Wind Power, National Security, and Sound Energy Policy

Elizabeth Burleson*

Citation: Elizabeth Burleson, "Wind Power, National Security, and Sound Energy Policy," 17 Penn State Environmental Law Review 137 (2009).

Table of Contents

I. INTRODUCTION 137
II. RENEWABLE ENERGY STANDARD BY 2020 138
III. WIND POWER AND MILITARY RADAR 140
IV. TRIBAL WIND 143
V. TRANSMISSION LINES: GRID PARITY 145
VI. CONCLUSION 153

I. INTRODUCTION

Wind-generated electricity in the United States has grown by more than 400% since 2000.[1] Public and private research and development has reduced wind energy's costs by more than 80% over the past twenty years.[2] The Department of Energy states that 6% of U.S. land could supply more than 1.5 times the current electricity consumption of the country.[3] Yet, challenges remain in matching demand for electricity with supply of wind as well as achieving reasonable and equitable access to the grid. Differences in temperature between land, water, and air and between the equator and the poles generate wind. Wind power is a solar resource, derived from the uneven warming of the earth by the sun.[4] When environmental and social costs of fossil fuel use are internalized,

---

* Professor Elizabeth Burleson has a LL.M. from the London School of Economics and Political Science and a J.D. from the University of Connecticut School of Law. She also has written reports for UNICEF and UNESCO and is a professor at the University of South Dakota School of Law.

1. Paula J. Dobriansky & R. James Woolsey, *Continuing the Clean Car Revolution*, WALL ST. J., May 24, 2008, at A11, *available at* http://online.wsj.com/article/SB121158189604118489.html?mod=googlenews_wsj.

2. U.S. Department of the Interior Bureau of Land Management, Wind Energy, http://www.blm.gov/wo/st/en/prog/energy/wind_energy.html (last visited Nov. 9, 2008).

3. U.S. Department of Energy, Wind Energy Resource Potential, http://www1.eere.energy.gov/windandhydro/wind_potential.html (last visited Nov. 9, 2008).

4. *See* Energy Information Administration, Wind, http://www.eia.doe.gov/cneaf/solar.renewables/page/wind/wind.html (last visited Nov. 11, 2008) ("Winds are created by uneven heating of the atmosphere by the sun, irregularities of the Earth's surface, and the rotation of the Earth. As a result, winds are strongly influenced and modified by local terrain, bodies of water, weather patterns, vegetative cover, and other factors.").

wind power becomes a comparatively economic and sensible source of electricity.

This Article describes the interrelationships between wind-generated electricity, national security, and sound energy policy. Part II addresses the need for an effective national renewable energy standard. Part III calls for energy generation parity. Part IV describes the current dilemma between facilitating greater wind power in light of wind turbine interference with military radar. Part V describes the cooperation that is taking place between the U.S. federal government and Native Americans to develop wind power and revitalize rural communities. Part VI describes the challenge to integrate such renewable energy as wind power into the North American transmission system. This Article concludes that timely transition to such renewable energy sources as wind-generated electricity can achieve a sound energy policy capable of addressing the threat that climate change poses to international peace and security.

II. RENEWABLE ENERGY STANDARD BY 2020

Global investment in renewable energy rose by 60% to $148 billion in 2007.[5] One third of renewable energy investment was directed to wind power, which received $50.2 billion.[6] By March 2008, global wind capacity was over 100 gigawatts.[7] The Intergovernmental Panel on Climate Change ("IPCC") notes that,

> [r]enewable energy generally has a positive effect on energy security, employment, and air quality. Given costs relative to other supply options, renewable electricity can have a 30% to 35% share of the total electricity supply in 2030. Deployment of low-GHG (greenhouse gas) emission technologies would be required for achieving stabilization and cost reductions.[8]

Already producing 15-20% of its electricity by wind, Denmark plans to introduce electric cars that can be charged by wind-power.[9] The United States has more than 8000 gigawatts of available land-based wind

---

5. UNITED NATIONS ENV'T PROGRAMME, GLOBAL TRENDS IN SUSTAINABLE ENERGY INVESTMENT 2008 8 (2008), *available at* http://www.unep.fr/energy/act/fin/sefi/Global_Trends_2008.pdf.

6. *Id.* at 12.

7. *Id.* at 36.

8. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CONTRIBUTION OF WORKING GROUP III TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE: SUMMARY FOR POLICYMAKERS 17 (2007), *available at* http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-spm.pdf. *See also* U.S. DEP'T OF ENERGY, 20% WIND ENERGY BY 2030: EXECUTIVE SUMMARY 16 (2008), *available at* http://www.20percentwind.org/Final_DOE_Executive_Summary.pdf ("Continued reliance on natural gas for new power generation is likely to put the United States in growing competition in world markets for liquefied natural gas (LNG)—some of which will come from Russia, Qatar, Iran, and other nations in less-than stable regions.").

9. Karin Jensen, *Business Leaders Unite To Sway UN Climate Talks*, REUTERS, Apr. 10, 2008, at 1, *available at* http://www.planetark.com/dailynewsstory.cfm/newsid/47875/story.htm.

resources that can be captured economically, according to the Department of Energy.[10] In 2008, the Department of Energy analyzed wind energy requirements and outcomes, looking at technology, manufacturing, transmission and integration, markets, environment, and siting.[11] Currently, wind generates 1% of U.S. electricity supply.[12] The U.S. wind sector produces over 10,000 megawatts of electricity, enough to power 2.5 million average American homes.[13] The Energy Information Administration has predicted that U.S. electricity demand will increase by 39% between 2005 and 2030.[14] The Department of Energy calls for the U.S. wind installation rate to increase from the 3 gigawatts per year base rate in 2006 to over 16 gigawatts per year by 2018 and then continue at that rate until 2030.[15]

Electricity generation consumes roughly half of U.S. water withdrawals.[16] The Department of Energy recommends that 20% of U.S. energy be supplied by wind by 2030. The Department of Energy notes that,

> [a]s additional wind generation displaces fossil fuel generation, each megawatt-hour generated by wind could save as much as 600 gallons of water that would otherwise be lost to fossil plant cooling. Because wind energy generation uses a negligible amount of water, the 20% Wind Scenario would avoid the consumption of 4 trillion gallons of water through 2030.[17]

---

10. 20% WIND ENERGY BY 2030: EXECUTIVE SUMMARY, *supra* note 8, at 8.

11. *Id.* at 1.

12. *Id.* at 2.

