by differential heating by the sun.[88] Wind then changes its velocity, turbulence and distance according to the landscape it encounters along the way.[89] Since the sun is not privately owned, and neither are most of the valleys, plains and oceans, no private entity can claim ownership over the wind they help produce. The wind blowing over the farmer's land is *not* exactly like her crops. The grown crops are a result of her planting, watering and tender care. The wind on the other hand was not produced by the farmer, it only happens to blow across her land. The wind was produced by public elements, and therefore is inevitably public, at least to a certain degree.

Alternatively, this matter could be viewed as a semicommons regime. Henry Smith has pointed out that a semicommons regime exists "where private and common property overlap and potentially interact," and is particularly likely to occur in assets where basic exclusion is difficult.[90] Giving the example of water, Smith explains that because water is a fugitive asset, it is generally recognized that exclusion in the sense of land or personal belongings is somehow difficult. The fugitive nature of the resource causes the price of exclusion to escalate quite rapidly. Since water is measured according to attributes that are difficult to assess, such as the speed and strength of the flow, evaluating the property and preventing others from using it becomes tricky.

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88. See *supra* Part II.B.2 (explaining why wind is a renewable source of energy).

89. See *infra* Part IV.A.2 (discussing the effect of friction on the course of the wind).

90. Henry E. Smith, *Governing Water: The Semicommons of Fluid Property Rights*, 50 ARIZ. L. REV. 445, 449 (2008). Exclusion in this respect is the possibility to prevent one from using the asset. For an additional analysis of excludability, see ROBERT COOTER & THOMAS ULEN, LAW & ECONOMICS 42-43 (3d ed. 2000).

None of the conventional land-based fencing strategies are helpful in the case of liquid assets.[91] Thus, since the asset at hand is not suited for pure private holding in the sense of exclusion, a more complex property regime is necessary: a regime that combines private and public holdings.[92] Similarly, it takes more than a simple fence to exclude one from enjoying wind, and the properties of the wind currents such as speed, distance, and turbulence are not suited for a fencing regime. Therefore perhaps the best way to view the wind property is through a mixture of private and public holdings.

As we have seen, there is a strong leaning towards private holding of wind rights, reflected in both government incentives and the *de facto* actions of the landowners and energy developers. Yet there is also a public aspect to the wind. This combination of holdings could cause some difficulties, as described in the next Part.

IV.
THE POTENTIAL TRAGEDY OF THE COMMONS

Environmental assets are largely affected by the property rights governing them. Property rights play a huge role in shaping the qualities of the environmental assets, as well as determining their use,[93] and many environmental problems typically originate from an imperfect alignment between resource ownership and resource use or benefit. One well-known example of this is the problem of the open-access assets, otherwise known as the Tragedy of the Commons. Some have claimed that inevitably

91. Smith, *supra* note 90, at 448. *See also* Dean Lueck, *The Rule of First Possession and the Design of the Law*, 38 J.L. & ECON. 393, 425 (1995) (analyzing the difficulties in gaining full ownership over fugitive resources such as wildlife, oil, and gas, and the analogous legal treatment they receive); Lior Jacob Strahilevitz, *Information Asymmetries and the Rights to Exclude*, 104 MICH. L. REV. 1835, 1843 (2006) ("[C]ertain fugitive resources, such as air. . : do not lend themselves to exclusion-oriented strategies"); Carol Rose, *The Comedy of the Commons: Custom, Commerce, and Inherently Public Property*, 53 U. CHI. L. REV. 711, 717-18 (1986) (explaining that resources that are so "unbounded" that the difficulties of privatization outweigh the gains of resources management, are left open to the public).

92. Smith, *supra* note 90, at 448, 459 (explaining that the more intricate regime is necessary because the exclusion regime in itself cannot deal with use-conflicts caused by multiple users of the same asset, therefore governance rules are required. Governance rules can be supplied by contract, common law, statute, regulation or social norms).

93. Kirsten Engel & Dean Lueck, *Symposium Introduction: Property Rights and the Environment*, 50 ARIZ. L. REV. 373, 373 (2008).

all environmental assets suffer from overuse.[94] But do wind farms also pose a Tragedy of the Commons risk? Is there a danger that all the wind will be extracted? The following discussion will attempt to answer these questions.

Garrett Hardin argued in his famous essay, *The Tragedy of the Commons*, that a resource open to all comers would be depleted and left to ruin.[95] He used the example of herders using a common meadow to demonstrate this, claiming that the addition of too many cattle to a grazing field eventually exhausts the total amount of grass available for the entire group of cattle. This occurs because each animal added to the grazing plain benefits only its specific owner, while each owner bears only a fraction of the cost the animal inflicts on the common pasture. The herders are therefore naturally inclined to add too many cattle,[96] and eventually the resource will be destroyed.[97] This process of resource exploitation is known as the Tragedy of the Commons.[98]

Looking at the example of the common meadow, we may see that the tragedy of the commons is typically characterized by overuse – the tendency to add too many cattle to a grazing field.[99] Similarly, the problem of overuse could occur with regards to capturing wildlife in a common forest or extracting oil

94. Carol Rose, *Rethinking Environmental Controls: Management Strategies for Common Resources*,1991 DUKE L.J. 1, 3 (1991) [hereinafter *Environmental Controls*].

95. Garrett Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968).

96. Lee Anne Fennell, *Common Interest Tragedies*, 98 NW. U.L. REV. 907, 914 (2004).

97. DAVID BOLLIER, SILENT THEFT: THE PRIVATE PLUNDER OF OUR COMMON WEALTH 19-20 (2003).

98. A rich body of literature has evolved on the subject of the tragedy of the commons. The first analysis of common ownership could actually be found over a decade before Hardin's monumental essay. *See* H. Scott Gordon, *The Economic Theory of a Common-property Resource: The Fishery*, 62 J. POL. ECON. 124, 124 (1954). Following Hardin's classic work, multiple works analyzing this problem have been published. *See, e.g.*, THE COMMONS IN THE NEW MILLENNIUM: CHALLENGES AND ADAPTATIONS (Nives Dolak & Elinor Ostrom eds., 2003); MANAGING THE COMMONS (John A. Baden & Douglas S. Noonan eds., 2d ed. 1998). Some related works analyze the problems of commons inter alia from the game theory perspective. *See* RICHARD CORNES & TODD SANDLER, THE THEORY OF EXTERNALITIES, PUBLIC GOODS, AND CLUB GOODS (1986); COOTER & ULEN, *supra* note 90, at 161-62.

