



WIND TURBINE SITE SUITABILITY IN SHERMAN COUNTY, OREGON

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Background

Wind energy reduces environmental impacts caused by electricity generation. Unlike fossil fuels, wind energy does not generate atmospheric contaminants or thermal pollution.

It is renewable and locally available, and has become very attractive to governments, organizations, and the public.



Sources

Dataset	Source
Oregon 10m DEM	USGS- EROS Data Center
Annual Average Daily Wind Speed @ 80 meter height	U.S. Depart of Energy: NREL
City Limits	ODOT-GIS
State Highways	ODOT-GIS
Oregon Scenic Byways	ODOT-RICS
State Parks	Oregon Parks and Recreation
County Boundaries	BLM-OR
Oregon Rivers	Oregon Department of Energy
Land Management	BLM
Land Ownership	BLM
OR Wetlands Geodatabase	OR Natural Heritage Information Center & The Wetlands Conservancy

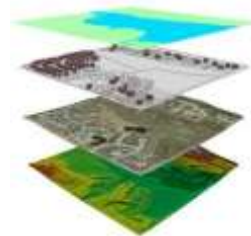
Methodology

Multi Criteria Evaluation analyze suitability based on *constraints*, *standardized factors* and its weighted overlay.

Constraints are based on the Boolean criteria (true/false), which limit the analyses to specific regions.

Factors define areas or alternatives according to a continuous measure of suitability.

Factor weights was determined by the Analytical Hierarchy Process.



Study Area

Sherman County, Oregon lies between the deep canyons of the John Day River and the Deschutes River on the Columbia River Plateau in north central Oregon.



Land area: 823.2 sq Miles

Population: 1,711 (2009 estimate)

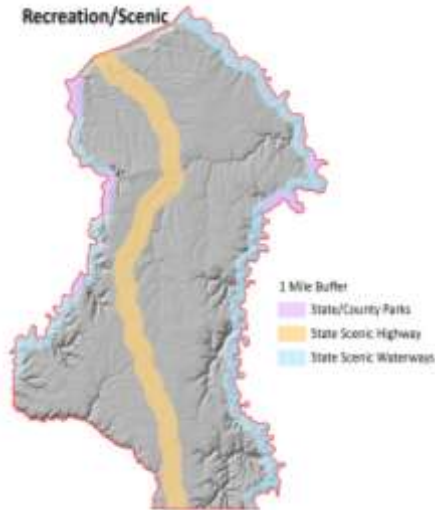
Constraints

Recreation/Scenic

There are three identified scenic resources in our study area:

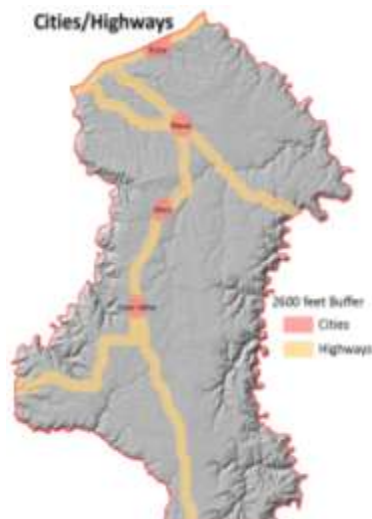
State/	John Day, Hilderbrand
County Parks	J.S. Burres
	Deschutes- Oregon Wildlife Heritage Foundation #1
	Deschutes- Hilderbrand
	Deschutes River State Recreation Area
	Cottonwood Canyon State Park
Scenic Byway	Journey Through Time (US-97 Sherman)
Scenic Rivers	Deschutes River State Scenic Waterway

Aesthetics



Modern wind turbines of 1.5-3 MW can be seen in the landscape from 20 miles away, but as one moves away, the turbines occupy an increasingly small part of the overall view. The most significant impacts are likely to occur within the first mile from the project.

Urban/Population



Standards have been set for evaluating impacts on the human environment. Noise reduction and safety issues determine a setback of 2600 feet from the nearest residence (NAS, 2007). A buffer within that distance was set from cities and highways.

Land Use Constraints

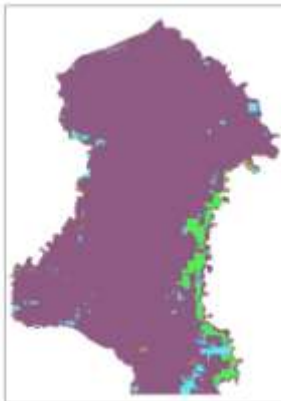
- Union of all layers with Sherman County.