13. National Renewable Energy Laboratory, Wind Research, http://www.nrel.gov/wind/ (last visited Nov. 11, 2008).

14. 20% WIND ENERGY BY 2030: EXECUTIVE SUMMARY, *supra* note 8, at 12 ("[W]ind would supply enough energy to displace about 50% of electric utility natural gas consumption and 18% of coal consumption by 2030. This amounts to an 11% reduction in natural gas across all industries. . . . [T]he increased wind development in this scenario could reduce the need for new coal and combined cycle natural gas capacity, but would increase the need for additional combustion turbine natural gas capacity to maintain electric system reliability. These units, though, would be run only as needed."). *See also* GRANGER MORGAN ET AL., THE U.S. ELECTRIC POWER SECTOR AND CLIMATE CHANGE MITIGATION 66 (2005), *available at* http://www.pewclimate .org/docUploads/Electricity%5FFinal%2Epdf ("Natural gas generators are a good pairing option for wind facilities, given their ability to increase or decrease electricity output quickly; thus, the two technologies in combination have the potential to produce significant emissions reductions.").

15. 20% WIND ENERGY BY 2030: EXECUTIVE SUMMARY, *supra* note 8, at 13 (noting that the Department of Energy calculations are based upon "241 GW of land-based and 54 GW of shallow offshore wind capacity to optimize delivered costs, which include both generation and transmission").

16. *Id.* at 17. ("This reduction would reduce the expected annual water consumption for electricity generation in 2030 by 17%. . . . [N]early 30% of the projected water savings from the 20% Wind Scenario would occur in western states, where water resources are particularly scarce.").

17. *Id.* ("This reduction would reduce the expected annual water consumption for electricity generation in 2030 by 17% . . . nearly 30% of the projected water savings from the 20% Wind Scenario would occur in western states, where water resources are particularly scarce.").

The Department of Energy recognizes that investing in wind power rather than fossil fuels reduces air/water pollution including greenhouse gas emissions in addition to stabilizing and diversifying national energy supplies.[18] "Supplying 20% of U.S. electricity from wind could reduce annual electric sector carbon dioxide (CO_2) emissions by 825 million metric tons by 2030," according to the Department of Energy.[19] Further, it will support over 500,000 jobs and reduce cumulative water use in the electric sector by 8% (4 trillion gallons).[20] Unlike fossil fuels, wind energy does not emit mercury or other heavy metals; it does not require large quantities of fuel for extraction and transport; it does not cause lake and streambed acidification from acid rain and mining; it does not require heavy water consumption for mining/electricity generation; and it does not produce toxic solid wastes, ash, or slurry.[21] Half of U.S. electricity and one fourth of total U.S. energy come from coal.[22] Achieving 20% wind by 2030 could avoid over 80 gigawatts of new coal capacity—reducing sulfur dioxide, nitrogen oxides, and mercury.[23]

III. WIND POWER AND MILITARY RADAR

Wind does not add to the stockpile of nuclear weapons nor is it of interest to terrorists. Yet, wind turbines can create holes in military radar coverage, cloaking aircraft flying overhead.[24] Plans to meet up to a third of Britain's energy from wind have been impacted by Ministry of Defense objections that turbines interfere with radar performance.[25] According to Squadron Leader Chris Breedon, "[t]his obscuration occurs regardless of the height of the aircraft, of the radar and of the turbine" based upon 2004-2005 studies.[26] The Ministry of Defense is opposed to all wind farms within the line of sight of its radar stations.[27] The U.S. Department of Defense explains that,

> [t]he first documented structured flight trials and analyses of these potential impacts were conducted by the UK Ministry of Defence (MoD) in 1994. This set of trials conducted ground measurements and flight trials using an ATC [air traffic control] radar located near a small wind turbine farm. . . . This was a relatively small-scale trial that involved flying a Sea King Helicopter over and around the wind turbines. This trial was structured to focus on the shadowing effect

---

18. *See id.* at 13.
19. *Id.*
20. *Id.*
21. *See* 20% WIND ENERGY BY 2030: EXECUTIVE SUMMARY, *supra* note 8, at 13.
22. Susan Moran, *Fight Against Coal Plants Draws Diverse Partners*, N.Y. TIMES, Oct. 20, 2007, at 1, *available at* http://www.nytimes.com/2007/10/20/business/20coal.htl?ex=1351051200&en=63cd02e10794d31e&ei=5088&partner=rssnyt&emc=rss.
23. 20% WIND ENERGY BY 2030: EXECUTIVE SUMMARY, *supra* note 8, at 16.
24. *See* Magnus Linklater & Dominic Kennedy, *Wind Farms 'A Threat to National Security,'* TIMES, Feb. 4, 2008, at 16, *available at* http://www.timesonline.co.uk/tol/news/environmentenvironment/article3300814.ece.
25. *See id.*
26. *Id.*
27. *See generally id.*

> that the turbines could have on targets just above or behind the wind farm, to estimate the RCS [radar cross section] of the turbines and to investigate the Doppler shift they would produce. The primary conclusion of that study was Wind turbines cause interference to primary surveillance radars. The responses appear as valid targets on the radar display. Responses cannot be inhibited using normal MTI [moving target indicator] based techniques since they are generated by a moving structure.[28]

The U.S. Department of Defense explains that there are air defense radars, ATC radars, missile warning radars, and weather radars.[29] Wind development can affect military training, weapon R&D, and security.[30] Generally, criticism has been based upon property values, bat/bird mortality, noise, and aesthetics.[31] Military installations that have wind turbines include the U.S. Navy base at Guantanamo, F.E. Warren Air Force Base in Wyoming, and an Air Force base on Ascension Island.[32] Yet, wind developers in Wisconsin, Illinois, North Dakota, and South Dakota who received "Notice of Presumed Hazard" letters from the Federal Aviation Administration ("FAA") were not able to proceed with financing or construction during crucial timeframes for federal credits.[33]

---

28. OFFICE OF THE DIR. OF DEF. RESEARCH AND ENG'G, REPORT TO THE CONGRESSIONAL DEFENSE COMMITTEE, THE EFFECT OF WINDMILL FARMS ON MILITARY READINESS 32-33 (2006), *available at* http://www.defenselink.mil/pubs/pdfs/WindFarmReport.pdf.