99. Fennell, *supra* note 96, at 914. The tragedy of the commons could also consist of the tendency to "underinvest," caused when the person making the investment does not enjoy the full extent of her effort. For example, a farmer cultivating a farm where the produce is open to the group as a whole will invest too little time and effort, because she will not receive the full benefits of her work. Underinvestment can thus lead to underuse of the resource in question, rather than overuse. *See* Gary

from the ground.[100] In all these cases, each individual benefits entirely from the use, but shoulders only a very small portion of the burden she poses on the system. This is true whether we are considering removing part of the common goods (such as wildlife animals, oil or water), or adding another harmful unit to the system (for instance cattle, litter or pollution).[101] In other words, these are situations where resource use involves negative and costly externalities, resulting in parties inflicting harm on one another.[102] The tragedy could also be described through the prisoner's dilemma: a greater long-term benefit can be achieved if each prisoner cooperates with the other, but each prisoner has powerful incentives to cheat.[103]

A. *When is the Tragedy of the Commons Likely to Occur?*

In order to determine whether the tragedy of the commons may be applicable to wind, let us look at the characteristics and conditions necessary for the tragedy to take place.

1. Property Allocation

The first aspect to consider is the property allocation of the resource at hand, since the tendency to overuse depends on the existence of private property rights in the resource that one harvests from. The overgrazing example only works if the rancher owns the meat that results from grazing cattle on the common land. In other words, even though the resource system in question is under common ownership, individuals have a right to capture and own specific resource units. Thus, the tragedy will typically occur when the allocation of property rights contains a mixture of private and commons interests.[104] As we have seen in the previous Part, wind is a resource that combines both private and public property interests. The landowner owns the wind she extracts, and may internalize the profits from the capture. Yet at the same time, the wind also has a public element due to its crea-

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D. Libecap, *Open-Access Losses and Delay in the Assignment of Property Rights*, 50 ARIZ. L. REV. 379, 382 (2008).

100. Fennell, *supra* note 96, at 914; Engel & Lueck, *supra* note 93, at 373.

101. Fennell, *supra* note 96, at 914-15; Bollier, supra note 97, at 19-20.

102. Fennell, *supra* note 96, at 915; Libecap, *supra* note 99, at 382. As Fennell notes, this situation could also be understood as a pricing error. When the user is not required to bear the "price" inflicted on the commons, seizing common goods becomes too "cheap." Fennell, *supra* note 96, at 916-17.

103. Bollier, *supra* note 97, at 19.

104. Fennell, *supra* note 96, at 916-17.

tion process and the inability to effectively exclude it from others. Because of the combined property interests in wind, we are faced with a situation where individuals are permitted to capture and own some of the resource which is otherwise subject to an open-access regime, and accordingly we are faced with the potentially tragic tendency to overuse the resource.

Even if the proposed notion of combined property interests is not accepted, competitive inefficient withdrawal of the asset - in our case the wind - can still exist. This is due to the method of property allocation, in which some resources are not assigned directly to the surface landowners. For example, as opposed to fixed subterranean resources such as minerals, due to the fugitive qualities of assets such as oil or gas, *in situ* property rights are not necessarily assigned to the owner of the surface area. Instead, the rights in these assets are awarded according to extraction or capture, like with wild animals.[105] Similarly, wind could be considered an elusive asset that is assigned to one upon capture. A regime that grants ownership upon capture sets the ground for competitive withdrawal.[106] With oil for example, it has been argued that commercial firms seeking to increase their revenue have strong incentives to over-explore and extort the ground, even though their actions could result in overall losses to the public goods.[107] Just as the oil could be over-extracted, wind energy producers lease the easement to capture the wind and transform it into useful energy. This could provide landowners and developers with incentives to exploit the wind more than necessary or efficiently, thus creating collective losses.

2. Rivalry in Consumption – The Question of Subtractability

In addition to the conditional property allocation, the tragedy of the commons only occurs when the common good is sub-

105. Libecap, *supra* note 99, at 392. This notion is demonstrated in the famous case of Pierson v. Post, 3 Cai. R. 175 (N.Y. Sup. Ct. 1805) (Presenting a dispute between fox hunters over a possession of a fox in the wild. The court held that possession of the fox is gained only upon capture. *Id.* at 178).

106. Libecap, *supra* note 99 at 392, 382. If we return to the example of the prisoner's dilemma, we could see that in anticipation of the other player "cheating," there can be a competitive rush to exploit the resource.

107. *Id.* at 392-93 (presenting the example of oil extraction to illustrate this notion and demonstrating how excessive drilling can impose unnecessary costs on all parties involved).

tractible,[108] meaning the use of one will lessen the possible use of another.[109] Put differently, an implicit condition of the grazing problem is that the resource at hand can in fact be depleted. This is naturally understood when discussing grazing fields or woodlands, but can the wind "run out"? At first glance, one may argue that since the wind is regenerated by the sun[110] it is endless and will never be worn out. However, taking a closer look at the behavior of wind may show that wind can in fact be exhausted, or at least be dramatically distorted.

a. Wind is not Endless – The Shadow Effect

Although this may seem at first counterintuitive, wind is not endless. The course and speed of the wind can be changed due to various factors. Wind, like other forces in nature, is affected by friction. We are all familiar with the force of friction – it is the force that causes our car to stop before a stop-light or the ball rolling on the grass to eventually stop. Similarly, friction occurs in moving fluids, as well as wind.[111] The frictional drag of obstacles on the ground slows the wind down,[112] so that the wind is decelerated considerably as it brushes the ground and vegetation.[113] The course, pace and force of the wind are all shaped by the landscape it meets on the way, such as hills, mountains, val-

108. Fennell, *supra* note 96, at 919; Bollier, *supra* note 97, at 37.

109. This is contrary to a public good, which is typically *not* subtractable and features *nonrivalry* in consumption. A song, for example, can be enjoyed by multiple users simultaneously, while an apple can only be enjoyed by limited users at once. In the case of the public good, since excludability is difficult, the problem of underinvestment can still arise. Yet in the case of public goods the problem of over-extraction will not occur since the source in question does not permit subtractability. *See* Cooter & Ulen, *supra* note 90, at 42-43, 103; Harold Demsetz, *The Private Production of Public Goods*, 13 J.L. & ECON. 293, 295 (1970); Cornes & Sandler, *supra* note 98, 10-13.

