Wind Energy on the Horizon: The New Energy Landscape

Session: Sun-C3
Sunday, October 7th, 4:15pm-5:45pm

Panelists: Brad Cownover, Director of Scenic Conservation Services- Scenic America
Rob Thayer, University of California–Berkeley
Robert Ryan, University of Massachusetts, Amherst
Stephen Sheppard, University of British Columbia, Canada

Photos courtesy Wind Watch

SESSION OVERVIEW:

Communities and landscapes across America face a new visual impact on the horizon, wind energy. Although considered by most to be environmentally benign when compared to nonrenewable energy methods, an unprecedented crop of new wind farms pose a unique challenge in protecting visual resource values in settings ranging from rural to urban. This session will debate the challenges in balancing sustainability with aesthetic impacts and highlight techniques for mitigating visual impacts.

ABSTRACT:

As our nation enters the 21st century, issues of energy production and consumption will not only affect our population, but also the landscapes in which we live, work, and play. With the quest for a more sustainable energy ethic rising to the forefront of discussion, sources of alternative energy production, such as wind power, are becoming more of a reality.

However, while the relative benignity of wind power production has endeared the technology to the environmental community, visual intrusions posed by these beacons of sustainability usually remain the primary opposition voiced by communities in the landscapes in which projects are proposed. The size, number, scale, motion and visual prominence of wind turbines makes visual mitigation nearly impossible and communities are faced with challenges in embracing green technology while protecting landscape views they value.

Planning, locating, and designing these facilities so that they fit into the landscape and minimize intrusiveness is both an art and science and represents a rapidly expanding field of opportunity for the landscape architecture profession. Yet significant questions remain beyond pure design mitigation. Does the type of landscape setting in which a project is proposed make a difference in regards to public perception of a project? Are individuals more likely to embrace the sculptural qualities of a wind farm in a relatively featureless prairie landscape and object to the same if proposed along the rugged ridgeline of a magnificent mountain view? Are issues of environmental justice being ignored when wind projects are proposed elsewhere along a coastline due only to wealthy community opposition?

This session will be structured as moderated panel presentations and forum on the history, trends, and debate regarding wind energy and landscape values. Panel speakers will discuss the current demand for wind energy projects and the potential impacts to the visual character of American communities and landscapes. Panelist will share professional experience and academic research in highlighting opportunities for landscape architects to take the lead in this rapidly expanding field through planning, design, and visualization services, as well as through skills in helping affected communities balance issues of sustainability with aesthetic and community impacts.

Twenty Five Points about Wind Energy for Landscape Architects

Robert Thayer, FASLA, FCELA
University of California, Berkeley
October, 2007

Rob Thayer has been involved in wind energy research and consulting since 1984. His writings on wind energy won the ASLA Honor Award for Research in 1993 and the ASLA Presidential Award for Excellence in 1994, and his professional clients have included Zond Systems, Pacific Gas and Electric Company, the US Bureau of Land Management, and the State of Kansas.

Critical Research Findings:

Scale

1) The **scale** and extent of wind energy development needed in the future to replace fossil-fuel-generated electricity is immense, will dwarf our current conceptions, and occupy vast acreages of American landscape.

Transparency and Non-functionality

2) Wind turbines are an exceptionally "transparent" technology. Therefore, non-functioning wind turbines are irritating to viewers (especially when compared to nearby turbines that *are* spinning) and are the worst possible public relations message from the wind industry to the consuming and viewing public.

Multiple Use

3) Wind is an incredible renewable resource that allows **multiple use of the land** it occupies (about 5%). This is vastly different than most other energy sources (solar PV excepted), and allows grazing, agriculture, open space, recreation, and in terms of off-shore sites, fishing, habitat, etc., to be co-located in and among wind turbines.
4) In some instances wind farm siting competes with housing for cheap rural land (Solano County, California, is a case in point). Housing developers are among the first to claim (falsely, it seems: see #12 below) that wind turbines "reduce property values".

Site Treatment

5) The public prefers uniform arrays of similar turbines, little or no extraneous site clutter (wires, substations, road cuts, etc.), and few or no auxiliary structures. They also prefer minimal or no site grading.
6) Another constraint (beyond visual impacts) facing wind energy siting is vegetation/species impacts due to **scarification of turbine tower base areas** (e.g., Walker Ridge BLM proposal in California). There are better, and worse, landscapes for installing turbines in terms of ground cover, ecology and topography.

