

Visibility and Visualization of Offshore Wind Facilities

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Topics

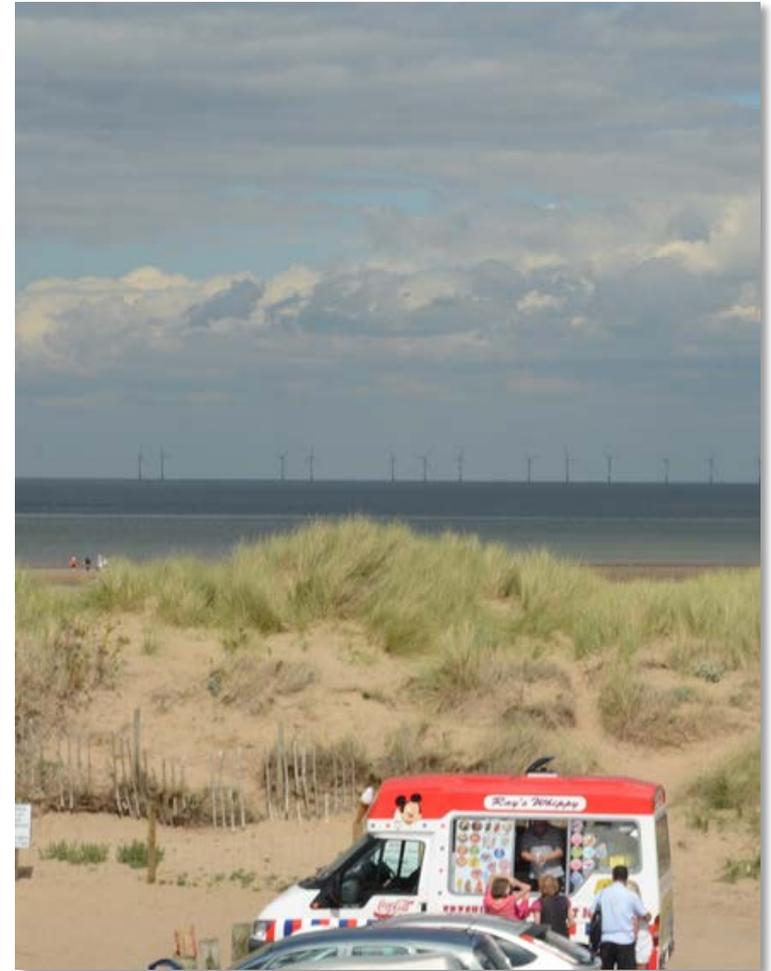
- **Visual Impacts of Offshore Wind Development**
- **Offshore Wind Facility Visibility Assessment Study**
- **Offshore Wind Facility Visualization Study**



Ocean Views Are Highly Valued and Very Sensitive

- Economic value - tourism and property values
- Sometimes have important historic and tribal values
- Quality of life concern

- Public opposition based on potential visual impacts can halt or delay offshore wind projects.
- Need to understand and be able to predict project visibility.



Offshore Wind Facilities May Be Highly Visible

- Very large facilities (thousands of acres) with very large turbines (700 ft+)
- Generally painted white to maximize visual contrast
- Huge spinning blades attract visual attention
- Aviation obstruction lighting and marine hazard navigation lighting
- Yellow paint on tower bases



Offshore Wind Facility Visibility Assessment

Answering the questions: How far can we see offshore wind turbines, and, what distances matter in terms of visual impact?

- Conducted study in the U.K. in 2012.
- Observed 11 offshore wind facilities.
- Facilities of 25-140 turbines.
- Distances between 3.4-32 mi.
- Turbines ranged from 2.0-5.0 MW, 350-500 ft tall.



Study Methodology

- Observations generally made from beaches, but some elevated and inland viewpoints.
- Visibility rated in the field using a visibility scale (1 – 6).
- Three trained observers.
- 49 daytime observations from 29 study observation points.
- Six observations at night.



Visibility Ratings

- **VISIBILITY LEVEL 1:** Visible only after extended, close viewing; otherwise invisible.
- **VISIBILITY LEVEL 2:** Visible when scanning in general direction of study subject; otherwise likely to be missed by casual observer.
- ■ **VISIBILITY LEVEL 3:** Visible after brief glance in general direction of study subject and **unlikely to be missed by casual observer.**
- **VISIBILITY LEVEL 4:** Plainly visible, could not be missed by casual observer, but does not strongly attract visual attention, or dominate view because of apparent size, for views in general direction of study subject.
- ■ **VISIBILITY LEVEL 5: Strongly attracts visual attention** of views in general direction of study subject. Attention may be drawn by strong contrast in form, line, color, or texture, luminance, or motion.
- **VISIBILITY LEVEL 6:** Dominates view because study subject fills most of visual field for views in its general direction. Strong contrasts in form, line, color, texture, luminance, or motion may contribute to view dominance.





Burbo Bank Wind Farm, 4.6 Miles From Closest Turbine



Burbo Bank Wind Farm, 9.9 Miles From Closest Turbine



Burbo Bank Wind Farm, 15.3 Miles From Closest Turbine



Thanet Wind Farm, 7.6 Miles From Closest Turbine



Thanet Wind Farm (7.6 Miles From Closest Turbine)

Offshore Wind Turbine Visibility | CORE | 11/2/2016

Night Lighting



Study Results Summary

- Maximum wind turbine visibility: 27 mi.
- Facilities were plainly visible up to **18 miles** (Visibility Level 3).
- Facilities were a major focus of visual attention up to **ten miles** (Visibility Level 5).
- Blade motion visible at 24 miles.
- Aviation hazard lighting visible at 24 miles.
- Marine navigation lighting visible to 13 mi; always visible at less than 7 mi.
- Marine paint visible up to 11 mi; easily visible at 8 mi.

Study results available on request.



BOEM Offshore North Carolina Visualization Study

- Wind facility visualization study conducted in cooperation with NPS.
- In response to concerns about potential BOEM-permitted wind development within view of Cape Hatteras and Cape Lookout (National Seashores)
- Spatially accurate and realistic simulations of multiple wind facilities with different wind turbine sizes at different distances, as seen from lighthouses and other key viewpoints
- Both “still image” photomontages and video animations
- Summary and simulations available on Web

Visual simulation of wind energy facilities

- A complex technical undertaking required advanced skills and equipment.
- Involves precise overlay of 3-D wind turbine models onto a base photograph.
- Models are then rendered to simulate proper color, lighting, and shading.
- North Carolina study simulations are of very high quality.
- Simulations are not the same as “being there” because of technical limitations of display media, and failure to show blade motion (for photomontages).
- In practice, they often under-represent visual contrast.



VISUALIZATION STUDY FOR OFFSHORE NORTH CAROLINA
010 Long Point Camps Simulation, Early Morning, Existing Conditions