Layers used:
BLM lands
Land Management
Land Ownership



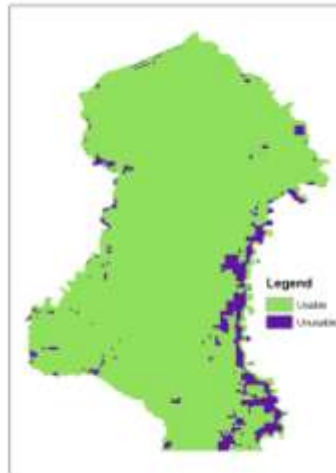
Land Use Constraint

- Rasterize and Reclassify into usable and unusable land.

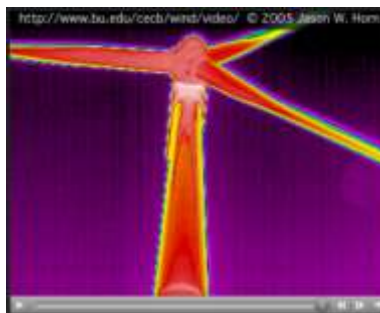


Land Use Constraint

- Final Raster.



Bats vs Wind Turbines



<http://www.bu.edu/cccb/wind/video/> © 2005 Jason W. Horn

Background

- Bat fatalities are documented at nearly every wind facility surveyed in North America
- Some sites cause the deaths of thousands of bats per year
- Exact cause is unknown, but most fatalities are migratory tree bats



Focal Species



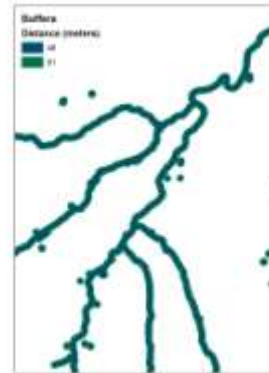
- Silver-haired bat (*Lasionycteris noctivagans*)
- One of the top 3 species most commonly killed by wind turbines
- On the FWS “Species of Concern” list for Sherman County

Habitat Buffer

- Restricted by water sources in dry habitats
- Foraging range of 46-91 meters



Wetlands of Sherman County

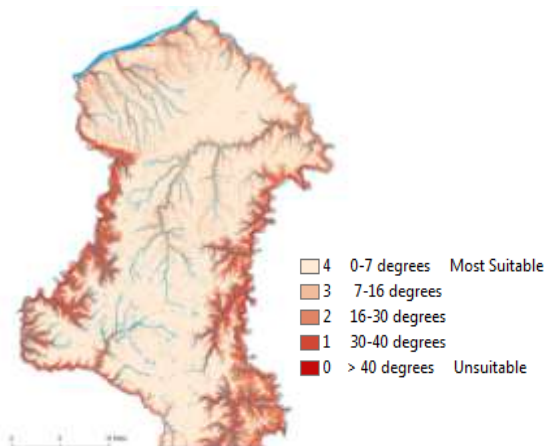


Buffered Wetlands

Factor: Slope

According to "A Geographic analysis of wind turbine placement in Northern California" (Rodmana, Meentemeyer) study; 5 slope classes defined.

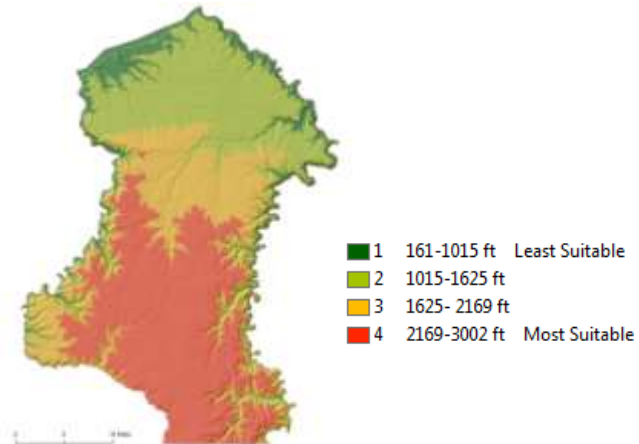
Several counties (i.e. Riverside, CA) prohibit wind turbines placed on slopes greater than 25% to reduce unwanted turbulence and high construction costs.