Acceptance Distance

7) Wind energy is preferred closer to home than any other power plant "fuel" source. For example: Minimum distance at which 50% or more of the public would accept a particular type of power plant from their homes:

Wind Farm:	2 miles	
Biomass Plant:	5 miles	
Fossil Fuel Plant:		11 miles
Nuclear Power Plant:		75 miles

Private Lands/Midwest

8) Jacob Sower's MS thesis (Arizona State University, '06) shows that the **Midwestern Plains** (eastern Wyoming, eastern Colorado, western Minnesota, Iowa, Kansas and Texas) have all experienced **little or no public resistance to wind energy** developments from farmers/ranchers on private land. What might the rest of America learn from this?

Public Lands

9) **Wind energy development on scenic public lands is less appropriate** than wind farming on private rangeland (more of a boost for productive farm/ranch management, less controversy over resource/aesthetic controls).

Indian Lands

10) Plains Indians, whose reservations are often the windiest landscapes, may inherit two of the most sustainable things we could do with prairie lands: wind energy and bison grazing (natural grass-fed meat instead of corn/antibiotic-stuffed cattle). Conclusion: *Native Americans get the last laugh in sustainable land management!*

Localized Benefits

11) **Local benefits of some kind must be returned to the community** in exchange for the local "costs" of accepting turbines. Wind energy is more visible, immediate, and "in your face" than other energy sources. With conspicuous wind development, local residents expect more in the way of local benefits.

Real Estate Value

12) Ben Hoen's Masters thesis in Environmental Science from Bard College ('06), has done research showing that visibility of wind farm development has no measurable impact on real estate transaction values. In short, **wind energy visibility does not lower property values.**

Meanings

13) Aesthetic response to wind power is related to the perceived "meaning" of the turbines and installation in general, not just the visual intrusion of the towers. Positive meaning associations for wind turbines have been capitalized upon my numerous movie producers, advertisers, etc., for over twenty years.
14) Wind energy produces somewhat of a "bipolar" response. Some love it, some hate it (a function of wind energy's transparent and conspicuous nature). Although it has the highest percentage of acceptors of any power plant fuel type, wind power also has the highest percentage of NIMBY's ("acceptors" who don't want it near their homes).

Avian Mortality

15) **Avian mortality** is perhaps the most serious constraint facing the siting of new wind power plants in California, if not worldwide.
Research findings listed below are extracted from "Repowering the Altamont Pass Wind Resource Area: Forecasting and Minimizing Avian Mortality Without Loss of Power Generation", K. Shawn Smallwood and Lee Neher, California Energy Commission Public Interest Energy Research Program, December 2004. I have followed each conclusion with a design implication.

16) Don't locate wind farms in areas of known raptor migration and foraging concentrations: (Altamont, although wonderful from a power standpoint, is the worst bird mortality wind farm in the world from a birds-killed-per-turbine standpoint)

Design implication: Prior to planning wind power plants, ***conduct a thorough baseline avian study.*** *(This was the first public comment made to the BLM—by me, actually – in response to their programmatic EIR: do a baseline avian study for all areas being considered for wind energy development)*

17) Some bird species are attracted to the areas near wind turbines.

Design implication: Wind turbines may inevitably attract birds to the site. Design wind farms to minimize conflicts (see below)

18) Taller turbine towers kill fewer birds: most foraging flights by raptors are at heights at or below the rotor planes of existing wind turbines.

Design implication: Taller turbines kill fewer birds, and the industry trend is toward taller turbines.

19) More birds are killed around rock piles at the bases of turbine towers (better prey habitat).

Design implication: Grading and landscape treatment of tower bases to match conditions of surrounding habitat are critical (not only visually for humans, but for lessening attraction to birds)

20) Golden eagles are killed more frequently than expected near wind farms, especially near wind turbines located in canyons.

Design implication: Don't site wind turbines in canyons. Take all steps necessary to prevent killing eagles, the most symbolically important bird species.

21) Bird kills are related to blade tip speed (not RPM). Larger turbines turn more slowly (lower rpm) but often have similar tip speeds as smaller turbines.

Design implication: Don't base turbine selection on RPM. Slower tip speed (regardless of RPM) is preferred for lessening avian mortality.