29. *Id.* at 15. *See also id.* at 16 ("Advances in electronics, processor, and computational technologies have enabled a number of radar system performance enhancements. A key capability provided by these advances and employed in virtually all modern radar systems today is the capacity to sense pulse-to-pulse phase differences, thus enabling the Doppler effect to be exploited. The Doppler effect, specifically the shift in frequency of the reflected signal that occurs when an object is moving, was first discovered by Christian Doppler. It applies to all propagating waves and is particularly useful for radars. This Doppler shift results from the fact that the frequency of a signal received by an observer will depend upon whether the source of that signal is stationary, moving toward, or moving away from the observer.").

30. *Id.* at 56.

31. *See* Migratory Bird Treaty Act, 16 U.S.C. §§ 703-712 (2005); *see also* Leonard Anderson, *Bird Deaths Stir Oversight for US Wind Power,* REUTERS, Oct. 8, 2007, *available at* http://www.planetark.com/dailynewsstory.cfm/newsid/44683/story.htm (noting that the Altamont Pass wind farm is installing "fewer but more efficient wind turbine with high blades that spin above birds' flight paths" and shut down during sensitive migratory timeframes); 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) ("By using so many acres of land for these large, manufactured generating structures, multi-turbine wind farms represent a major change to existing, low-density, natural land use patterns. Because high quality, commercially-viable wind power sites are located in rural places, these land use conversion effects are frequently experienced at largely undeveloped sites sometimes possessing significant natural resource and aesthetic importance. Therein lies the conflict. Wind power facilities represent a new carbon-free source of electricity while at the same time they present significant changes to current land uses—sometimes imposing burdens on existing environmental and natural resource values."); Cindy Skrzycki, *A New Blip on Wind Power's Radar Screen*, WASH. POST, June 20, 2006, at D1, *available at* http://www.washingtonpost.com/wpdyn/content/article/2006/06/19/AR2006061901337.html.

32. Skrzycki, *supra* note 31, at D1.

33. *Id.*

The FAA has slowly been working through the projects on a case-by-case basis.[34] Laura Brown of the FAA notes that the process has been slow due to rapid growth in the wind sector and only twelve FAA staff to review proposals.[35] A directive from the Defense Department and the Department of Homeland Security states that "any establishment of windmill farms within radar line of sight of the National Air Defense and Homeland Security Radars" would be contested. Lt. Col. William Crowe explains that the military would like to evaluate sites before FAA reviews.[36] While wind project developers are required to apply for approval of each turbine within a project, the Department of Energy notes that "[t]here are a number of technical mitigation options available today, including software upgrades to existing radar, processing filters related to signature identification, [and] replacing aging radar."[37] The Department of Energy explains that the FAA has approved wind turbines within the line of sight of long-range radars, which are generally of concern to the Department of Defense.[38]

---

34. *See* Kari Lyderson, *Wind-Power Projects Halted*, WASH. POST, June 10, 2006, at A2, *available at* http://www.washingtonpost.com/wp-dyn/content/article/2006/06/09/AR2006060901420.html ("[T]here are already numerous wind farms operating in military radar areas."); *see also* U.S. Department of Energy, Radar, http://www1eere.energy.gov/windandhydro/federalwindsiting/radar.html (last visited Nov. 11, 2008) ("On September 27, 2006, the Department of Defense (DOD) released a report on windmill impacts on military readiness. The report concluded that more needs to be known about potential impacts of wind systems on military radar and that in the interim, a case-by-case approach to evaluating wind projects impacts is appropriate."); Press Release, Am. Wind Energy Ass'n, Statement of the Am. Wind Energy Ass'n (AWEA) on the September 27 Report by the U.S. Dep't of Def. (DOD) on the Effect of Wind Farms on Military Radar (Sept. 28, 2006), *available at* http://www.awea.org/newsroom/releases/AWEA_statement_on_DOD_study_092806.html ("Some wind turbines can affect radar systems, but thousands of wind turbines generating electricity nationwide demonstrate that impacts can be, and have been, mitigated through measures such as relocating turbines or upgrading radar systems.").

35. Skrzycki, *supra* note 31, at D1.

36. *Id.*

37. U.S. Department of Energy, Frequently Asked Questions About Wind and Radar, http://www1.eere.energy.gov/windandhydro/federalwindsiting/radar_faqs.html (last visited Nov. 11, 2008) ("The Department of Energy is currently working with radar system experts across the country and overseas to catalogue known mitigation experiences, most promising options that exist, and those that are worth of developing in the future.").

38. *Id.* ("[T]he Department of Energy and industry partners lead the national investment to improve performance of wind energy technology and move the technology to market. The Department of the Interior has responsibility related to wind development on federal lands onshore and offshore and protection of endangered species and migratory birds across three elements: Fish and Wildlife Service; Bureau of Land Management; and Minerals Management Service. Each of these Interior elements has or is soon to have guidelines related to wind development. USDA's Forest Service has similar responsibility for development on federal lands under its control and is working to craft siting practices. The National Oceans and Atmospheric Administration within the Department of Commerce has responsibility for operations of weather stations across the U.S. and interested in ensuring proposed development near or around weather stations does not unreasonably impact their radar operations.").

IV. TRIBAL WIND

Winona LaDuke notes that "[w]e need to recover democracy, and one key element is democratizing power production. . . . [T]ribes live in some of the poorest counties in the country, yet the wind turbines they are putting up could power America—if they had more markets and access to power lines."[39] She goes on to point out that to build a wind generator, the Rosebud Sioux had to import turbine parts from Denmark.[40]

The northern Great Plains can supply over 300 gigawatts of wind power, "about one-half of the total installed electric capacity for the entire United States, and over 100 times the capacity of all the mainstream dams on the Missouri River," according to Robert Gough of the Intertribal Council on Utility Policy.[41] Tribal and Department of Energy cooperation has established the first large utility scale (750 kW) commercial wind development in the lower forty-eight states owned and operated by Native Americans.[42] Federal purchase of green power through the "green tags" program is central to ramping up wind power capacity.[43]

Gough calls for renewable energy studies and bi-annual reporting to achieve grid parity. Tribes served by outside utilities often lack control of their own rate bases. Utilities favor existing sources over new users, particularly those introducing newer renewable energy technologies to

---

39. Winona LaDuke, *Local Energy, Local Power*, YES! MAGAZINE, Winter 2007, at 26, *available at* http://www.yesmagazine.org/article.asp?ID=1553.

40. *Id*.