110. *See supra* Part II.B.2 (discussing the properties of wind as a source of renewable energy).

111. AHRENS, *supra* note 1, at 223. For a comprehensive review of the properties of the wind and the forces affecting it, see *id.* at 203-19.

112. *Id.* at 212-13. In addition to the friction caused when brushed against solid objects, such as trees or buildings, friction could occur from the moving fluidic forces as well. Consider, for example, a steady flow of water in a stream. When a paddle is placed in the stream, turbulent whirls form behind it. These whirls create fluid friction by draining energy from the main stream flow, slowing it down. Similarly, as wind blows over a landscape dotted with trees and buildings, it breaks into a series of irregular, twisting whirls (called "eddies") that can influence the air flow for hundreds of meters above the surface. Within each eddy, the wind speed and direction fluctuate rapidly, producing irregular air motions known as wind gusts. *Id.* at 223.

113. AWEA, Wind Power Today, *supra* note 2.

leys, and oceans.[114] Thus, each environment has a unique landscape that creates or modifies the wind.[115] For example, wind is consistently stronger at higher altitudes and in areas with few physical obstructions, such as the Great Plains and the West Coast.[116] Just as the course of the wind can be changed due to natural obstacles such as mountains and valleys, wind can likewise be altered due to man-made barriers, such as buildings, bridges and wind turbines. However, unlike buildings, wind turbines not only redirect and decelerate the wind, they harvest it. Harvesting the wind on one end inevitably means that there is less wind on the other end.

Sailors have recognized this principle for centuries, and have directed their ships through the seas attempting to beat each other to a particularly desirable current, or at least avoid the drag of another ship's wind.[117] This principle is also known to engineers today: when planning a wind farm, they take into account what is known as the Shadow Effect.[118] The weakening of the wind strength and speed after it hits the turbine. Since a wind turbine generates electricity from the energy in the wind, the wind leaving the turbine naturally has lower energy content than the wind arriving in front of the turbine.[119] This follows directly from the fact that energy can neither be created nor consumed.[120] Therefore, a wind turbine will always cast a wind

114. Wilson, *supra* note 16.

115. Stull, *supra* note 2, at 205.

116. This is because in addition to having less causes of friction at higher attitudes that slow the air-movement. Borowitz, *supra* note 2, at 145. The effect of the friction decreases as we move away from the earth's surface, wind speeds tend to increase with height above the ground. AHRENS, *supra* note 1, at 212-13.

117. Duff, *supra* note 62, at 400.

118. For example, see STEN FRANDSEN ET AL., SUMMARY REPORT: THE SHADOW EFFECT OF LARGE WIND FARMS: MEASUREMENTS, DATA ANALYSIS AND MODELING (2007), *available at* http://www.risoe.dtu.dk/rispubl/reports/ris-r-1615.pdf. *See also* Tadashi Naitoh et al., *Criterion of Wind Turbine Generator Operation Using Tower Shadow Effect*, 162 ELECTRICAL ENGINEERING IN JAPAN 25 (2008), *available at* http://www3.interscience.wiley.com/cgi-bin/fulltext/116324674/PDFSTART.

119. This is also sometimes known as the Wake Effect, named after the wake caused at the back of the ship. *See Wake Effect*, DANISH WIND INDUSTRY ASS'N, http://www.windpower.org/en/tour/wres/wake.htm (last visited Apr. 14, 2009) [hereinafter DWIA, Wake Effect]. For a technical discussion of wind turbine wake effects, see Angel Jimenez et al., *Large-Eddy Simulation of Spectral Coherence in a Wind Turbine Wake*, ENVTL. RES. LETTERS 1-3 (2008), *available at* http://www.iop.org/EJ/abstract/1748-9326/3/1/015004.

120. PETER WILLIAM ATKINS & JULIO DE PAULA, PHYSICAL CHEMISTRY 28-56 (2006) (reviewing the first law of thermodynamics and how it governs the transformation of various forms of energy within a bio-system). This phenomena is also represented in the Bernoulli's Equation: along any one streamline (such as a flowing

shade in the downwind direction, causing a long trail of wind behind the turbine that is quite turbulent and slow when compared to the wind arriving in front of the turbine.[121] To avoid the Shadow Effect and gain maximum electrical capacity from each turbine, the turbines must be installed at a certain minimal distance apart.[122]

Once the shadow effect is recognized, it may be argued that just like turbines can shadow each other, they can shadow neighboring farms, or even countries. One research study showed that the average recovery distance downwind of a turbine, is between 30 and 60 km.[123] Put differently, the wind within up to 60 km after it "hits" the wind turbine is altered, slowed. To demonstrate, 60 km is almost three times the length of the island of Manhattan or about one and a half times the distance of a marathon. This could easily affect neighboring homes, towns or states. For a neighboring wind farm, the weakening wind flow due to the shadow effect is very real and can easily be translated into a tangible financial interest.[124] Consider, for example, the

river, or a breeze), energy can be converted from one form to another, and the sum of changes of all the terms must equal zero. Stull, supra note 2, at 212. *See also Wind Turbines Deflect the Wind*, DANISH WIND INDUSTRY ASS'N, http://www.windpower.org/en/tour/wres/tube.htm (last visited Apr. 14, 2009) [hereinafter DWIA, Turbines Deflect the Wind].

121. DWIA, Wake Effect, *supra* note 116. It is important to highlight that wind varies in speed, direction, gustiness and other parameters. Changes due to friction or energy extraction could alter anyone of these parameters. For example, Ahrens points out that in addition to changing the wind's speed, friction could cause changes in the direction and turbulence, since when the wind encounters a solid object, a whirl of air – an eddy – forms on the object's leeward side. AHRENS, *supra* note 1, at 225. But whether the change occurring in the wind is directional, turbulent or velocity related – it is clear that one way or another the friction and subtraction along the way will change the course of the wind.

122. AWEA, Wind Power Today, *supra* note 2. In large wind-farms, turbines are usually spaced at least three rotor diameters from one another in order to avoid too much turbulence around the turbines downstream. In the prevailing wind direction turbines are usually spaced even farther apart. *See* DWIA, Wake Effect, *supra* note 116.

123. Frandsen et al., *supra* note 118. Note that this is true for a single turbine. The impact of several turbines combined could be even greater. Yet no current data was found on the distance of the cumulative shadow effect of several turbines together.

