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NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Estimates of Windy[1] Land Area and Wind Energy Potential, by State, for areas >= 30% Capacity Factor at 80m

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February 4, 2010 (updated April 13, 2011 to add Alaska and Hawaii)

These estimates show, for each of the 50 states and the total U.S., the windy land area with a gross capacity factor (without losses) of 30% and greater at 80-m height above ground and the wind energy potential that could be possible from development of the "available" windy land area after exclusions. The "Installed Capacity" shows the potential megawatts (MW) of rated capacity that could be installed on the available windy land area, and the "Annual Generation" shows annual wind energy generation in gigawatt-hours (GWh) that could be produced from the installed capacity. AWS Truewind, LLC developed the wind resource data for windNavigator® (http://navigator.awstruewind.com) with a spatial resolution of 200 m. NREL produced the estimates of windy land area and windy energy potential, including filtering the estimates to exclude areas unlikely to be developed such as wilderness areas, parks, urban areas, and water features (see Wind Resource Exclusion Table for more detail).

	Windy Land Area >= 30% Gross Capacity Factor at 80m						Wind Energy Potential	
State	Total (km^2)	Excluded[2] (km^2)	Available (km^2)	Available % of State	% of Total Windy Land Excluded		Installed Capacity[3] (MW)	Annual Generation (GWh)
Alabama	80.4	56.7	23.6	0.02%	70.6%		118.2	333
Alaska	412,610.7	313,670.1	98,940.6	6.57%	76.0%		494,702.9	1,620,792
Arizona	4,545.0	2,364.1	2,180.8	0.74%	52.0%		10,904.1	30,616
Arkansas	4,663.2	2,823.2	1,840.1	1.34%	60.5%		9,200.3	26,906
California	26,901.3	20,079.2	6,822.0	1.67%	74.6%		34,110.2	105,646
Colorado	95,830.4	18,386.5	77,443.9	28.73%	19.2%		387,219.5	1,288,490
Connecticut	31.4	26.1	5.3	0.04%	83.1%		26.5	73
Delaware	36.6	34.7	1.9	0.04%	94.8%		9.5	26
Florida	9.6	9.5	0.1	0.00%	99.2%		0.4	1
Georgia	281.3	255.3	26.0	0.02%	90.7%		130.1	380
Hawaii	4,537.0	3,884.0	653.0	3.91%	85.6%		3,264.9	12,363
Idaho	13,420.4	9,805.3	3,615.1	1.67%	73.1%		18,075.6	52,118
Illinois	70,763.6	20,787.1	49,976.4	34.25%	29.4%		249,882.1	763,529
Indiana	46,255.2	16,609.7	29,645.5	31.63%	35.9%		148,227.5	443,912
Iowa	134,900.1	20,757.3	114,142.8	78.32%	15.4%		570,714.2	2,026,340
Kansas	211,861.3	21,387.1	190,474.2	89.38%	10.1%		952,370.9	3,646,590
Kentucky	48.7	36.6	12.1	0.01%	75.1%		60.6	173
Louisiana	125.5	43.6	82.0	0.07%	34.7%		409.8	1,100
Maine	6,026.5	3,776.2	2,250.2	2.69%	62.7%		11,251.2	33,779

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Maryland	567.7	271.1	296.6	1.18%	47.8%		1,482.9	4,269
Massachusetts	1,709.0	1,503.4	205.6	0.99%	88.0%		1,028.0	3,323
Michigan	19,761.3	7,952.9	11,808.5	7.85%	40.2%		59,042.3	169,221
Minnesota	121,884.7	24,030.6	97,854.1	44.83%	19.7%		489,270.6	1,679,480
Mississippi	0.0	0.0	0.0	0.00%	N/A		0.0	0
Missouri	69,676.8	14,805.8	54,871.0	30.39%	21.2%		274,355.1	810,619
Montana	232,768.6	43,967.7	188,800.9	49.60%	18.9%		944,004.4	3,228,620
Nebraska	199,627.8	16,028.0	183,599.7	91.64%	8.0%		917,998.7	3,540,370
Nevada	5,873.6	4,424.2	1,449.4	0.51%	75.3%		7,247.1	20,823
New Hampshire	1,663.8	1,236.8	427.1	1.78%	74.3%		2,135.4	6,706
New Jersey	280.8	254.5	26.4	0.14%	90.6%		131.8	373
New Mexico	111,445.8	13,029.1	98,416.7	31.25%	11.7%		492,083.3	1,644,970
New York	17,705.8	12,549.6	5,156.3	4.10%	70.9%		25,781.3	74,695
North Carolina	1,155.6	994.1	161.5	0.13%	86.0%		807.7	2,395
North Dakota	182,374.6	28,335.4	154,039.2	84.25%	15.5%		770,195.8	2,983,750
Ohio	17,189.9	6,205.9	10,983.9	10.28%	36.1%		54,919.7	151,881
Oklahoma	123,243.6	19,879.2	103,364.4	57.10%	16.1%		516,822.1	1,788,910
Oregon	17,109.8	11,689.7	5,420.1	2.16%	68.3%		27,100.3	80,855
Pennsylvania	2,123.5	1,462.1	661.4	0.56%	68.9%		3,307.2	9,673