41. *Hearing on Indian Energy Legislation S. 424 and S. 522 Before the S. Comm. on Indian Affairs*, 108th Cong. 1 (2003) [hereinafter *Hearing*] (testimony of Robert Gough, Intertribal Council on Utility Policy (COUP) and the Rosebud Sioux Tribe Utility Commission), *available at* http://indian.senate.gov/2003hrgs/031903hrg/gough.pdf. *See also South Dakota's Wind Potential* (Minnesota Public Radio May 16, 2007), *available at* http://minnesota.publicradio.org/display/web/2007/05/14/sdwind/ ("South Dakota has the potential to generate enough wind energy to power half of the nation's electrical needs."); *Dakota Wind Energy, LLC Announces South Dakota's First Utility Scale Community-Owned Wind Project*, REUTERS, Jan. 17, 2008, *available at* http://www.reuters.com/article/pressRelease/idUS249349+17-Jan-2008+PRN20080117; Press Release, Shakopee Mdewakanton Sioux (Dakota) Cmty., Honor the Earth Receives $250,000 SMSC Donation (May 8, 2008), *available at* http://www.ccsmdc.org/press/2008/20080508.html (noting that the Shakopee Mdewakanton Sioux Community has given Honor the Earth, founded by Winona LaDuke, a grant of $250,000, and "[a] 65 kilowatt refurbished turbine for KILI Radio on the Pine Ridge Reservation and community-scale solar panel installations and trainings on the Northern Cheyenne and Sisseton-Wahpeton Reservations and at the Little Earth of United Tribes community in Minneapolis are being financed. Honor the Earth will also conduct a large-scale photovoltaic installation and training at the Shiprock Middle School on the Navajo Reservation. And, lastly, funds will be used for tribal renewable energy educational literature and planning materials that can lead to further development of tribally owned wind and solar projects.").

42. *Hearing*, *supra* note 41, at 3 (noting that wind power is generally increasing in the Dakotas).

43. The sale of wind energy generated on Rosebud to Ellsworth Air Force Base through a Western Area Power Administration "green tags" program has played an essential role in facilitating wind power in the region. *Id.*

the grid, deeming them competition to utilities' established markets.[44] Gough explains that,

> Federal Power Marketing Administrations are critical to the development and expansion of tribal wind power. In the Dakotas and for Tribal renewable energy development in some 15 states across the West, the WAPA [Western Area Power Administration] federal transmission grid crosses or interconnects to the vast majority of Indian reservations. WAPA, along with the Bonneville Power Administration, provide our "farm to market roadways." They are in strategic positions to facilitate the collection of tribal energy generation and for the delivery of tribal green power to federal facilities throughout the west. Further, under a tribal "green tag" program, the federal power administrations could meet the entire federal governments "green power" requirements.[45]

Changing climate precipitation patterns have increased costs of replacing hydropower in the Missouri River basin. Climate induced precipitation shifts lead to reduced snowpack and drought in the Missouri River basin. The Army Corps of Engineers reduces hydroelectric power generation when it responds to drought and flood conditions by holding back water. The hydropower marketing administration ("WAPA") has been purchasing coal to offset reductions in hydropower, causing a cyclical increase in atmospheric CO_2 and furthering drought and precipitation shifts. Gough notes that Tribal Wind can replace diminishing Federal Hydropower:

> Twenty Northern Plains Indian Reservations hold several hundred gigawatts of wind power potential. Wind power potential on the Pine Ridge and Rosebud Reservations alone are enough to met the Kyoto targets for all of North America.[46]

On and off grid wind generation can power local Tribal communities, while Tribes interconnected to federal electrical grids can generate off-reservation wind power sales.[47] Yet, Gough testified to the U.S. Senate that "[i]f you do not have accurate data for the resource, the documented desire in the market to purchase the power over a number of years, or a way to get your power to that market, you simply cannot get the financing to build the project."[48]

---

44. *Id.* at 4.
45. *Id.* at 4.
46. *Id.* at 8.
47. *Id.* at 7.
48. *Hearing*, *supra* note 41, at 3 ("The inability of Tribes to own a project and receive a bankable 'Production Tax Credit' that has driven non-Indian renewable energy development is a major economic barrier that disadvantages the financing of large tribal projects. Simply put, the REPI is not bankable, since it can't be included in a business plan. The power of making Tribes eligible for the bankable PTC that is assignable, tradable, or which could be used to offset federal loan financing, would greatly encourage Tribal renewable development.").

V. TRANSMISSION LINES: GRID PARITY

From the mid 1970s to the late 1990s, new electric transmission capacity investment declined from an average of $5.5 billion annually to under $3 billion annually, according to the Department of Energy.[49] While recent transmission investment growth has been helpful, insufficient transmission infrastructure continues to hinder U.S. capacity to meet rising energy demand.[50] The Department of Energy calls for $60 billion to be spent on transmission investments through 2030.[51]

The Department of Energy reports that,

> [t]he Midwest ISO compared the benefits and costs of bringing 8,640 MW of new wind energy online. Using a natural gas price of $5 per million British thermal units (MMBtu; well below 2007 prices), the annual benefits of reduced natural gas costs from new transmission and development of wind generation were between $444 and $478 million (Midwest ISO 2003). The Midwest ISO recently studied the costs of developing 16,000 MW of wind within its system, along with 5,000 miles of new 765-kV transmission lines to deliver the wind from the Dakotas to the New York City area. Although the overall generation and transmission costs reached an estimated investment of $13 billion, the project produced annual savings of $600 million over its costs. These savings are in the form of lower wholesale power costs and prices in the eastern part of the Midwest ISO footprint—

---

49. U.S. DEP'T OF ENERGY, 20% WIND ENERGY BY 2030: INCREASING WIND ENERGY'S CONTRIBUTION TO U.S. ELECTRICITY SUPPLY 94 (2008), *available at* http://www1.eerre.energy.gov/windandhydro/pdfs/41869.pdf.

50. DONALD N. FURMAN, SENIOR VICE PRESIDENT OF BUSINESS DEVELOPMENT, U.S. SENATE COMM. ON ENERGY & NATURAL RES., IBERDROLA RENEWABLES 3 (2008), *available at* http://www.awea.org/newsroom/pdf/AWEA_Iberdrola_Senate_Transmission_Testimony_061708.pdf ("Transmission congestion limits the ability of utilities to access cheaper sources of generation that may be located some distance away. Congestion also limits fuel diversity. If there is not sufficient transmission capacity to access electricity generated at remote locations, utilities will be forced to rely increasingly on natural gas-fired electric generation facilities, which are easier to site closer to load centers. There are legitimate concerns that a dramatic rise in the reliance on natural gas for electric generation will further increase U.S. demand for energy imports and will increase the pressure on gas prices. . . . Many states, utilities, and end users across a wide region and over a long time period benefit from interstate transmission, and it is not in any of their interests to pay for something that benefits so many others. With jurisdiction largely at the state level, where state public utility commissions ('PUCs') generally permit cost recovery of only those costs that provide direct benefits to that state's ratepayers, it is difficult to gain approval for the recovery of costs associated with interstate transmission. The situation with siting is similar. State siting approvals are based on demonstrations of need where 'need' is defined as impacts within the state. Interstate lines that benefit a region and the nation can be prevented from being built by individual states. States may also fail to consider regional needs when approving the location of specific transmission lines.").