124. Consider for example the loss of potential wind rights lease, amounting to thousands of dollars per year. *See* Dietz, *supra* note 73, at 1135 (discussing the potential income for landowners from wind-rights lease). In addition, there could be various side-effects caused by the lack of wind such as rising temperatures. This could cause the landowner excessive use of air-conditioning to compensate for the rising temperatures, an expense that could easily be viewed as a financial loss. There could also be a more direct effects on the pricing of the property- any realtor will

potential loss of profit the neighbor suffers if she cannot harvest the wind blowing across her property due to the alteration it had endured up-wind.

One may still argue that since the wind is regenerated by the sun, even though some of the energy locked in the wind is lost to electricity production, over distance and time this energy will be recreated. Looking at technical terms only, this argument is indeed true, and the wind shade behind the rotor will gradually diminish as we move away from the turbine.[125] Yet the question should be *how long* must we wait and *how far* must we travel to allow the wind to recover. The recovery period should be reasonably proportional to the value that is gained. To illustrate this, consider the following example: let us assume that a river flows through multiple properties. Assume that the landowner at the river spring wishes to build a dam on the river to irrigate her crops. Should we allow her to build the dam, knowing that the water-flow downstream will inevitably be affected? And how many dams should we allow to be built along the river so that the farmer living downstream can still enjoy a decent flow and the fish downstream can still exist? These questions are readily understood when flocks, grazing areas and woodlands are concerned. Yet what is the price in distance and time we are willing to pay for the diversion of wind? True, it may be difficult to see today how this is possible. But just as we now realize that too many dams will ruin a river,[126] we could possibly come to a stage where too many turbines will ruin the wind flow.

Perhaps a more subtle argument is in place: even if the wind will not entirely run out, over time overusing it as a resource could change its course so dramatically that the recovery time or the recovery distance will be too high.[127] As Fennell has pointed out, even this more subtle problem of overuse can also create a

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agree that otherwise similar properties could vary significantly in price only because they have or lack a breeze. A similar analysis could also apply for a building shadowing the wind of another building in an urban surrounding.

125. DWIA, Turbines Deflect the Wind, *supra* note 120.

126. Consider also the example of radio waves: at one point radio frequencies were plentiful, and were thought to be a completely endless resource. Yet as the use of the resource gradually increased, we have come to realized that even wave lengths in the air are not an infinite resource. *See* Bollier, *supra* note 97, at 148-149.

127. Perhaps the best way to describe "subtractability" is not as a zero-one problem, but as a range or a scale. In this case, it is fair to say the wind is not as subtractable as an apple, but not as non-rivalrous as a song.

tragic effect when combined with underinvestment.[128] With regards to wind, it may be argued that even if the tragedy on the larger scale does not occur, there could be underinvestment in wind on the local scale, for example in urban planning. To illustrate this, consider the recent expansion of small wind projects.

b. Small Wind Projects- The Growing Influence of the Shadow Effect

Small wind typically refers to an individual windmill, which generates no more than 100 KW.[129] Small wind projects hold many advantages both to the community and to private home owners. In the long term, communities could benefit from small wind schemes. Wind farm projects create new local jobs; encourage local sales; increase property tax revenues from wind farm profits and decrease the cost of electricity that will be produced locally instead of purchasing from costly state-wide utilities.[130] Home owners are encouraged to engage in small wind programs by multiple support programs that exist today.[131] With these programs the system costs are low enough to return the initial capital investment within ten years, providing economic incentives to take on such projects.[132] Combing these factors, one may claim that an increase in small wind installations is almost inevitable.[133]

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128. Fennell demonstrates this by giving the example of a shopping area: Every member of the community enjoys strolling through boutique, locally-owned unique shops, but prefers shopping at suburban supercenters. This could be understood as a problem of underinvestment in the ambience produced by the local businesses. Each member of the community who pays a higher price at the local stores bears the full financial burden of doing so, but enjoys only a share of the ambient benefits. Because everyone is better off letting someone else pay the higher prices, nobody shops in the small shops, and result is an overall loss. See Fennell, *supra* note 97, at 924.

129. Fry, *supra* note 13, at 436; *SWIIS Project Description*, SMALL WIND INDUSTRY, http://www.smallwindindustry.org/index.php?id=112 (last visited Apr. 11, 2009). *See also supra* notes 56-58 & accompanying text.

130. Fry, *supra* note 13, at 450.

131. *Id.* at 449.

132. *See e.g.,* Dietz, *supra* note 57.

133. In addition to private small wind, there is also Community Wind, which occupies the space between large-scale utility wind farm models and individual small wind. Federal tax incentives do not apply to these projects; however several states have adopted tax regimes that encourage cooperative wind production as well. Combining this factor with the multiple financial and environmental advantages projects as such could hold for the community, it is likely that we will witness an increase in community wind projects as well. *See* Fry, *supra* note 13, at 452; *What is Community Wind?*, WINDUSTRY, http://www.windustry.org/what-is-community-wind (last visited Apr. 14, 2009); Paul Gipe, *Community Wind: The Third Way*, WIND-

The growing development of small wind is no doubt welcome progress as far as reducing emissions and reducing costs in the long run are concerned.[134] Yet this may also increase the potential problem of overuse. It might be hard to imagine this today, but consider what would happen to the wind flow if there was a turbine on each rooftop? Would there be any wind left for the family living on the down-wind side of the neighborhood or the city? Will there be enough wind left for one state if the up-wind state installs too many turbines? How will the lack of breeze in certain areas affect the wildlife in the region? These questions must be taken into account when planning wind energy installations, whether in an urban environment or in the wild. This is not to say that wind energy is not a clean and welcome energy production method. Still, we must realize that wind is not an entirely endless asset and use it wisely.

This also brings us back to the question of ownership of the wind – who has a right to gain from the wind blowing through the up-wind neighborhood or the up-wind state? If the wind is created over time and distance, perhaps the wind should be the property of all the areas that took part in creating the energy locked in the wind and not just the end users. Who will ensure that we do not come to the point of overuse? The next Part explores this thought, and suggests the public trust doctrine as one possible solution for this dilemma.

V.
PROTECTING THE PROPERTY INTERESTS IN WIND

A. *The Shadow Effect on Neighboring Properties*

As discussed in the previous Part, for a landowner neighboring a wind farm the weakening wind current could have a substantial influence on her financial interests[135] and general well-being.[136] This demonstrates that changing the course of the wind can negatively affect the residents of the nearby properties. This problem is not exclusive to rural areas and farm owners, since with the

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WORKS.ORG, http://www.wind-works.org/articles/community windthethirdway.html (last visited Apr. 14, 2009).

