Wind and the Landscape

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Wind Basics

How big are they?

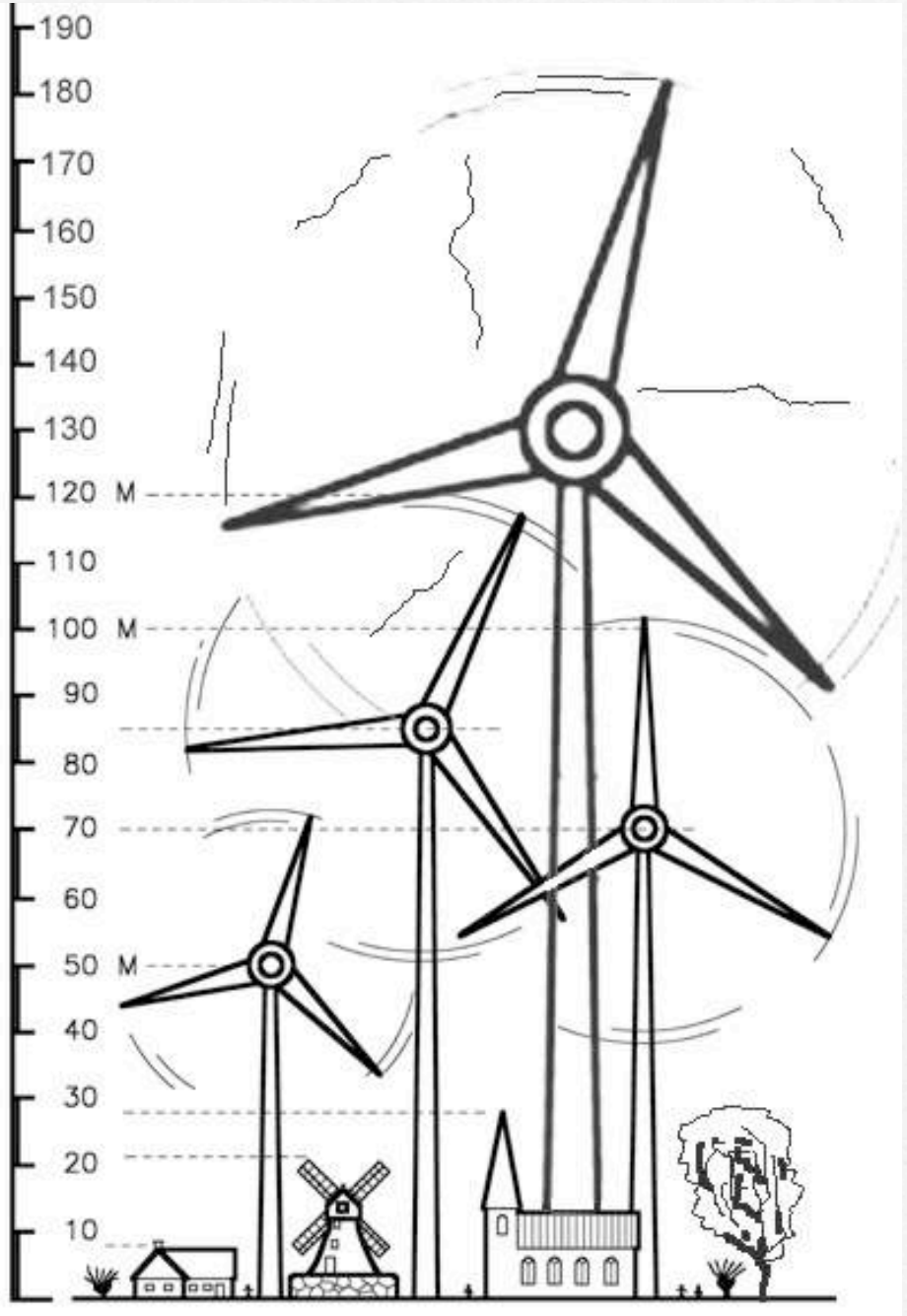
250' - 450' tall

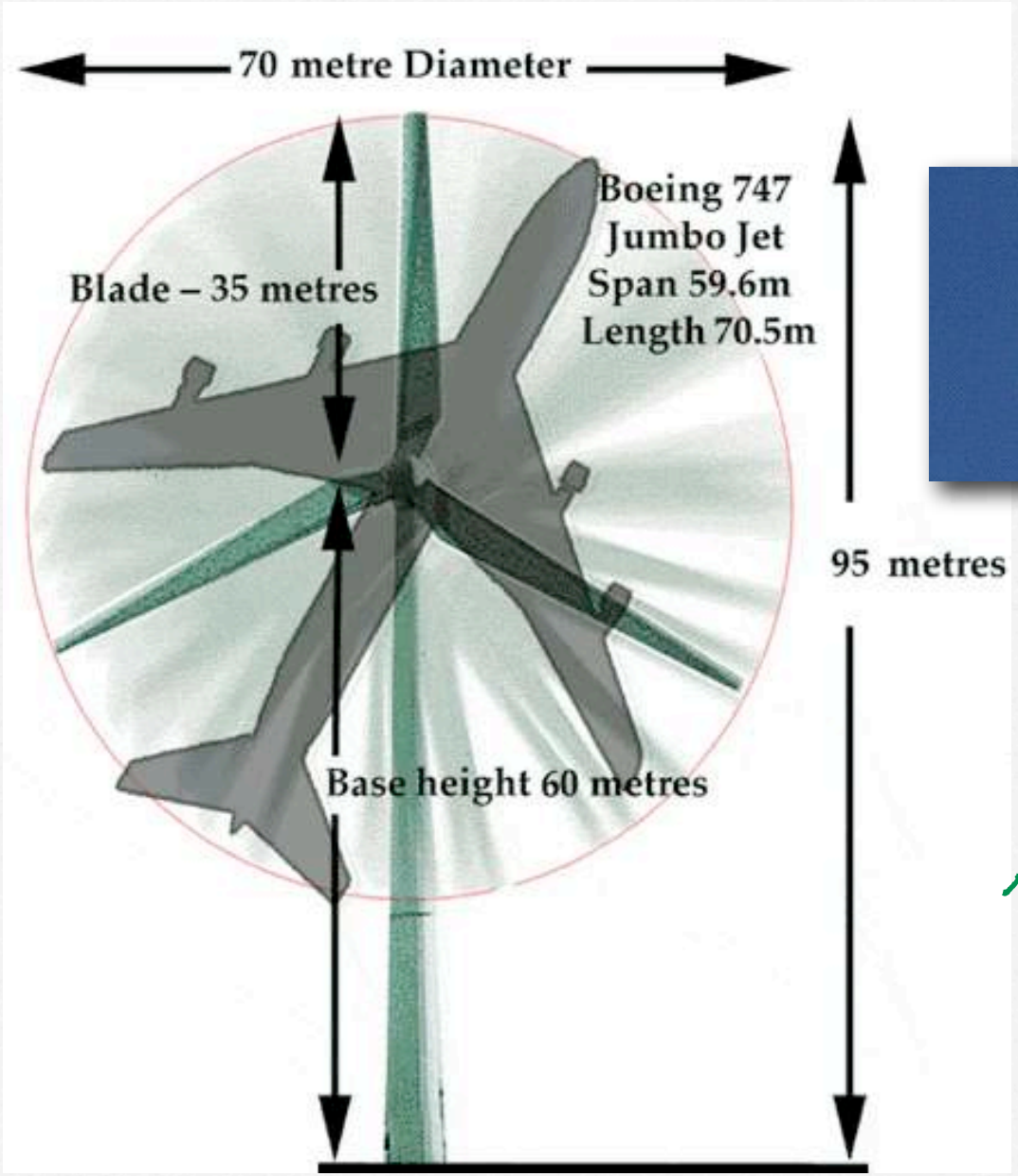
165' - 295' blade span

165' - 295' to the nacelle

offshore turbines can be 540' tall with blade spans of 360'

Wind turbines can be as tall as a skyscraper.





And as wide as a 747.

Some call them "wind farms," but they aren't.

Generally,wind projects
are large
industrial facilities.