Factor: Elevation

Wind Turbine Placement Analysis study by Washington Department of National Resources claims that high elevations preferred.

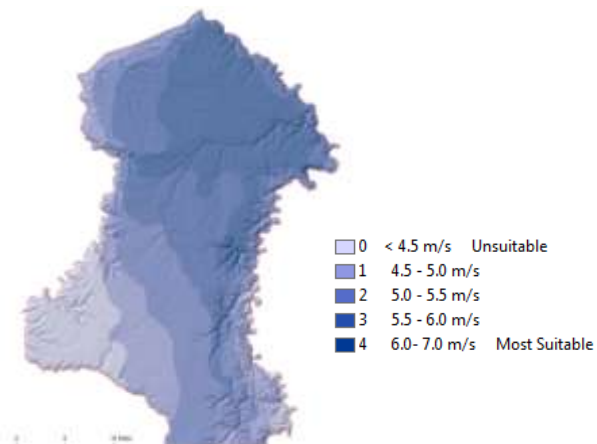
Natural breaks define classes away from steep slopes and elevation variation.



Factor: Wind Speed

Department of Energy, NREL study outlines guidelines for suitable wind standards for land based turbines at 1.5 to 3 mW, grid connected.

Based on annual average daily wind speed @ 80 meter height



Analytic Hierarchy Process (AHP)

AHP (factor weights)			
Factors	Constraints (exclusionary)		
Terrain (A) (elevation + slope)	Landuse		
Wind Speed (B)	Recreation/Scenic		
Wetland & Bat Habitat (C)	Urban/Population		
Matrix			
	A	B	C
A	1	1/3	1/3
B	3	1	3
C	3	1/3	1
Criterion	Geometric Mean	Factor Weight	
A	$[1*1/3*1/3]^{1/3} = .4807$	0.1386	
B	$[3*1*3]^{1/3} = 2.08$	0.5668	
C	$[3*1/3*1]^{1/3} = 1$	0.2877	
Sum	3.7356		

How important is A relative to B?	Preference index assigned
Equally important	1
Moderately more important	3
Strongly more important	5
Very strongly more important	7
Overwhelmingly more important	9

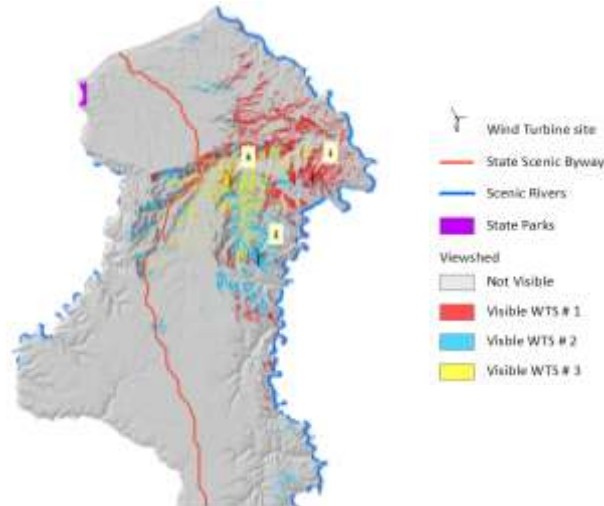
LC Rodman, R.K.
 Meentemeyer Energy Policy
 34 (2006) 2137-2149 - A
 Geographic analysis of wind
 turbine placement in Northern
 California

Wind: 3	0.5454
Terrain: 1	0.1818
Wetland/Habitat: 1.5	0.2727
Sum: 5.5	



Aesthetic assestment

A viewshed analysis was performed for 3 random sites within the most suitable areas. A OFFSETA field was added for simulation of wind turbine site at 200 feet height according to Oregon Columbia Plateau Ecoregion Wind Energy Siting and Permitting Guidelines.



Conclusions

- In the MCE were used 8 constrains and 3 factors, that the most influential was wind speed.
- The 68 % of the study area is not suitable for wind turbine placement.
- The most suitable category only represent the 2.4 %. The second most suitable cover more than 21 %. Together, there are 225788.2 acres suitable for wind energy development in Sherman County .
- The most suitable areas should have aesthetic conflicts with the State Scenic Byway in some sectors. Specific measures are needed for mitigate the visual impacts.

References

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- http://libweb.uoregon.edu/map/gis_data/or_10mdemlist.htm
- <http://www.oregon.gov/DAS/EISPD/GEO/sdlibrary.shtml>