22) The most isolated wind turbines killed disproportionately more birds, and

23) Turbines at the ends of an array killed more birds/turbine than those in the middle

Design implication: Continuous arrays, rather than isolated turbines, yield more net power per bird killed.

24) Perching on wind turbine towers and/or blades is not that important a factor.

Design implication: Selecting wind turbines for perching properties is not critical.

25) "Wind wall" configurations of turbines (alternating high and low turbines) kill fewer birds per turbine.

Design implication: Consider "wind walls" (alternating identical turbines on taller/shorter towers) when power generation and avian conditions allow.

Important references:

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Techniques for Assessing the Visual Impact of Wind Energy Facilities: A Case Study from the Boston Harbor Islands National Park Area

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Robert Ryan is an Associate Professor in the Department of Landscape Architecture and Regional Planning at the University of Massachusetts at Amherst where he teaches courses in landscape and greenway planning, research methods, and environment and behavior. He is the co-author with Rachel and Stephen Kaplan of the book, With People in Mind: Design and Management of Everyday Nature. He has also worked as a licensed landscape architect in California.

I. Introduction to Visual Assessment Approaches (3 SLIDES)

A. Introduction/ History
   1. Response to EIS requirements beginning in 1970's.
   2. US Bureau of Land Management. Visual Resource Management Program (VRM), 1980.
   3. USDA Forest Service, Visual Management System (VMS) 1974; Scenic Management System (SMS) 1995.
   4. USDA Natural Resource Conservation Service's Landscape Resource Management (LRM) system is designed more for rural and suburban landscapes and thus, takes a more landscape approach than a visual approach (Schauman and Anderson, 1979).

B. Expert assessment approaches
   1. Landscape architect or other professional as evaluator.
   2. Criteria derived from aesthetic theory (ex. form, color, contrast).
   3. Generally additive numerical approach for range of criteria.
   4. Landscape classification by type.
   5. Visibility and frequency of uses (along roadside, tourist dest.).

C. Pro's and Con's
   1. Used primarily on public land with govt. control (NRCS is exception).
   2. Focus on wilder, less developed landscapes.
   3. Cultural modifications are perceived as negative.
   4. Little public input in earlier versions.
   5. Experts often rate scenery different than gen. public.

II. Landscape Preference Approach and Public Rating of Scenic Resources. (2 SLIDES)

A. Background- developed in similar period, 1970's to present.
   1. Kaplan and Kaplan (1989).
   2. Terry Daniels.
   3. Ervin Zube and others.

B. Public ratings of photos and/or at particular sites.
   1. In the landscape.
   2. Slide shows.
   3. Mail-out surveys.
   4. Web-based surveys.

III. Future Development- Visual Simulations (1 SLIDE)

A. Used with both type of assessment approaches.
B. Increased sophistication with regards to spatial accuracy, GIS, terrain modeling.

IV. Boston Harbor Islands National Park Area Visual Assessment Case Study. (8 SLIDES)

A. Context of study area.
B. Wind turbine development and proposals.
C. Landscape assessment approaches.
1. BLM modified approach- graduate studio and expert panel.
2. Landscape preference approach- student ratings of 66 photos.
D. Study results- similarities and differences.
1. Context and acceptance of wind-turbines.
2. Comparison to other industrial appearing structures.
E. Group differences- importance of natural resource knowledge.

V. Conclusion- Boston Harbor Island wind turbines (Hull) versus Cape Wind (2 SLIDES)

A. Importance of context in potential public acceptance and/or conflict.
B. Landscape context and type.
C. Social and cultural values.
D. Need to use range of landscape architects' skills to evaluate range of impacts on historic cultural resources, environmental, and scenic

[*The following is an abstract from my CELA 2007 presentation that summarizes the Boston Harbor Island section and introduction in more detail*]

Summary: This study in the Boston Harbor Islands National Park Area compared expert-panel visual assessment methodology to landscape preference methodology. The study results provide insights for perceptions of wind turbines and other cultural modifications in urban waterfronts, as methodological advancement of visual assessment techniques.