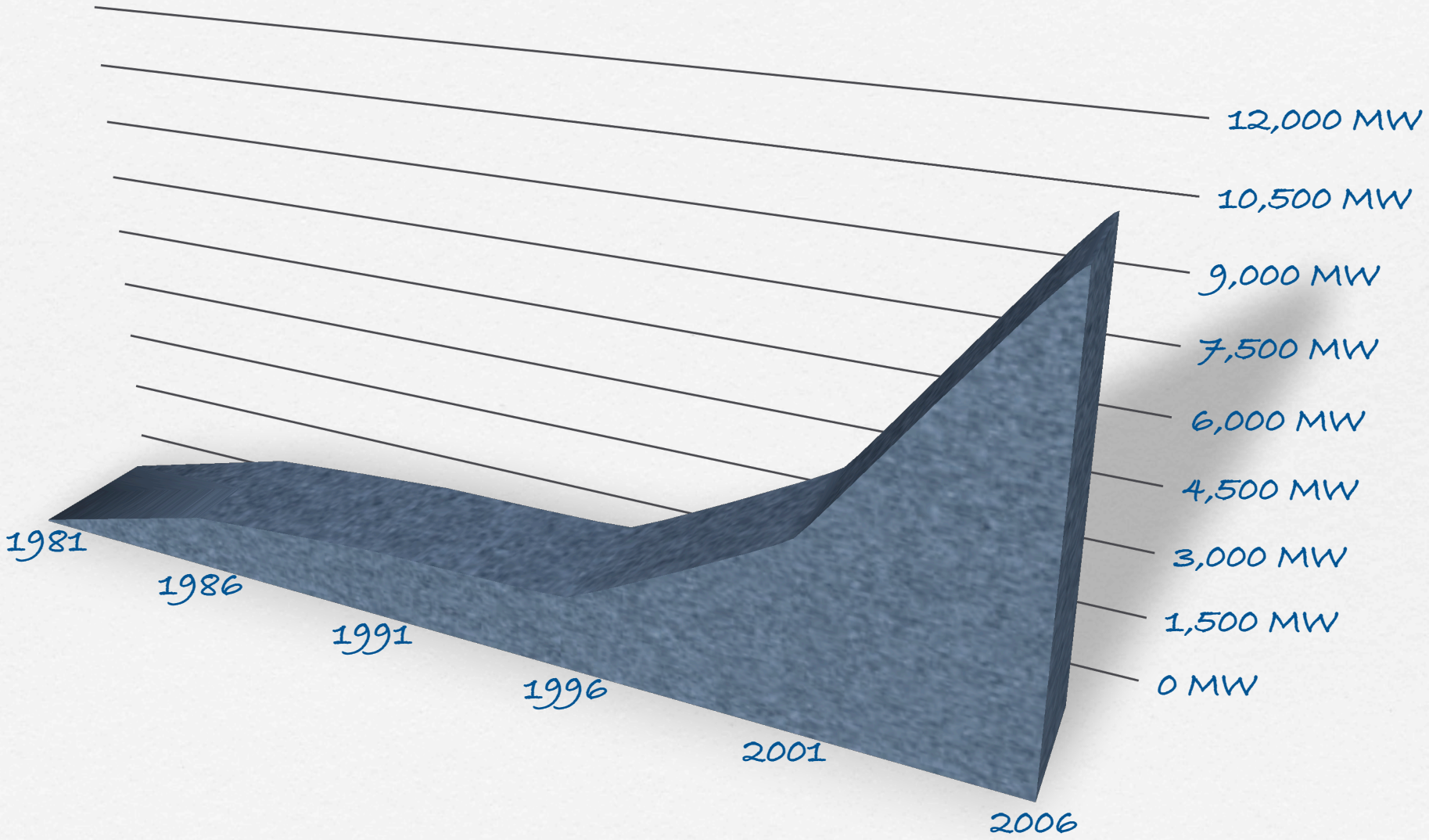
That isn't a value judgment,
or an aesthetic judgment, but it is the reality.

Wind energy is an increasingly important component of national energy policy.