51. 20% WIND ENERGY BY 2030: INCREASING WIND ENERGY'S CONTRIBUTION TO U.S. ELECTRICITY SUPPLY, *supra* note 49, at 94. *See also* AM. ELEC. POWER, INTERSTATE TRANSMISSION VISION FOR WIND INTEGRATION 6-7 (2007), *available at* http://www.aep.com/about/i765project/docs/WindTransmissionVisionWhitePaper.pdf (The American Electric Power notes that a $2.6 million per mile 765 kV line cost would be complicated by fluxuations in the cost of labor, material, and right-of-way agreements.).

> such as Ohio and Indiana—resulting from greater access to lower cost generation in the western states such as Iowa and the Dakotas.[52]

The U.S. wind power sector grew at a rate of 45% in 2007, adding capacity capable of powering 1.5 million homes.[53] Yet, insufficient transmission line capacity is impeding progress towards state renewable energy targets of 20% renewable energy by 2020.[54] Transmission of wind power from high-resource regions to high-demand regions remains problematic given the fragmented and aging electric grid.[55] The American Wind Energy Association ("AWEA") calls for "[m]ore efficient use of existing transmission lines—needed because long-term firm contracts can lock up transmission lines even if they are not fully used."[56] Substantial progress in forecasting wind power output enables operators to schedule wind power more accurately than in the past, according to the AWEA, which recommends the establishment of procedures for transmission system operators to efficiently use wind forecasting results in system operations.[57]

While wind farms can be built in a year and a half, transmission line expansion can require a decade.[58] The United States lacks a grid system that is capable of meeting the country's growing energy needs and security concerns. The North American electricity transmission system is comprised of three interconnected systems: the Western Interconnection, the Eastern Interconnection, and much of Texas. Over 140 control areas control local operations and coordinate reliability through ten regional councils.[59] Federal Energy Regulatory Commission ("FERC") Order 890-B clarifies that,

> [t]he fact that a transmission provider's affiliate may profit from congestion on the system does not relieve the transmission provider

---

52. *See* 20% WIND ENERGY BY 2030: INCREASING WIND ENERGY'S CONTRIBUTION TO U.S. ELECTRICITY SUPPLY, *supra* note 49, at 96. The Midwest Independent System Operator monitors the high voltage transmission system throughout the Midwest. *Id.*

53. AM. WIND ENERGY ASS'N, WIND POWER OUTLOOK 2008 1 (2008), *available at* http://www.awea.org/pubs/documents/Outlook_2008.pdf.

54. Paul Davidson, *Wind Energy Confronts Shortage of Transmission Lines*, USA TODAY, Feb. 26, 2008, at 1, *available at* http://www.usatoday.com/money /industries/energy/environment/2008-02-25-wind-power-transmission_N.htm ("[T]he first wind developer in an area is often asked to shoulder much of the $1.5 million-per-mile cost of a high-voltage line."). *See also* Eileen O'Grady, *US Wind Sector Urges Tax Credit, Power Line Work*, REUTERS, June 3, 2008, at 1, *available at* http://www.planetark.com/dailynewsstory.cfm/newsid/48603/story.htm; Peter Harriman, *Grid Deal Could Help Wind Power Transmission Cost Prohibitive Now*, ARGUS LEADER, Jan. 28, 2008, at 1, *available at* http://www.argusleader.com /apps/pbcs.dll/article?AID=/20080128/NEWS/801280320/1001/rss01.

55. *See* 20% WIND ENERGY BY 2030: INCREASING WIND ENERGY'S CONTRIBUTION TO U.S. ELECTRICITY SUPPLY, *supra* note 49, at 11; *see also* WIND POWER OUTLOOK 2008, *supra* note 53, at 4.

56. WIND POWER OUTLOOK 2008, *supra* note 53, at 4.

57. *Id.*

58. *See* Davidson, *supra* note 54, at 1; *see also Hearing*, *supra* note 41, at 4.

59. DEP'T OF ENERGY, OUR NATIONAL TRANSMISSION SYSTEM: TODAY AND TOMORROW 2 (2002), *available at* http://www.ferc.gov/industries/electric/indus-act/trans mission-grid.pdf.

> of its obligation to offer all available transmission capacity and expand its system as necessary to accommodate requests for service.[60]

FERC Order 890 established conditional firm contracts that help new generators access transmission lines.[61] FERC requires transmission providers to post daily load forecasts, including underlying assumptions, and actual daily peak loads in order to increase transparency and prevent transmission providers from favoring their affiliates:[62]

> [a]ll data used to calculate ATC and TTC for any constrained paths and any system planning studies or specific network impact studies performed for customers are to be made available on request, regardless of whether the customer is non-affiliated or affiliated with the transmission provider. The Commission also clarifie[s] that underlying load forecast assumptions to be posted on OASIS should include economic and weather-related assumptions. The Commission conclude[s] that posting load forecast and actual load data on a control area and LSE level does not raise serious competitive implications.[63]

Privately owned transmission systems have practiced price discrimination.[64] Joseph Tomain explains that, "the transmission segment must have adequate capacity, maintain reliability, avoid congestion, and do so at reasonable prices with no discrimination."[65] Instead, transmission providers have declined requests for use of transmission lines based upon insufficient available transmission

---

60. 18 C.F.R. § 37 (1996), *available at* http://www.ferc.gov/whats-new/comm-meet/2008/061908/E-1.pdf (reforming the framework set out in 1996 and ensuring nondiscriminatory transmission service and increased transparency). *See also* 18 C.F.R. §§ 35, 37.1-37.8, 385.