134. See advantages of wind energy discussion *supra* Part II.B.2.

135. *See supra* note 57 (reviewing typical income from wind rights lease).

136. *See, e.g., infra* Part V.A. (discussing noise, flicker effect and property pricing).

growing popularity of small wind projects,[137] the problem of shadow effects could soon affect urban settings as well.

The introduction of a wind farm presents a number of potential conflicts with neighboring residents and land uses. A wind generation project could potentially interfere with a number of different interests,[138] ranging from the significant aesthetic impact[139] and changing of the landscape,[140]interference with communications, shadow flicker,[141] noise produced by rotating blades,[142] impact on aircraft communications and navigation sys-

137. *See supra* Part IV.2.b (discussing the growing popularity of small wind projects).

138. Rosenberg, *supra* note 80, at 530; Sutton & Tomich, *supra* note 44, at 93 ("Because of the misconception that renewable energy sources do not cause any environmental damage, the regulatory development in renewable energy has been economically driven, and lacks requirements to avoid negative environmental impacts.").

139. Dietz, *supra* note 73, at 1135 (noting that the perceived aesthetic impact wind turbines have on the rural vista is the most frequently mentioned objection to the use of wind energy across the world); Firestone et al., *supra* note 23, at 76; COMMITTEE ON ENVTL. IMPACTS OF WIND ENERGY PROJECTS, NAT'L RESEARCH COUNCIL, ENVIRONMENTAL IMPACTS OF WIND-ENERGY PROJECTS 141-142 (2007) [Hereinafter: Nat'l Research Council]; Avi Brisman, *The Aesthetics of Wind Energy Systems*, 13 N.Y.U. ENVTL. L.J. 1 (2005).

140. For an example of such a dispute over changing the landscape as a result of wind farm installation, see Dietz, *supra* note 73 (reviewing the case the Flint Hills project in Kansas and the conflict it caused); Citing the potential impacts on the ecology and "viewshed" of the Kansas Flint Hills, groups such as Protect the Flint Hills and the Flint Hills Tallgrass Prairie Heritage Foundation have formed to oppose large-scale wind farm development in Kansas. *See The Issues*, PROTECT THE FLINT HILLS, http://www.protecttheflinthills.org/issues.htm (last visited Apr. 15, 2009) ("While we are in favor of renewable alternative energy, we strongly oppose placing industrial wind energy complexes in the Flint Hill . . . . The Flint Hills are not a renewable resource. It's a one-of-a-kind landscape. As an alternative, we support siting wind turbines on land that has already been fragmented by farming or other development.").

141. The "flicker" effect is not to be confused with the shadow effect. The flicker effect is created by the turbine blades creating a shifting *sunlight*-shadow (as opposed to the shadow effect discussed above which refers to wind shadow), resulting in a feeling similar to turning the lights on, off and back on again. *See Shadow Casting from Wind Turbines*, DANISH WIND INDUSTRY ASS'N, http://www.windpower.org/en/tour/env/shadow/index.htm (last visited Apr. 15, 2009); For a very vivid demonstration of this effect, see *Slagschaduw? Shadow Effects Wind Turbine*, YOUTUBE.COM, http://www.youtube.com/watch?v=TLFzFtXHWAg&NR=1 (last visited Mar. 20, 2009).

142. Nat'l Research Council, *supra* note 139, at 157 (noting that noise cause by wind turbines can be caused by the mechanical movements of the gearbox and generator, and the aerodynamic noise caused by interaction of the turbine blades with the wind).

tems, ice throws from the blades of turbines, and effects on resident or migrating bird and bat populations.[143]

These problems have also been known to have a negative effect on pricing of properties adjacent to wind farms,[144] and have occasionally been brought before the court. They mostly fit within the common law doctrine of nuisance and can be tried on that base.[145] For instance, New Jersey citizens sought to enjoin the operation of a single, private windmill placed in a single-family residential area as a private nuisance. The citizens were concerned that the windmill created offensive noise levels that interfered with the quiet enjoyment of their properties. The court found that the impact from this single windmill did in fact represent an actionable nuisance.[146] In Maryland, a number of private residents brought a declaratory judgment action against the Maryland Public Utility Commission regarding an order authorizing the construction of wind turbines, arguing that farm

143. *Id.* at 111 (noting that the cumulative effects of wind-energy development could result in negative impacts on bird populations); Guzek, *supra* note 36, at 125 ("The Shaffer Mountain project, for instance, is proposed to be built within the migratory fly zone of several types of raptors including hawks, falcons, and Eastern Golden Eagles); Rosenberg, *supra* note 80, at 530-31; Ronald H. Rosenberg, *Making Renewable Energy a Reality–Finding Ways to Site Wind Power Facilities*, 32 WM. & MARY ENVTL. L. & POL'Y REV. 635, 640 (2008); Firestone et al., *supra* note 23, at 76. However, some argue that although birds do collide with wind turbines at some sites, modern wind power plants are collectively far less harmful to birds than are radio towers, tall buildings, airplanes, vehicles and numerous other manmade objects. *See Wind Energy and Wildlife: Frequently Asked Questions*, AM. WIND ENERGY ASS'N, http://www.awea.org/pubs/factsheets/Wildlife_FAQ.pdf (last visited Apr. 15, 2009); Fry, *supra* note 13, at 451 (arguing on the other hand that this problem will have less of an impact in the future due to technological improvements in auditory technology that promise to divert birds away from wind turbines).

144. *See, e.g., Impact of Wind Farms of the Value of Residential Property and Agricultural Land*, THE ROYAL INST. OF CHARTERED SURVEYORS, http://www.stop-wadlow-wind-farm.org.uk/resources/RICSSurvey-WindFarmEffects.pdf (last visited May 2, 2009); Nigel Bunyan & Martin Beckford, *Homeowners Living Near Windfarms See Property Values Plummet*, TELEGRAPH, July 26, 2008, www.telegraph.co.uk/earth/earthnews/3348084/Homeowners-living-near-windfarms-see-property-values-plummet.html. On the other hand, some research has shown that property values are not necessarily negatively affected. *See Does a Small Wind Turbine Installation Diminish Property Values?*, AM. WIND ENERGY ASS'N, http://www.awea.org/faq/propvalue.html (last visited Apr. 15, 2009); Rosenberg, *supra* note 80, at 531.