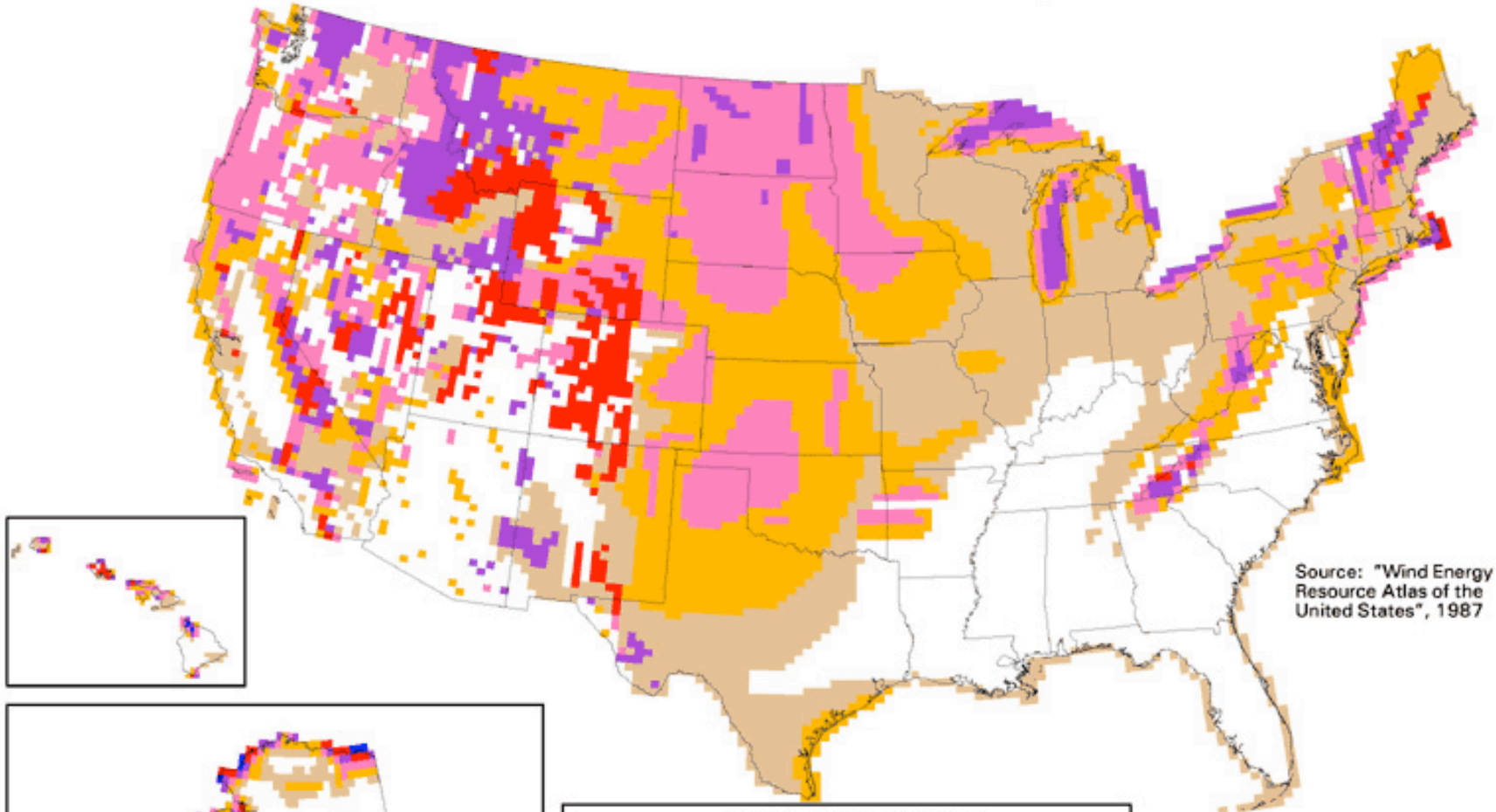
The total installed capacity of wind energy is currently 10,492 megawatts, which is less than 1% of the national total.

The industry goal: 6% by 2020.