61. WIND POWER OUTLOOK 2008, *supra* note 53, at 4.

62. *See* 18 C.F.R. § 37 ("The Federal Energy Regulatory Commission affirms its basic determinations in Order Nos. 890 and 890-A, granting rehearing and clarification regarding certain revisions to its regulations and the pro forma open-access transmission tariff, or OATT, adopted in Order Nos. 888 and 889 to ensure that transmission services are provided on a basis that is just, reasonable, and not unduly discriminatory. The reforms affirmed in this order are designed to: (1) strengthen the pro forma OATT to ensure that it achieves its original purpose of remedying undue discrimination; (2) provide greater specificity to reduce opportunities for undue discrimination and facilitate the Commission's enforcement; and (3) increase transparency in the rules applicable to planning and use of the transmission system.").

63. Available Transfer Capability ("ATC"), Total Transfer Capability ("TTC"), and Load Serving Entity ("LSE") are economics and general power system concepts. *Id*.

64. *See* Joseph Tomain, *The Past and Future of Electricity Regulation*, 32 ENVTL. L. 435, 435 (2002).

> [F]or the most part the transmission segment is privately owned and private owners have a fiduciary duty to their shareholders to maximize value. In other words, private owners will raise prices to what the market can bear. There is little incentive to give up either ownership or operation. To this point, interregional coordination has proceeded on a voluntary basis.

Id. at 457.

65. *Id.* at 454. "Without proper backup, down time can mean significant data losses, not only in our homes, but in banks, work places, and in the national defense system, for example." *Id.* at 464.

capacity even when capacity exists.[66] Separating control over generation from that of transmission would lessen the ability of vertically integrated utilities to restrict wind power access to the grid.[67] The federal government has had minimal involvement with transmission line siting. Such decisions generally are approved by state governments through public utility commissions and similar agencies.[68] The Energy Policy Act of 2005 expanded the transmission line role of FERC.[69]

---

66. *See* Richard R. Bradley, *Over the River and (Around) the Woods to Grandma's House We Go: Long-Term Firm Transmission Rights, Transmission Market Power, & Gaming Strategies in a Deregulated Energy Market—an International Comparison*, 30 HOUS. J. INT'L L. 327, 379 (2008). Bradley explains,

> Transmission Providers have incentives to refuse to assist competitors by granting access to transmission networks. If the Transmission Provider grants access, then a course of dealing is established, and any subsequent refusals to grant access may run afoul of the antitrust laws. It appears that the antitrust laws and the profit-maximizing objectives of the utility serve to undermine competition and FERC's open access policies.

Id. at 371. Bradley also points out that,

> [t]he complexity and secretive nature of the process subjects the market to enormous abilities for firms to engage in gaming behaviors or withholding strategies in an attempt to limit access to the grid in violation of FERC open access rules, increase price, and benefit native generation to the detriment of competitors.

Id. at 378.

67. *See id.* at 337. Bradley notes that,

> [a] complete separation between generation and transmission is likely to run afoul of U.S. Supreme Court jurisprudence on 'takings.' Allowing generators to own the transmission assets but not exercise any control over operations would drastically reduce the ability of the generator or Transmission Provider to game the system. Furthermore, government regulators would not be bound by a fiduciary duty to stockholders to maximize profits. Regulators would control the transmission grid and operate it in the public interest, which would be for the safe, efficient, and reliable transmission of electricity products to end-users. In addition, proceeds received from usage of transmission lines may be used to upgrade the transmission network or build new transmission lines to meet burgeoning demand. Regulators may also need to provide compensation to generators for the functional control of the transmission assets to avoid the destruction of all economic value. However, government regulators could provide generators with a reasonable rate of return, like under a cost-of-service regime, for usage of the transmission lines; therefore, government regulators could avoid a "takings" claim by generators for the destruction of all economic value of the transmission lines. . . . [G]eneration assets should be separated from transmission assets, thus eliminating much of the vertical integration of the utilities.

Id. at 429-431.

68. *See* U.S. GOV'T ACCOUNTABILITY OFFICE, TRANSMISSION LINES: ISSUES ASSOCIATED WITH HIGH-VOLTAGE DIRECT-CURRENT TRANSMISSION LINES ALONG TRANSPORTATION RIGHTS OF WAY 13 (2008), *available at* http://www.gao.gov/new.items/d08347r.pdf.

69. *See* Energy Policy Act of 2005, Pub. L. No. 109-58, 119 Stat. 594 (2005); Energy Policy Act of 1992, Pub. L. No. 102-486, 106 Stat. 2776 (1992) (codified as amended in scattered sections of 15 U.S.C., 16 U.S.C., 25 U.S.C., 26 U.S.C., 30 U.S.C., 42 U.S.C.); Michael Grunwald & Juliet Eilperin, *Energy Bill Raises Fears About Pollution, Fraud Critics Point to Perks for Industry,* WASH. POST, July 30, 2005, at A1, *available at* http://www.washingtonpost.com/wp-dyn/content/article/2005/07/29/AR2005072901128.html (criticizing the "repeal of the Public Utility Holding Company Act of 1935, which has blocked the owners of utilities from owning other companies and has prevented mergers in the electricity industry. Utility officials and other proponents of

Energy Policy Act of 2005 section 1221(a) added section 216 to the Federal Power Act and called upon the Department of Energy to conduct a National Electric Transmission Congestion Study every three years.[70] The Energy Policy Act of 2005 calls upon the Department of Energy to issue a report, designating areas with transmission constraints/congestion as national interest electric transmission corridors ("NIETCs").[71] Within the NIETCs that the Department of Energy has recently designated, FERC now has the authority to approve siting of new transmission lines when a state does not have authority to approve siting or consider interstate benefits; when an applicant cannot qualify for state approval because it does not serve in-state consumers; and when a state declines siting approval for over a year or conditions approval on the basis of substantial interstate transmission congestion or economic feasibility.[72] President Bush states that,

> [l]arge-scale renewable energy installations are most likely to be built in sparsely populated areas—which will require advanced, interstate

---

repeal say it will attract capital, helping utilities build transmission lines and generating plants that will prevent blackouts. Consumer advocates warn that the repeal will trigger a flurry of mergers and acquisitions by banks, oil firms and even foreign countries, leading to increased rates and Enron-style frauds. Supporters point out that the electricity industry will still be regulated by a slew of state and federal agencies. But both sides agree the obscure provision will transform the industry, thrusting as much as $1 trillion in utility assets into the global marketplace.").

70. DEP'T OF ENERGY, NATIONAL ELECTRIC TRANSMISSION CONGESTION STUDY vii (2006), *available at* http://www.oe.energy.gov/DocumentsandMedia/Congestion_Study_2006-9MB.pdf; Energy Policy Act of 2005 § 216(b) (explaining FERC's authority over transmission line siting).