The majority of viewshed impact assessment methods have been developed for natural settings, such as national forests and other more remote public lands (USDA Forest Service, 1995; US Department of the Interior, 1980). The application of existing impact assessments to urban settings has been particularly problematic, since the landscape is dominated by cultural influence rather than nature. Another challenge is that many viewshed impact assessment methods rely on experts, such as landscape architects to judge the scenic beauty of a particular scene. Unfortunately, design experts' landscape preference can differ from those of the general public (Kaplan and Kaplan, 1989). Landscape preference rating systems that use public evaluation of landscape scenes have been found to be reliable in a variety of settings from urban parks to national forests. The current study provides a venue for comparing the visual assessment approach using an expert-panel approach to the landscape preference approach using a more general audience.

The Boston Harbor Islands National Park Area is a unique geologic, natural, cultural, and historic resource in the heart of one of the nation's most densely populated urban areas. The 34 glacially-formed islands and peninsulas are the only submerged drumlin formation in the country and include a range of terrestrial and marine ecosystems. The human impacts on the islands include Native American use, lighthouses, coastal defense, resorts, agriculture, landfills and sewer treatment facilities. The premier position of the islands, visible from a variety of mainland and harbor areas, required a sensitive approach to identifying and assessing existing visual quality and a methodology to evaluate the visual impacts of future management and development alternatives. Current proposals to site energy generating facilities including wind turbines and a liquid natural gas facility within the National Park area created the immediate need for a viewshed assessment study.

This pilot study conducted as part of a graduate landscape planning studio began with documenting the important viewsheds of the study area using GPS. An expert-panel assessment method was developed that modified the Bureau of Land Management's Visual Resource Program for the particular study area. After incorporating cultural elements within this modified rating system, it was tested with a panel of approximately 20 stakeholders from the region. Initial comparison of these two methods found that historic-cultural elements were generally rated slightly higher by the expert-panel than the general public, as were other more industrial land uses. The final assessment tool was modified to incorporate these findings and 66 key viewsheds were evaluated including existing wind turbines. The second phase of the study involved had 80 college students, who were less familiar with the study area; rate the same scenes using landscape preference methodology. The study results showed similarity in the highest and lowest rated scenes between the two groups, but there were significant differences with regard to familiarity, residential setting of participants, and level of expertise. This study provides new insights into perceptions of urban harbors, including new technologies such as wind turbines, which have received little study to date (Bishop and Miller, 2007).

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LANDSCAPE ARCHITECTURE Considerations: WINDPOWER and the LANDSCAPE

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Stephen Sheppard teaches in landscape planning, aesthetics, and visualization in Landscape Architecture and Forestry at UBC. He received a Ph.D. in Environmental Planning at UC. Berkeley. He directs the Collaborative for Advanced Landscape Planning (CALP), a research group using 3D visualization tools to support public awareness-building and planning on climate change and sustainability. He has 25 years' experience in consulting, has worked on several windpower projects, and did the visual impact assessment for the first major windpower project in the US, near Palm Springs.

1. **Role of aesthetics in blocking/delaying windpower development:** aesthetics has been and remains a major barrier to siting and developing windpower sites in several countries, and therefore in achieving renewable energy/climate change mitigation targets. Many key sites and developments have been turned down or delayed or reduced due to landscape reasons and associated emotions (eg. James Lovelock's "scars on the face of GAIA"), in Britain, Canada, and elsewhere (despite successful built examples). Thus, controversy is good for consultants in visual assessment!

2. **There are several factors that affect public acceptability of wind energy development, going beyond the narrower definition of design aesthetics and visual impact:** including ecological context, cultural context, economic flows of benefits, planning process used, and information context for the proposals; many of these issues may be reflected in the visual symbols of the windpower facilities.

3. **Lessons learned/examples from the first big North American windfarm (San Gorgonio, 1980s):** large scale windfarms seemed unthinkable but were actually accepted; effectiveness of the development was a major aesthetics factor; scale of the landscape/backdrop helped minimize the scale impacts of the development; many impacts are reversible.

4. **Lessons learned/examples from UK developments:** local community involvement and economic benefits aided acceptability; offshore sites preferred; some opposition comes from nuclear lobby; some opposition comes from public concern over industrial development in sacred wild and cultural/historic landscapes, eg. Scotland.