Installed wind capacity in megawatts



United States - Wind Resource Map



Source: "Wind Energy Resource Atlas of the United States", 1987

Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m^2	Wind Speed[a] at 50 m m/s	Wind Speed[a] at 50 m mph
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

[a] Wind speeds are based on a Weibull k value of 2.0

U.S. Department of Energy
National Renewable Energy Laboratory

NREL

20-MAR-2000 1.1.5

Top Twelve States: Now

- Texas (2,323 mw)
- California (2,323 mw)
- Iowa (837 mw)
- Minnesota (812 mw)
- Oklahoma (475 mw)
- Oregon (438 mw)
- New Mexico (407 mw)
- Washington (390 mw)
- Kansas (364 mw)
- Colorado (291 mw)
- Wyoming (288 mw)
- New York (280 mw)

Top Twelve States: Future?

- North Dakota (1,210 TWh)
- Texas (1,190 TWh)
- Kansas (1,070 TWh)
- South Dakota (1,030 TWh)
- Montana (1,020 TWh)
- Nebraska (868 TWh)
- Wyoming (747 TWh)
- Oklahoma (725 TWh)
- Minnesota (657 TWh)
- Iowa (551 TWh)
- Colorado (481 TWh)
- New Mexico (435 TWh)

Factors Pushing Wind

- Global Warming/Climate Change
- Pollution from traditional energy sources
- Concerns about fossil fuel supplies
- Tax breaks for renewable energy projects
- Renewable Portfolios Standards (RPS)