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Rhode Island	74.0	64.7	9.3	0.35%	87.4%		46.6	153
South Carolina	102.8	65.8	37.0	0.05%	64.0%		185.0	504
South Dakota	193,828.3	17,345.8	176,482.5	88.36%	8.9%		882,412.4	3,411,690
Tennessee	359.9	298.1	61.9	0.06%	82.8%		309.3	900
Texas	435,638.6	55,332.7	380,305.9	55.54%	12.7%		1,901,529.7	6,527,850
Utah	5,273.6	2,652.8	2,620.7	1.19%	50.3%		13,103.7	37,104
Vermont	2,569.6	1,979.8	589.7	2.39%	77.0%		2,948.7	9,163
Virginia	1,567.2	1,208.5	358.7	0.35%	77.1%		1,793.3	5,395
Washington	11,932.6	8,236.9	3,695.7	2.12%	69.0%		18,478.5	55,550
West Virginia	1,495.2	1,118.6	376.6	0.60%	74.8%		1,883.2	5,820
Wisconsin	30,228.8	9,477.3	20,751.4	14.29%	31.4%		103,757.1	300,136
Wyoming	146,166.2	35,751.7	110,414.5	43.58%	24.5%		552,072.6	1,944,340
U.S. Total	2,988,328	796,945	2,191,382	22.36%	26.7%		10,956,912	38,552,706

[1] NREL's wind potential estimates were based on maps produced by AWS Truewind using their MesoMap® system.

[2] Excluded lands include protected lands (national parks, wilderness, etc.), incompatible land use (urban, airports, wetland, and water features), and other considerations. See Table 1 for full listing.

[3] Assumes 5 MW/km^2 of installed nameplate capacity

Wind Resource Exclusions	
Criteria for Defining Available Windy Land (numbered in the order they are applied):	
Environmental Criteria	*Data/Comments:*
2) 100% exclusion of National Park Service and Fish and Wildlife Service managed lands	USGS Federal Lands shapefile, Dec 2005
3) 100% exclusion of federal lands designated as park, wilderness, wilderness study area, national monument, national battlefield, recreation area, national conservation area, wildlife refuge, wildlife area, wild and scenic river or inventoried roadless area.	USGS Federal Lands shapefile, Dec 2005; Inventoried Roadless Areas, 2004; BLM Areas of Critical Environmental Concern (2008)
4) 100% exclusion of state and private lands equivalent to criteria 2 and 3, where GIS data is available.	State/GAP land stewardship data management status 1, from Conservation Biology Institute Protected Lands database, 2004
7) 50% exclusion of remaining USDA Forest Service (FS) lands (incl. National Grasslands) except ridgecrests	USGS Federal Lands shapefile, Dec 2005
8) 50% exclusion of remaining Dept. of Defense lands except ridgecrests	Military Lands boundary files, internal dataset (2007)
9) 50% exclusion of state forest land, where GIS data is available	State/GAP land stewardship data management status 2, from Conservation Biology Institute Protected Lands database, 2004
Land Use Criteria	
5) 100% exclusion of airfields, urban, wetland and water areas.	USGS North America Land Use Land Cover (LULC), version 2.0, 1993; ESRI airports and airfields (2006); U.S. Census Urbanized Areas (2000 and 2003)
10) 50% exclusion of non-ridgecrest forest	Ridge-crest areas defined using a terrain definition script, overlaid with USGS LULC data screened for the forest categories.
Other Criteria	
1) Exclude areas of slope > 20%	Derived from 90 m national elevation dataset.
6) 100% exclude 3 km surrounding criteria 2-5 (except water)	Merged datasets and buffer 3 km
Note - 50% exclusions are not cumulative. If an area is non-ridgecrest forest on FS land, it is just excluded at the 50% level one time.	