145. For an analysis of such nuisance claims through Calabrasi and Melamed's "Cathedral Model," see Troy Rule, *A Downwind View of the Cathedral: Using Rule Four to Allocate Wind Rights*, 46 SAN DIEGO L. REV. 207 (2009).

146. Rose v. Chaikin, 453 A.2d 1378, 1382 (N.J. Super. Ct. Ch. Div. 1982); *see also* Guzek, *supra* note 36, at 131, and Dietz, *supra* note 73, at 1159 (both reviewing this case).

and residential properties would be negatively affected by the visual and noise impacts of the proposed wind turbine project, but the case was dismissed on procedural grounds.[147] A proposed large wind turbine project in West Virginia led to a citizen nuisance suit by local residents who sought injunctive relief from the installation of up to 200 nearly 450-foot tall windmill towers spanning an area 14 miles long.[148]

In some cases, legislation has been brought forth to protect these interests. For example, in New York State, the Town Board of Italy enacted a moratorium prohibiting "the construction or erection of wind turbine towers, relay stations, and/or other support facilities in the Town of Italy."[149] The Town Board stated that they enacted the moratorium, *inter alia*, to protect "the value, use and enjoyment of property in the town" by its citizens and also the "scenic and aesthetic attributes" of the town.[150] Some have even called upon Congress to establish a clear position on the common complaints that accompany wind farms.[151]

This group of cases illustrates a general concern among affected citizens regarding proposed wind turbine projects and their willingness to mount legal challenges to these projects.[152] Yet these cases do not refer to the damage caused by the exhaustion of wind over distance and time. The plaintiffs in those cases were concerned about the noise, light or view – but not about the changing winds. However, with the recent growth in demand for wind energy, the development of wind energy projects within some geographical areas is becoming increasingly competitive. In this competitive environment, the rise of wind-shadow conflicts is inevitable.[153] Therefore, in light of the fact that wind energy production does in fact lessen the readily available energy for neighboring properties, perhaps we may consider recognizing

147. Sprengerv. Pub. Serv. Comm'n of Maryland, 926 A.2d 238, 247 (Md. 2007); *see also* Guzek, *supra* note 36, at 131.

148. Burch v. Nedpower Mount Storm, LLC, 647 S.E.2d 879, 885 (W.Va. 2007).

149. Ecogen, LCC v. Town of Italy, 438 F. Supp. 2d 149 (W.D N.Y. 2006).

150. *Id.* at 161; Guzek, *supra* note 36, at 129.

151. Hadam, *supra* note 54, at 134; Hayden, *supra* note 54, at 227 (presenting an interesting factual comparison between wind turbines and cell phone towers).

152. Guzek, *supra* note 36, at 132. *See also* Dinnell & Russ, *supra* note 31, at 548 (explaining that this is an example of NIMBY- those whose property values and aesthetic sightlines may be affected by these projects do not object to wind power altogether, but do not wish to suffer the costs in their backyards).

153. Rule, *supra* note 145, at 214-15.

the loss of wind in itself as harm to one's interests, just like high noise levels or the obstruction of the view.[154]

B. *Sustainability and the Public Trust Doctrine*

Besides the *private* damage caused to down-wind landowners that can no longer enjoy the breeze, some emphasize the loss of *public* goods. Various business interests are gaining ownership and control over dozens of valuable resources that the people collectively own.[155] Arguably, one of these assets is wind. Wind farm developers are buying rights to harvest the winds that are created along the public plains and seashores, harvesting them once they howl over private land. This shifts large sums of money away from the public purse, money that could be used for various social investments.[156] In addition, this also threatens the environment by favoring short-term exploitation over long-term stewardship.[157] One example could be the potential overuse of the wind assets we have today, favoring short term gains over long-term landscape planning.

One possible method of protecting the public interest could be through the Public Trust Doctrine. The benefits and shortcomings of the public trust doctrine have already been examined extensively,[158] and that discussion exceeds the scope of this note. However, it is worthwhile mentioning this doctrine as a possible response to the complex wind property regime.

The Public Trust Doctrine embodies several notions. At heart, it is a rule of property law that assigns the sovereign states with the ownership and holding rights of assets, in trust for the people

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154. As mentioned in Part III.A above, on one occasion the court has in fact recognized the wind as a separate interest, worthy of compensation. *See* Contra Costa, *supra* note 67 & accompanying text. However no other cases have been found to further establish this notion, and the cases dealing directly with wind-turbine nuisances do not recognize the wind as a separate property interest.

155. Bollier, *supra* note 97, at 2.

156. *Id.* at 7 (arguing that the public's assets and revenue streams are privatized, with only fractional benefits accruing to the public in return).

157. *Id.* (noting for example, the fact that leading companies often find it useful to displace the health and safety risks onto the public or shift them to future generations).

158. For further discussion of this matter see Richard J. Lazarus, *Changing Conceptions of Property and Sovereignty in Natural Resources: Questioning the Public Trust Doctrine*, 71 IOWA L. REV. 631 (1986); James L. Huffman, *Avoiding the Takings Clause Through the Myth of the Public Rights: The Public Trust and Reserved Rights Doctrine at Work*, 3 J. LAND USE AND ENVTL. L. 171 (1987); Joseph D. Kearney & Thomas W. Merrill, *The Origins of the American Public Trust Doctrine: What Really Happened in* Illinois Central, 71 U. CHI. L. REV. 799 (2004).

of the state. It reflects a belief that although private ownership of land and resources generally dominates property law, there are some resources that should be protected by the state for the benefit of the public.[159] By doing so, the trust allows public access to vital assets such as water, beaches and fishing, which would otherwise be dominated by private ownership, and thus serves as a possible defense against private taking of the trust assets. In addition, it includes the notion that states should ensure that trust resources are sustainable,[160] and as such, are to be protected and available for the future generations.[161] The beneficiary of the trust is the unorganized public, the ambiguous collective body of the public at large, rather than a governmentally-organized public. The government in this case would only hold the assets entrusted with it for safe keeping, as a legal trustee would.[162]

The basic principles of the public trust date back to Roman law,[163] and were expressed by the U.S. federal court over a hundred years ago.[164] It has received further attention since 1970 following Joseph Sax's famous article *The Public Trust Doctrine in National Resource Law*.[165] Since then, courts have become increasingly aware of environmental issues in implementing and expanding the public trust doctrine, while state legislatures have acted in a similar manner by adopting state environmental protection provisions that often reflect public trust principles.[166]

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159. Alexandra B. Klass, *Modern Public Trust Principles: Recognizing Rights and Integrating Standards*, 82 NOTRE DAME L. REV. 699, 702 (2006). This belief is thought to have originated, inter alia, in the "prescriptive", or "implied dedication" doctrines in the early English and American common law. Rose, *supra* note 91, at 723-26.