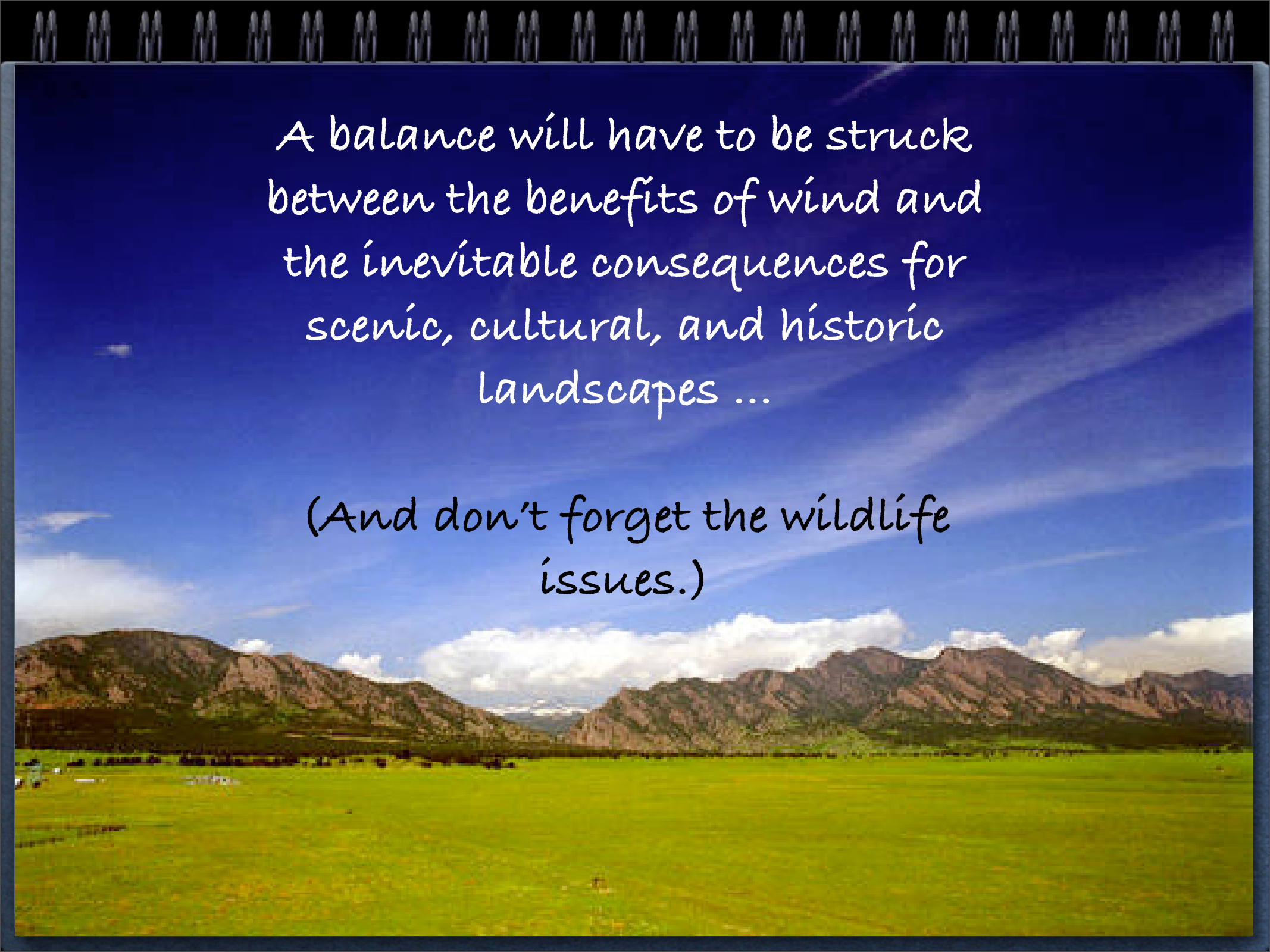
The Wind Dilemma

In the context of growing concern about global warming and climate change, wind power is considered by many as an important, nonpolluting alternative source of energy.

But there is a tradeoff ...

Golden, Colorado

The places that often have the highest wind values are also the places with the highest scenic, cultural, and historic values.


A balance will have to be struck between the benefits of wind and the inevitable consequences for scenic, cultural, and historic landscapes ...
(And don't forget the wildlife issues.)

in mountainous areas ...

Vermont

Colorado

... the lowlands
and hill country ...

Flint Hills,
Kansas

… plains and farmland …

Elk River Project

Butler County, Kansas

(100 turbines)

... and offshore.

Denmark

Photo simulation off Long Island, NY

Turbines are often placed on ridgelines in order to capture the strongest winds.

Economics and technical requirements often favor large arrays.

Wyoming

California


Some of the older projects are
enormous and completely
disregard the landscape.

Not all projects are big, but arrays of 40-200 turbines are very common.

Projects on farms are often smaller.

Visual issues are about more than just the turbine.

maintenance buildings
power lines
transformers
substations

… excessive vegetation clearance …

... and access roads.

Highly sensitive areas

- ridgelines
- steep slopes
- shorelines
- flood plains and wetlands
- historic areas
- battlefields
- communities with strong visual characteristics

Other sensitive locations: consider what is seen from these places,not just within them

- Federal lands and parks
- State lands and parks
- Scenic byways and roads
- Hiking & biking trails
- Greenways
- National historic trails
- Wilderness areas
- Wild and scenic rivers

Other issues

- Light (FAA requirements for structures over 200' tall)
- Noise
- Shadows & strobing
- Wildlife (birds and bats)
- Decommissioning and removal

Principles of assessment and mitigation

The issues are:

The design and quality of the project itself

The relationship of the project to the
scenic, cultural, and historic landscape

The visual impact of the project
from various vantage points and distances

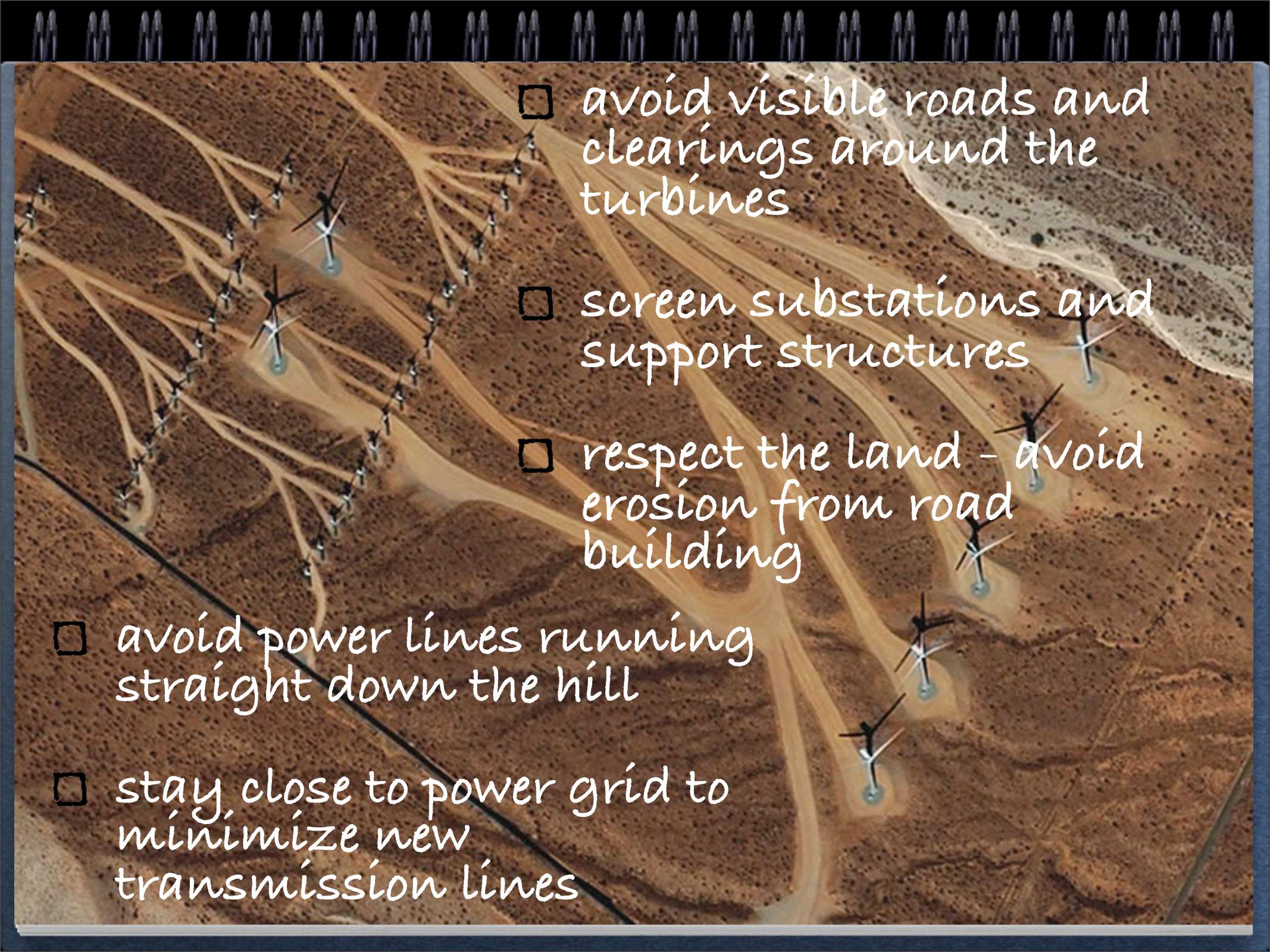
The attitudes of the surrounding community
toward the landscape and the project

Visual Mitigation

- White or neutral color
- Columnar, not lattice, structures
- Be sure all turbines are the same
- Blades should move in the same direction … and should keep moving

- Smaller groupings are better than one continuous large one
- fewer larger turbines better than more smaller ones, but don't make them bigger than they need to be
- lights should be shielded from below

don't do this ...


avoid visible roads and clearings around the turbines
screen substations and support structures
respect the land - avoid erosion from road building
avoid power lines running straight down the hill
stay close to power grid to minimize new transmission lines

- provide visual order
- avoid clutter and chaos

- promote visual unity (spacing and shapes)
- use only one kind of turbine (or keep like turbines together)

- don't overwhelm the landscape
- keep turbines in a line, but don't allow small gaps
- avoid excessive density
- if gaps are necessary, create distinct groupings

Adverse Impacts: Some Considerations

- Does the project alter the meaning of the landscape? Is it distracting from what should be seen or felt? Does it conflict with public expectations about the landscape?
- Is the project visible from iconographic landforms & structures, historic buildings, cultural landmarks, etc.?

- Are there local or regional plans, corridor management plans, historic district plans, or other formal visioning or planning statements that have identified important visual qualities or sensitive or invaluable scenic, cultural, or historic resources with which the project is out of compliance?

- Will it interfere with the "postcard" image of the place?