71. *See* NATIONAL ELECTRIC TRANSMISSION CONGESTION STUDY, *supra* note 70, at 74 (citing Energy Power Act of 2005 § 216). In making such designations, section 216(a)(4) of the Energy Power Act of 2005 allows the Secretary to consider whether,

> (A) the economic vitality and development of the corridor, or the end markets served by the corridor, may be constrained by lack of adequate or reasonably priced electricity; (B)(i) economic growth in the corridor, or the end markets served by the corridor, may be jeopardized by reliance on limited sources of energy; and (ii) a diversification of supply is warranted; (C) the energy independence of the United States would be served by the designation; (D) the designation would be in the interest of national energy policy; and (E) the designation would enhance national defense and homeland security.

§ 216(a)(4); Janet Wilson, *In a Boost for Utilities, the Southland is Deemed a Key Energy Corridor, Allowing Federal Officials to Overrule the State and Condemn Property*, L.A. TIMES, Oct. 3, 2007, *available at* http://www.latimes.com/news/science/environment/la-meenergy3act03,1,7991143.story?track=rss&ctrack=8&cset=true ("The U.S. Department of Energy on Tuesday designated nearly all of Southern California, parts of Arizona and much of the northeast as 'national interest' energy transmission corridors, an action that allows federal regulators to approve new high-voltage towers and lets private utilities condemn homes and land even if a state agency won't.").

72. TRANSMISSION LINES, *supra* note 68, at 18 ("As required by the Energy Policy Act of 2005, the Department of Energy established NIETCs in October 2007, within which FERC now has the authority to approve siting of new transmission lines under certain circumstances; that is, if: (1) the state does not have authority to approve siting or consider what the interstate benefits might be; (2) the applicant does not qualify for state approval since it does not serve consumers in that state; or (3) the state entity with siting authority withholds approval for more than 1 year, or conditions its approval such that the project will not significantly reduce interstate transmission congestion or is not economically feasible.").

> transmission systems to deliver this power to major population centers. If we're serious about confronting climate change, then we have to be serious about addressing these obstacles.[73]

Beyond costs, transmission line siting appears to be the most contentious issue. As Credit Suisse's Raymond Wood notes, "I don't think the barrier to transmission will be capital adequacy or availability. It will be resistance to adding capacity by people who don't want it in their neighborhood."[74] A politically fractured transmission system that lacks the capacity to integrate large-scale wind production currently prevents the transmission of wind-generated electricity from the windiest regions to population centers. Land-based wind turbine siting would be optimal in the high wind corridor from Texas through the Dakotas—far from coastal high energy demand.[75] Tapped-out Texan oil fields are becoming wind farms.[76] "Texas has been looking at oil and gas rigs for 100 years, and frankly, wind turbines look a little nicer," said Texas land commissioner Jerry Patterson.[77] Wind power is revitalizing rural economic development, raising property values and lowering taxes.[78] Roughly 330 megawatts of installed capacity is located on federal lands.[79] Active transportation rights of way for railroads, highways and pipelines potentially may be used to building new high voltage transmission lines. Yet economic, safety, and security issues remain.[80]

Congress included a provision in the Implementing Recommendations of the 9/11 Commission Act of 2007 requiring the U.S. Government Accountability Office to assess the siting of High Voltage Direct Current ("HVDC") transmission lines along active transportation rights of way.[81] High-voltage transmission lines are often 230 kilovolts ("kV") or greater.[82] Electricity can be transmitted by alternating current ("AC") or direct current ("DC"). AC reverses direction at regular intervals while DC flows in one direction. Generally, the United States has depended upon AC to transmit electricity. The United States only has five long-distance HVDC transmission lines,

---

73. President George W. Bush, Speech at the Rose Garden: Bush's Climate Strategy (Apr. 16, 2008), *in* WALL ST. J., Apr. 16, 2008, *available at* http://blogs.wsj.com/washwire/2008/04/16/bushs-climate-strategy/#more-4641.

74. "Unless we figure out a way to move capital into transmission, moving power from the Dakotas to Chicago or from the Mojave to Los Angeles is going to be a great dream." Nichola Groom, *Lack of New Power Lines Threatens Renewable Growth*, REUTERS, June 23, 2008, *available at* http://www.planetark.com/dailynewsstory.cfm/newsid/48932/story.htm.

75. *See* Clifford Krauss, *The Energy Challenge: Move Over, Oil, There's Money in Texas Wind,* N.Y. TIMES, Feb. 23, 2008, *available at* http://www.nytimes.com/2008/02/23/business/23wind.html?_r=1&ex=1361422800&en=0ad41e11b4cf3ae6&ei=5088&partner=rssnyt&emc=rss&oref=login.

76. *Id.*

77. *Id.*

78. *Id.*

79. Wind Energy, *supra* note 2.

80. TRANSMISSION LINES, *supra* note 68, at 1.

81. *Id.*

82. *Id.* at 14.

representing 2% of total U.S. transmission line miles.[83] Transmission line expansion can facilitate use of renewable energy sources, decrease congestion and improve reliability of the grid.[84] On the other hand, expanding transmission lines may reduce incentives to conserve energy.[85] Transmission line expansion can also lower property values. This can be mitigated to some degree by using underground lines. While instillation and maintenance costs may be higher, such costs may be outweighed by increased safety and security.[86] The World Health Organization explains that,

> [e]lectric fields from power lines outside the house are reduced by walls, buildings, and trees. When power lines are buried in the ground, the electric fields at the surface are hardly detectable. . . . In contrast to electric fields, a magnetic field is only produced once a device is switched on and current flows. The higher the current, the greater the strength of the magnetic field. Like electric fields, magnetic fields are strongest close to their origin and rapidly decrease at greater distances from the source. Magnetic fields are not blocked by common materials such as the walls of buildings.[87]

The World Health Organization concludes that "the responsibility to investigate fields around power lines, mobile phone base stations or any other sources accessible to the general public lies with government agencies and local authorities. They must ensure that compliance with guidelines is maintained."[88] Public participation in decision-making regarding siting new power lines is also crucial[89] as is research coordination.[90]

HVDC generally costs less and loses less power than High Voltage Alternating Current ("HVAC") over long distances.[91] Since HVDC only