160. *See infra* note 179 (discussing the principle of Sustainable Development).

161. Sam Kalen, *The Coastal Zone Management Act of Today: Does Sustainability Have a Chance?*, 15 S.C. ENVTL. L.J. 191, 212-14 (2006).

162. Rose, *supra* note 91, at 721-23.

163. *See* Robin Kundis Craig, *A Comparative Guide to the Eastern Public Trust Doctrines: Classifications of States, Property Rights, and State Summaries*, 16 PENN ST. ENVTL. L. REV. 1, 5-6 (2007). For a further review of the origins of the public trust idea, see Rose, *supra* note 91, at 727-730.

164. Illinois Cent. R.R. Co. v. Illinois, 146 U.S. 387 (1892). For a review of this case, see Klass, *supra* note 159, at 703-707.

165. Joseph L. Sax, *The Public Trust Doctrine in National Resource Law: Effective Judicial Intervention*, 68 MICH. L. REV. 471 (1970).

166. Klass, *supra* note 159, at 706-707. It is interesting to note that the notion of the public trust theory has flourished in these years, although at the same time the classical economy theory–which generally rejects the notion of publically managed property–also enjoyed a growing popularity. Rose, *supra* note 91, at 730.

The doctrine initially applied to navigable and tidal waters, but has since been expanded to include a wide range of environmental assets: in certain states in the U.S., courts have expanded the doctrine to include protecting use, access to, and preservation of all waters usable for recreational purposes,[167] the dry sand area of beaches for public recreation purposes,[168] parklands,[169] wildlife habitat connected to navigable waters,[170] drinking water resources,[171] and inland wetlands.[172] The California Supreme Court in *Marks v. Whitney*[173] recognized that the doctrine has long included the right to "fish, hunt, bathe, swim, to use for boating and general recreation purposes the navigable waters of the state, and to use the bottom of the navigable waters for anchoring, standing, or other purposes."[174] *Marks* is also a significant case because it expanded the public trust doctrine to include ecological concerns.[175] In discussing the inclusion of tidelands in the public trust doctrine the court noted that

> [T]he public uses . . . are sufficiently flexible to encompass changing public needs . . . There is a growing public recognition that one of the most important public uses of the tidelands . . . is the preservation of those lands in their natural state, so that they may serve as ecological units for scientific study, as open space, and as environments which provide food and habitat.[176]

The court in *Marks* thus asserted that the public trust doctrine is sufficiently flexible to encompass important natural resources.[177]

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167. *See* Mont. Coal. for Stream Access v. Curran, 682 P.2d 163, 171 (Mont. 1984) (extending public trust doctrine to all waters capable of recreational use by the public).

168. *See* Matthews v. Bay Head Improvement Ass'n, 471 A.2d 355, 363-66 (N.J. 1984) (stating that the public trust doctrine requires public access to dry sand beaches between high water mark and vegetation line in both public or quasi-public ownership).

169. *See* Paepcke v. Pub. Bldg. Comm'n, 263 N.E.2d 11, 15 (Ill. 1970).

170. *See* Pullen v. Ullmer, 923 P.2d 54, 61 (Alaska 1996) (holding that the doctrine applies to salmon and other fish).

171. Mayor v. Passaic Valley Water Comm'n, 539 A.2d 760, 765 (N.J. Super. Ct. Law Div. 1987).

172. *See* Just v. Marinette County, 201 N.W.2d 761, 769 (Wis. 1972). For a review of some of the judiciary opinions on this matter, see Klass, *supra* note 159, at 707-708.

173. Marks v. Whitney, 491 P.2d 374, 380 (Cal. 1971).

174. *Id.* at 380.

175. For a discussion of the Marks case and its significance, see Erik Swenson, Comment, *Public Trust Doctrine and Groundwater Rights*, 53 U. MIAMI L. REV. 363, 367-368 (1999).

176. Marks, *supra* note 173, at 380.

177. *See also* Swenson, *supra* note 175, at 368.

Given that the doctrine is elastic enough to include various ecological resources, one may wonder - why not also apply the doctrine to wind?

As Joseph Sax noted in his monumental article, the doctrine applies where there is a legal right vested in the public, and the substance of the right is harmonious with environmental concerns.[178] Looking at wind, it is fairly easy to see how these criteria could both be relevant. First, as discussed in Part IIIB above, the public has a property interest in the wind thus allowing it, at least to some degree, to prevent the resource from shifting into private hands. Second, the public holding of the wind complies with the principle of sustainability.[179] The principle of sustainable development requires that we achieve development and protect the environment at the same time, pacing development in a manner that does not jeopardize the ability of future generations to meet their needs. In this case, entrusting the wind with the state could easily be seen as promoting sustainable development, since it could ensure long-term landscape planning rather than short-term exploitation, and furthermore could help tackle the potential problem of overuse.

The Public Trust Doctrine could not only ensure access of the public to the resource, but could also assist with handling the po-

178. Sax, *supra* note 165, at 491-531.

179. The term sustainable development was first formally endorsed by nations of the world in 1992 at the United Nations Conference on Environment and Development ("Earth Summit") in Rio de Janeiro, where the participating nations adopted a set of twenty-seven principles, known as the Rio Declaration, to guide national sustainable development actions. *See* U.N. Conference on Environment and Development, Rio Declaration on Environment and Development, U.N. Doc. A/CONF.151/26, *available at* http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm (last visited May 2, 2009). This plan and these principles were reaffirmed at the World Summit on Sustainable Development ("WSSD") in Johannesburg. *See* generally DIVISION FOR SUSTAINABLE DEV., UNITED NATIONS DEP'T OF ECON. AND SOCIAL AFFAIRS, JOHANNESBURG PLAN OF IMPLEMENTATION OF THE WORLD SUMMIT ON SUSTAINABLE DEVELOPMENT (2005), *available at* http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/WSSD_PlanImpl.pdf. *See also* DIVISION FOR SUSTAINABLE DEVELOPMENT, UNITED NATIONS DEP'T OF ECON. AND SOCIAL AFFAIRS, http://www.un.org/esa/dsd/ (last visited May 2, 2009). For further discussion of the principle of sustainability, see Paul Shrivastava & Stuart Hart, *Creating Sustainable Corporations*, 4 BUS. STRATEGY & ENV'T 154 (1995); Andrew W. Savitz, *What U.S. Environmental Lawyers Need To Know About Sustainability*, 17 NAT. RESOURCES & ENV'T 98 (2002); John C. Dernbach, *Making Sustainable Development Happen*, 8 ALB. L. ENVTL. OUTLOOK 173 (2004); Ilias Bantekas, *Corporate Social Responsibility in International Law*, 22 B.U. INT'L L.J. 309, 334-337 (2004); Nancy J. King & Brian J. King, *Creating Incentives for Sustainable Building: A Comparative Law Approach Featuring the United States and the European Union*, 23 VA. ENVTL. L.J. 397 (2005).