5. **Lesson learned/examples from Western Canada developments:** no BC windfarm sites accepted yet in populated areas, due in part to aesthetics; some proposals to use windpower as symbol of green community identity (eg Squamish); vertical scale of landscape may help. Albertan prairie windfarms accepted; Toronto urban icon (gateway)
6. **Public perceptions can be influenced by planning process and information context:** eg. avoidance of industrial facilities with remote beneficiaries, growing social awareness of imperative of climate change, recognition of scale of renewable energy needed (all communities), intergenerational impacts comparison with other energy sources (eg. nuclear), appropriate use of visualisation/animations, participatory "4D visioning" processes, etc. Will attitude shift compensate for massive windfarm development?

7. **Urban windpower:** Feasibility/clutter issues with roof-top turbines; community turbines more feasible; symbolic value of Toronto icon, Scandinavian icons: urban identity/urban design role.

8. **Do wind turbines spin?** Watch out for spurious use of wind-power imagery to convey disproportionate notions of sustainability/performance, eg. by energy companies, cities, governments, marketing companies using distorted visualisations.

9. **Visual design can assist acceptability:** sensitive siting and clustering, creative sculptural designs, strategies for making turbines more and less visible, interpretive/educational designs, urban examples, etc.

10. **Landscape architects have a role beyond visual assessment:** designing and running participatory design/planning processes, informing context, responsible advocacy of renewable energy alternatives, creative and sensitive site design etc.

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For More Information: Additional Resources/References/ WEBSITES

- **Scenic America:** National Advocacy organization dedicated to visual character of American communities and countryside. Provide a range of technical services on issues relating to scenic byways, visual impacts, community character and visual corridor management. Website: www.scenic.org
- **Wind Action. Org:** www.windaction.org
- ***Wind Power in View: Energy Landscapes in a Crowded World,*** Martin J. Pasqualetti, Paul Gipe, Robert W. Righter, Academic Press, San Diego, CA, 2002.
- **Environmental Impacts of Wind Energy; Impacts of Wind Energy on Humans; Aesthetic Impacts:** Technical Report from National Academies of Science on Wind Energy http://www8.nationalacademies.org/cp/projectview.aspx?key=BEST-K-05-01-A
- **BLM Wind Energy Website:** http://www.blm.gov/wo/st/en/prog/energy/wind_energy.html
- **BLM Wind Energy EIS website (Argonne National Laboratories):** http://windeis.anl.gov/
- **McCauley Institute,** Scotland: http://www.macaulay.ac.uk/index.php
- **Paul Gipe's website** on Wind Energy: http://www.wind-works.org/articles/TehachapiTourGuide.html
- **American Wind Energy Association**: http://www.awea.org/
- **U. S. Department of Energy** website on Wind Technology: http://www1.eere.energy.gov/windandhydro/
- **National Renewable Energy Lab's** website on Wind Resource information/links: http://rredc.nrel.gov/wind/
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- US-DOE Energy Efficiency and Renewable Energy http://www.eere.energy.gov/windandhydro/windpoweringamerica/
- EIA (Energy Information Administration) http://www.eia.doe.gov/
- Renewable Energy Access http://www.renewableenergyaccess.com/rea/home
- **North American Windpowe**r http://www.nawindpower.com/naw/e107_plugins/content/content.php?cat.8
- **Canadian Wind Energy Association** website http://www.canwea.ca/
- Wind Energy Programs of Natural Resources Canada http://www.canren.gc.ca/programs/index.asp?CaId=61&PgId=201
- TheRenewablePlanet.com http://www.therenewableplanet.com/

- The American Council On Renewable Energy (ACORE): Building Domestic and International Partnerships for the Success of Renewable Energy http://www.ostina.org/content/view/671/133/
- Environmental and Energy Study Institute http://www.eesi.org/
- Rocky Mountain Institute http://www.rmi.org/
- **World Wind Energy Association** (WWEA) http://www.wwindea.org
- World Wind Energy Conference 2007 Argentina http://www.wwec2007.org.ar
- International Renewable Energy Alliance (IREA) http://www.ren-alliance.org/
- World Council for Renewable Energy (WCRE) http://www.wcre.org
- **British Wind Energy Association website** http://www.bwea.com/
- **Univ. of Massachusetts, Renewable Energy Lab** http://www.ceere.org/rerl/index.html
- **Collaborative for Advancement of Landscape Planning,** University of British Columbia, Canada: http://www.calp.forestry.ubc.ca/people.htm