---

83. *Id.*
84. *Id.* at 22.
85. *Id.*
86. *See* TRANSMISSION LINES, *supra* note 68, at 22.
87. World Health Organization, What Are Electromagnetic Fields?, http://www.who.int/peh-emf/about/WhatisEMF/en/ (last visited Nov. 12, 2008).
88. *Id.* ("To compensate uncertainties in knowledge (due, for example, to experimental errors, extrapolation from animals to humans, or statistical uncertainty), large safety factors are incorporated into the exposure limits. The guidelines are regularly reviewed and updated if necessary. It has been suggested that taking additional precautions to cope with remaining uncertainties may be a useful policy to adopt while science improves knowledge on health consequences. However, the type and extent of the cautionary policy chosen critically depends on the strength of evidence for a health risk and the scale and nature of the potential consequences. The cautionary response should be proportional to the potential risk.").
89. *Id.*
90. World Health Organization, Research Agenda, http://www.who.int/peh-emf/research/agenda/en/index.html (last visited Nov. 12, 2008) ("Because of the scientific questions and the public concern regarding the potential health effects from electromagnetic fields (EMF), several countries have funded research programmes and, in some cases, set up foundations to sponsor studies relating to this topic. . . . [T]he International EMF Project, in collaboration with major national and multinational research funding institutions, has been providing such an umbrella for worldwide coordination and exchange of information about planned and ongoing projects.").
91. *See* TRANSMISSION LINES, *supra* note 68, at 27.

requires two lines rather than the three lines needed for HVAC, HVDC lines may not need as wide a right of way.[92] Furthermore, HVDC lines can provide operators increased control over the direction and amount of power than HVAC lines.[93] On the other hand, HVDC lines generally bypass residents along their routes unless converter stations are installed, and short-distance HVDC lines can be more expensive due to conversion from DC to AC.[94] The U.S. Government Accountability Office notes that,

> it may be less costly to acquire the right to add a new transmission line to an existing right-of-way from a single owner—such as a pipeline, highway, or railroad—than it would be to acquire the needed rights from multiple property owners. Potential risks of collocation may include the increased likelihood of safety and security incidents due to the proximity of the transmission lines and the transportation infrastructure. For example, train derailments or highway crashes potentially could damage transmission lines and fallen transmission lines could damage transportation infrastructure. In addition, a collocated transmission line and natural gas line may be a more desirable terrorist target than either facility on its own.[95]

The U.S. Government Accountability Office also explains that, "[e]lectromagnetic fields and stray current could interfere with railroad signaling systems and highway traffic operations, and accelerate pipeline corrosion, resulting in accidents."[96] Mitigating measures include: (1) minimizing pipeline corrosion by ensuring that transmission line electric current does not interfere with cathodic protection; (2) minimizing railroad interference by ensuring that transmission lines' magnetic fields do not impede railroad signal systems and that sufficient clearance remains for maintenance; and (3) minimizing highway interference by ensuring that transmission lines do not impact the free flow of traffic and future expansion.[97]

---

92. *Id.*
93. *Id.*
94. *Id.* at 35.
95. *Id.* at 4. The report notes that: (1) use of right of ways is required to the extent practical under the Federal Land Policy and Management Act (FLPMA) to minimize adverse environmental impacts; (2) the Energy Policy Act of 2005 requires streamlined review and permitting within corridors designated by FLPMA; (3) existing right of ways should be given priority as locations for additional electricity transmission facilities pursuant to FERC guidance for hydroelectric projects. *Id.* at 20.
96. TRANSMISSION LINES, *supra* note 68, at 28 ("Maintenance workers may be more likely to be injured given increased safety risk from close proximity of transmission lines to [a] transportation [right of way]. . . . Collocation may make the corridor a more attractive target. Events that would otherwise be isolated (e.g., a pipeline explosion) could lead to service interruptions on the transmission line or along [an] active [right of way].").
97. *Id.* at 29.

VI. CONCLUSION

U.S. tax incentives have helped establish a wind power industry.[98] Yet, the growth of the renewable power sector falls far short of what is possible and of what is needed to address climate change.[99] Governments need to financially support the transition to environmentally sound technology and increase energy efficiency through regulatory standards.[100] Congress should pass a national renewable energy standard of at least 20% renewable energy by 2020, guided by an ongoing scientific understanding of the measures required to avert severe climate change.

Political, economic, and technical factors have delayed wind power development. If social costs are included in market pricing then wind power's environmental and social costs are outweighed by those of other energy sources. Tax credits encourage development of equipment but when credits end, projects are often abandoned. Innovation has made wind power an increasingly efficient addition to the generation of electricity. Tribal wind initiatives have shown that developing wind power can also benefit rural communities. Careful wind turbine and transmission line siting can occur through cooperation between federal, state, tribal, and civil society participation in decision-making. A sound energy policy that facilitates wind-generated electricity can sustain international peace and security.

---

98. *See* 26 U.S.C. § 48 (1996); *see also* Furman, *supra* note 50, at 2 (noting that the production tax credit is currently available for the production of electricity from wind, but that "[w]ith the renewable energy production tax credit ("PTC") currently scheduled to expire on December 31, 2008 and the current uncertain legislative environment, projects representing thousands of megawatts of renewable energy expected to be installed next year are now in question. The PTC, since its enactment, has expired on three separate occasions and has never been extended for longer than a three year period. The stop-start nature of the PTC has impeded development of a domestic manufacturing base and has raised significantly the capital cost of a wind power project. It is important for Congress to extend the PTC as soon as possible for as long as possible. Congress should also consider more stable long-term policies, including the adoption of a national renewable portfolio standard (RPS).").

99. *See generally* Elizabeth Burleson, *Multilateral Climate Change Mitigation*, 41 U.S.F. L. REV. 373, 400-06 (2007).

100. *See* UNITED NATIONS DEV. PROGRAMME, HUMAN DEVELOPMENT REPORT 2007/2008—FIGHTING CLIMATE CHANGE: HUMAN SOLIDARITY IN A DIVIDED WORLD 17 (2007), *available at* http://hdr.undp.org/en/media/hdr_20072008_en_ complete.pdf; Alan Murray & Kimberly A. Strassel, *Ahead of the Pack: GE's Jeffrey Immelt on Why It's Business, Not Personal*, WALL ST. J., Mar. 24, 2008, at R3 (General Electric CEO Jeffrey Immelt explains that, "[f]rom a competitiveness standpoint, it's really education, health care, energy and financial policies that encourage innovation. . . . There's such a time discrepancy in this industry that's unique to the industry that by the time you decide pollution is a problem, by the time you decide that there is real shortage, by the time there's a grid in place in this country that actually facilitates low-cost energy distribution, microturbines, things like that, it ain't going to happen. The government has its hands in almost every industry we're in, whether you want to say it or not, and there's tax deductions for home mortgages.").