tential threat of overuse. Some may claim that the notion of property rights vested in the public contradicts the fundamental attributes of ownership: the ability to manage the property or invest in it (given that no one can fully enjoy the gain of their investment), or alienation (because no one clear seller could be defined, a purchase could not take place).[180] How then could the public trust theory attempt to tackle the challenge of potential overuse?

If we return to the basic problem of overuse, we see that it is at heart a problem of negative externalities. One response to patterns of overuse and overexploitation is to extend the scope of property rights so that their scale is consistent with the asset as a whole.[181] In the case of wind, given that the wind is created along public plains and by the public sun, it might be useful to assign the property rights to the public.[182] Property rights are relevant, *inter alia*, because they address the externality directly and link individual incentives with social objectives for resource use.[183] In other words, the incentives for each individual user to overexploit the resource will lessen, since each user – as part of the public – internalizes the costs of her use.[184] Therefore, applying the public trust doctrine to wind could not only address its complex property regime, but could also aid in addressing the

180. *See* Rose, *supra* note 91, at 739.

181. Engel & Lueck, *supra* note 93, at 373-74. Of course, there are questions remaining regarding the development of property rights, such as political, social and legal considerations, yet in theory changing the property regime could still be a useful tool in addressing the over-exploitation problem. *Id.*

182. Another solution could be completely privatizing the asset, however, this solution could hold the risk of anticommons. The Anticommons is "an imaginary regime in which everyone had the power to prevent everyone else from using a particular resource." It results from overly "propertized" or "privatized" responses to commons dilemmas, so that efforts to solve one tragedy may introduce another. *See* Fennell, *supra* note 96, at 907. For further reference, see Michael Heller, *The Tragedy of the Anticommons: Property in the Transition from Marx to Markets*, 111 HARV. L. REV. 621 (1998).

183. Libecap, *supra* note 99, at 380. However, property rights are typically adopted only when their costs have come to a point where they are lower than the gains from over-exploitation. Because these transaction costs can be quite considerable, the value of the resource and the nature of uncertainty determine the optimal time for introducing formal property rights. *Id.*

184. In addition, it could be noted that private property regimes suffer from problems such as holdouts and monopolies, so that their ability to deal with the commons dilemma is not necessarily better than the public property notion. Put differently, even if one is not convinced that the public trust doctrine is the best solution for the problem of overuse, it might at least be the lesser of two evils.

potential tragedy of the common wind, thus allowing for future generations to enjoy the same breeze that we enjoy today.

Critics of the Public Trust Doctrine argue that it conflicts with the private property interest in the resources.[185] While this may be true to some degree, note that the examples of the doctrine's application given above do not expand to the entire resource, but rather only to the areas in which there is a strong public or environmental need.[186] For example, the doctrine does not apply to wildlife as a whole, only to wildlife connected with navigable waters. Similarly, one could imagine that the doctrine will not apply to all wind, yet it could apply to wind within certain areas, such as seashores, highlands or possibly even urban settings. This way, we can maintain both private property interests in wind, and at the same time ensure public access to the resource and secure its existence in the future.

Lastly, holding the wind in trust for the people does not suggest the prevention of wind energy production or development. Quite the opposite is true – since the remarkable advantages of wind energy are widely recognized today, it is only natural that it is in the public's interest to continue developing and encouraging its growth. Yet at the same time the principle of sustainability may entail that the potential problem of overuse be taken into account when planning future energy production, whether it be large wind farms or the rapid expansion of small wind projects, so that the gentle cool breeze brushing through the trees on a summer's eve, the howl of a blizzard on a cold winter night, the twirling of leaves on an autumn morning and the scent of fresh cut grass on a spring day could all be enjoyed for many more years to come.

VI.
CONCLUSION

With the advancement of new energy production technologies, we are faced with a compelling conflict: wind power represents a new carbon free source of electricity while simultaneously

185. *See, e.g.*, James L. Huffman, *A Fish out of Water: The Public Trust Doctrine in a Constitutional Democracy*, 19 ENVTL. L. 527, 565-68 (1989) (arguing that the public trust doctrine could cause the taking of private property without due compensation, and is therefore incompatible with the values of a constitutional democracy). Rose, *supra* note 91, at 714-716.

186. Swenson, *supra* note 175, at 380.

presenting possible difficulties. One of these intricacies is the potential problem of overuse.

Wind has an important function in the ecosystem, and it plays a large role in our lives. Wind is an asset, which will become increasingly important in our private lives, as well as our society, in years to come. In light of this growing significance, it is wise to explore the property rights in this unique asset. Being a unique, fugitive asset, wind entails a complex property regime combining both private property interests and pubic ones. In addition, despite the initial intuition, wind is not entirely endless. Over time it can be exhausted, or at least changed significantly. The combination of these factors may lead to excessive use of the resource, causing notable changes in the wind currents over time. In view of this possibility, we should think about how we wish to protect property interests in wind. At the private level, there is reason to consider recognizing the damage caused to wind currents as damage to property interests. On the public level, perhaps the Public Trust Doctrine is best suited to ensure sustainable development.

It is important to emphasize that this Article is not intended to present a scientific argument in anyway. Nor is it intended to prevent the future development of wind energy production. On the contrary, there is no doubt that wind energy is a clean, renewable energy option that should be further examined and advanced in the future. It presents multiple economic growth options as well as plenty of environmental advantages. This article seeks only to highlight the importance of the proper allocation of wind rights in order to ensure sustainable development; and to suggest that, following the principles of sustainable development, the potential problem of overuse of this precious asset should be taken into account.