- Is the project visible from places where people don't expect to find visual intrusions, such as along hiking trails, at battlefield sites, in cemeteries or other culturally sensitive places, or wilderness areas?

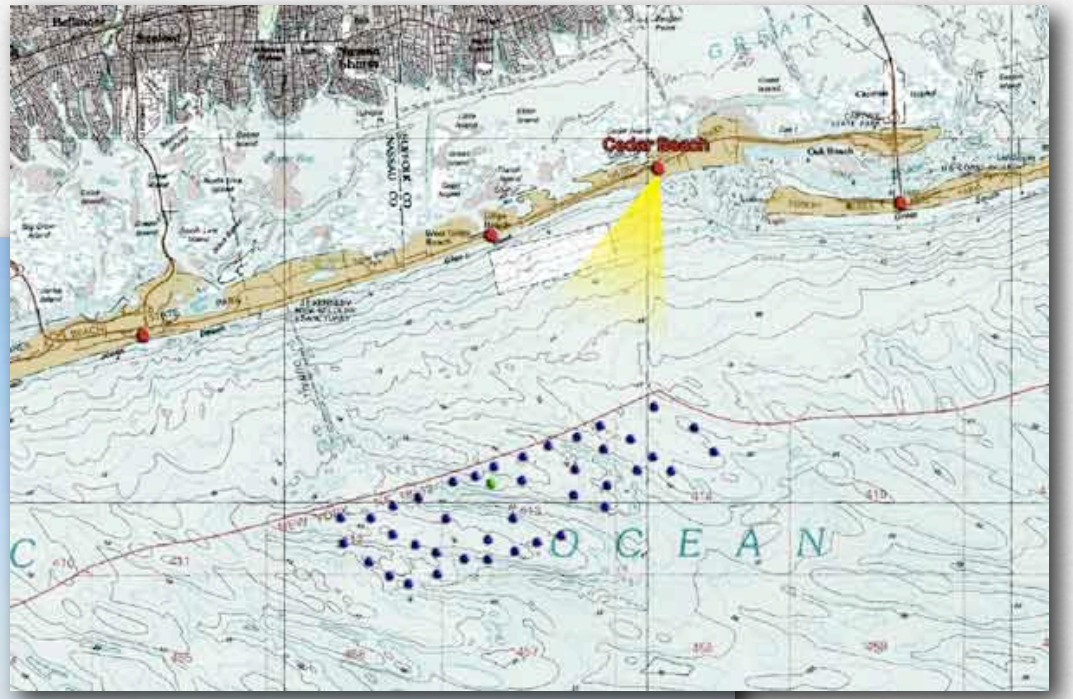
- Does the project significantly diminish visual qualities, and are there mitigation strategies that could be considered?

Visual Impact Assessments

Should be required for every project.

- Inventory of visual resources
- Viewshed mapping
- Identify key scenic, cultural, and historic landscapes
- Full photo documentation

- Photo simulations and computer modeling (with motion, if possible)
- Cross sections
- Balloon tests
- Day and night images
- From various distances and vantage points



simulation and viewshed analysis:
Long Island, NY

After the data is gathered …

- Then match findings with assessments of what visual values are most important and to what degree they are affected (from various sites in the area)

- Rate scenic, cultural, and historic attributes so that they can be compared with the benefits of the project

Communities should ...

- Fully understand the scope of the project: the turbines plus everything else
- Require a complete visual impact assessment
- Ensure compliance with the National Environmental Policy Act, FAA requirements, and the National Historic Preservation Act (require comments from SHPO)

- Know how much land will be cleared and what will need to be restored
- Know how close the project is to residential areas and non-participating land owners
- Know how close the project is to existing transmission lines
- Know how close to and visible from historic and cultural sites, scenic areas, byways, parks, trails, etc.

- Require surety bonds or binding letters of credit to ensure the money will be available to remove the turbines and everything else when the times comes
- Require strict maintenance schedules
- Require undergrounded utilities
- Require all ancillary structures be shielded from view and not allowed on the top of ridges

the key is informed decision-making and community involvement

There is a lot at stake.

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Change is inevitable. Ugliness is not.